

Artículo de investigación

Human Capital for Digital Education

Человеческий Капитал для Цифрового Образования

Recibido: 4 de agosto del 2019

Aceptado: 8 de septiembre del 2019

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Abstract

This article is devoted to the role of information and communication technologies (ICT) in forming the human capital that meets the needs of modern world economies. The quality of employees' education and the ability to use digital and information technologies are closely related to the digital competencies in the qualification requirements of educational employees. The creation of a "smart society" depends on the skills related to using digital ICT in the educational process. The study of the human capital development in education has been based on the indicators suggested by UNESCO in Guide to Measuring Information and Communication Technologies in Education. In order to compare countries with high, medium and low levels of using and mastering ICT, the Final Report Survey of Schools: ICT in Education and the OECD Statistical database have been used.

Аннотация

Данная статья посвящена роли ИКТ в формировании человеческого капитала, отвечающего запросам современных мировых экономик. Качество образования работников, умение использовать цифровые и информационные технологии тесно коррелирует с наличием цифровых компетенций в квалификационных требованиях работников образования. Именно от навыков использования цифровых информационно-коммуникационных технологий в образовательном процессе зависит процесс создания "умного общества". Исследование развития человеческого капитала в образовании опиралось на показатели, предложенные Unesco in Guide to measuring information and communication technologies in education. Для сравнения стран с высоким, средним и низким уровнем использования и владения ИКТ применялись данные Final Report Survey

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Keywords: Digital economy, information technology, human capital, ICT use, implementation of ICT, educational policies.

of Schools: ICT in Education и база данных OECD. Stat.

Ключевые слова: цифровая экономика, информационные технологии, человеческий капитал, ICT use, Implementation of ICT, Educational policies.

Introduction

Since the world economies, as well as the Russian economy are moving to new functioning and modernization parameters, it is necessary to create and implement educational technologies that meet modern knowledge and competencies. At the same time, it is impossible to introduce educational technologies without modern information and digital resources. The latest IT developments in education and other sectors of the economy are confidently gaining leading positions in the labor and education market, and pose a serious challenge to outdated business models (Guide to measuring information and communication technologies (ICT) in education, 2009). A modern specialist in any area, and educational in particular, needs the competencies that allow using the latest IT developments. A new function of education is emerging – gaining skills in the new organizational structures “Internet of People”, “Internet of Technical Devices”, “Internet of Services”, and “Internet of all” (Haddad, 2002).

It is possible to formulate today’s UNESCO’s principles of ICT in education as follows:

- When developing a methodology for indicators of ICT in education, it is necessary to take into account information needs, labor force indicators, skills, and knowledge resources in the relevant country,
- Old and new technologies should be used in a balanced manner. Both traditional ways of obtaining education and online distance learning are relevant and cost-effective,
- The considerable role of ICT during the teachers’ continuous education due to

the frequent adaptation of school curricula to new realities,

- The ability to meet the ever-increasing demand for higher education by using virtual modes of learning,
- Use of new technologies (virtual classes, virtual laboratories, computer simulations, business cases, marathons for generating ideas, case championship, harvesters, hackathons, etc.) in educational programs at various levels, and
- ICT indicators in education should take into account gender factors and measure gender gaps.

ICT-related concepts covered in the school questionnaires of SITES 2006 (Law, 2008) included four blocks of indicators (Table 1). In order to study the role of human capital in digital education, in this article special attention will be given to the indicators related to the skills to use digital and information and communication technologies in the educational process and the system of training and retraining of teachers for using digital technologies. These tasks are solved by indicators of the third block – Staff development. The study of the development of human capital in education is based on the indicators encouraging teachers to obtain new knowledge and teaching practice by using ICT, the opportunity for teachers to take further education courses both in real time and remotely by using ICT, and the teachers’ use of new ICT in teaching.

Table 1. ICT-related concepts covered in the school questionnaires of SITES 2006 (Guide to measuring information and communication technologies (ICT) in education, 2009)

Concept(s)	Description
Infrastructure	-Availability of ICT hardware (types of computers, local area network, Internet connections, electronic whiteboards, etc.) -Availability of ICT software (general and subject specific software, learning management systems, assessment tools, etc.) -Infrastructure needs and issues
Vision	-The vision of the school management with regard to pedagogy and ICT, covering three dimensions: traditional, lifelong learning, and connectedness -Encouragement or requirements for teachers to acquire knowledge and skills with regard to pedagogical practices and the use of ICT
Staff development	-Ways that teachers in the school have acquired knowledge and skills for using ICT in teaching and learning -Availability (school-based and/or externally) of ICT-related courses
ICT support	-Persons involved in providing ICT support and time expenditure -Extent to which pedagogical support for ICT use is available for teachers -Extent to which technical support for ICT use is available for teachers

In order to adequately monitor events in ICT in education, the UNESCO Statistical Committee offers to supplement the indicators in Table 1 with new ones. This will cover the main gaps in international information requirements for monitoring the integration of ICT in educational institutions. The offered indicators were developed in accordance with the relevance policy, monitoring needs, feasibility in terms of collecting reliable data by country and international comparability of the collected indicators (Table 2). A majority of these

indicators can be used at both the international and national levels for monitoring and supporting policy formulation and decision-making. Many of them can also be used at the subnational and school levels to compare ICT infrastructure, access, usage and outcomes. Most of the required quantitative data can be collected from the educational institutions during school censuses or surveys, while others can be obtained from official government documents on policies, plans, and budgets.

Table 2. List of proposed new indicators on ICT in education for teaching staff development (Guide to measuring information and communication technologies (ICT) in education, 2009)

Conceptual domains	Indicator
Teaching staff development	-Proportion of ICT-qualified teachers in primary and secondary schools; -Proportion of schools with ICT support service; -Proportion of primary and secondary-school teachers trained via ICT-enabled distance education programs; -Proportion of primary and secondary-school teachers who teach basic computer skills (or computing); -Proportion of primary and secondary-school teachers who currently teach subject(s) using ICT facilities; -Proportion of primary and secondary-school teachers trained to teach subject(s) using ICT facilities; -Ratio of learners-to-teachers of basic computer skills (or computing); and -Ratio of learners-to-teachers using ICT to teach.

The main problem of data collection in accordance with the offered system of ICT indicators in education is the comparability of information. This is primarily due to the different socio-economic level of countries' development. Setting priorities in selecting ICT-related indicators for an internationally comparable statistical monitoring system requires the following (Guide to measuring information and communication technologies (ICT) in education, 2009):

- Knowledge of the information needs of major international stakeholders and policymakers who have been committed to cross-national monitoring and evaluation. The two main WSIS goals (B6b: to connect universities, colleges, secondary schools, and primary schools with ICTs and B6g: to adapt all primary and secondary school curricula to meet the challenges of the Information Society, taking into account national circumstances), including the MDGs, EFA and UNESCO policy frameworks, to provide a good basis as a starting point for prioritization,
- Minimizing the burden on respondents in order to guarantee a high response rate (ideally 80 % or higher as with IEA or OECD surveys),
- Ensuring the quality of responses by minimizing the complexity of questionnaire content and layout in order to avoid potential misinterpretations of items, and
- Consideration of the statistical capacity of countries and factoring in the training needs of data providers.

When choosing indicators in the international monitoring system, countries should indicate which points of the questionnaire are feasible, and what consequences the removal of certain points of the questionnaire may have. In this case the main problem is that certain countries may consider a number of indicators to be very important, however, another group of countries may think that these indicators are too difficult to collect or are not effective for the estimation.

Methods

In the new information society, the employees' education quality is of high priority. Despite the fact that the human capital needs constant training, its value depends on the form and method of training. The ability to use digital and

information technologies enables labor resources to withstand competition in the modern world. The human capital is becoming the main asset of the state. This is not merely a person, but the person with professional competencies in the area of new technologies who can research, introduce something new, and improve something old. This may be not one person, but a group of people who can combine and activate the individuals' competencies into a single collective intellect. Therefore, it is necessary to form a new innovative environment focused on the collective activity, and to involve a person since his/her school years. All levels of the education system, all subjects of the economy, all regions should be engaged in this, i.e., a "smart society" that will use modern information and digital technologies both to reduce manual labor and increase the share of intellectual activity, and to form humanistic, human-oriented environment (Lukin, 2002). Due to this, it is necessary to consider education not as a service, but as a priority sector of the economy focused on the strategic development of the country based on the society digitalization.

The management of the educational services market is based on information and digital technologies that allow maintaining and developing the human capital, and enable the state to estimate the results of the training system. Labor resources should be able to manage their main capital – qualification. This can only be implemented if the population is provided with vocational education that will make it easy to master professions in the future and realize the possibility of its own development based on information and digital technologies. The quality of the educational process directly depends on the competencies of the teaching staff: the system of teachers' training and retraining to use digital technologies and indicators of the skills related to using digital and information and communication technologies in the educational process (Andryushkova, 2018).

Due to the fact that the competence of teachers has considerable impact on the students' performance level (Owston, 2007), teachers are required to have the necessary competencies to integrate ICT resources in their professional activities. In its turn, this will help to improve students' competencies when using ICT in the educational process. In addition, there is an almost functional relation between the digital competence of teachers and their use of ICT in the educational process (Valiente, 2010). Thus, regular training of teachers and their mastering of new educational ICT in the further education

courses will considerably improve the use of new technologies in the educational process (Fredriksson, 2008). According to the recent studies, teachers prefer informal teaching methods, online learning and training associated with the immersion in a simulated real environment created in the classroom (Balanskat, 2006). Let us consider indicators of the teachers' ICT qualification in more detail.

The proportion of teachers who report a high level of the need to develop their ICT skills for teaching in OECD countries is 18.9 % on average (OECD, n.d.). The teachers who are the most confident in their ICT skills live in the United Kingdom (the proportion of teachers who need to develop their ICT skills is only 7.7 %, which is 2.5 times lower than the average for all countries), Portugal (9.2 %), and Canada (9.3 %), which is twice lower than the average level (Figure 1). The teachers who are the least confident and need to develop their ICT skills live in Italy (the proportion of teachers who need to develop their ICT skills is 35.9 %, which is

twice higher than the average for all countries), Iceland (28.6 %), and Japan (25.9 %), which is 1.5 times higher than the average.

The proportion of teachers who report a high level of the need to develop their ICT skills for teaching as taken for all countries with non-OECD economies under consideration is 20.6 % on average. The teachers who are the most confident in their ICT skills come from the United Arab Emirates (the proportion of teachers who need to develop their ICT skills is only 9.5 %, which is twice lower than the average for these countries) and Singapore (11.8 %), which is 1.7 times lower than the average. The teachers who are the least confident and need to develop their ICT skills come from Malaysia (the proportion of teachers who need to develop their ICT skills is 37.6 %, which is only 55 % of the average value for all countries) and Brazil (27.5 %), which is 75 % of the average.

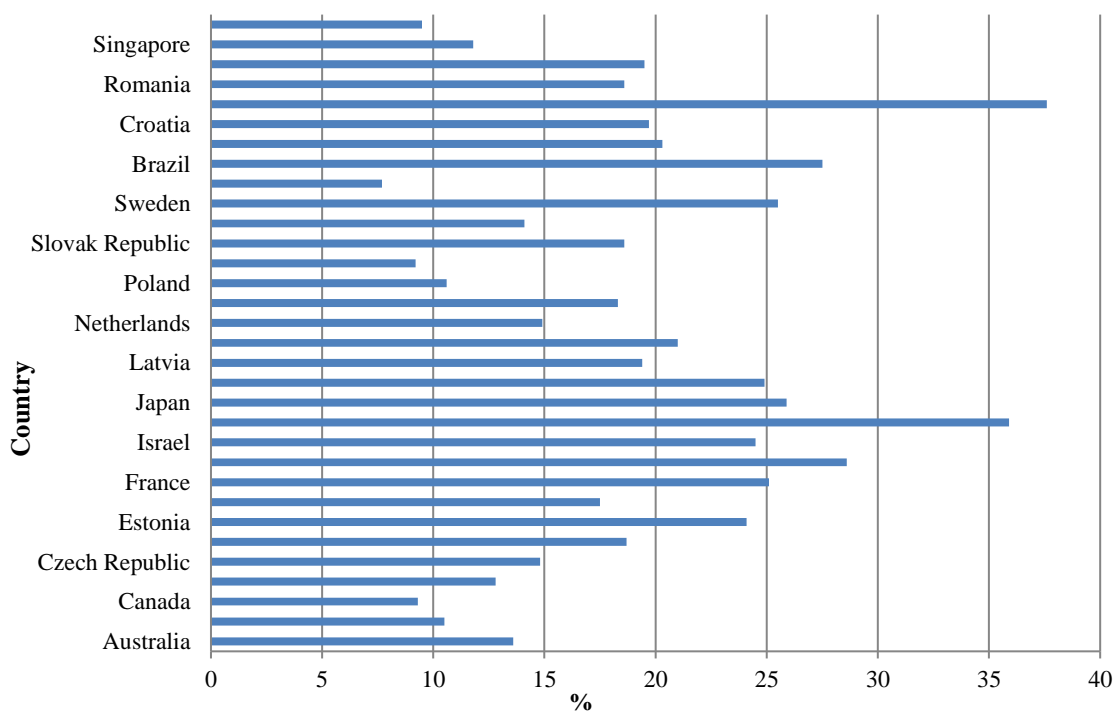


Figure 1. Teachers who report a high level of need to develop their ICT skills for teaching (%)

Results

The largest proportion of students taught by the teachers for whom ICT knowledge is compulsory when taking the relevant position live in Lithuania (on average 76 %) and Romania (62 %), which is twice more than the average for all EU countries. The smallest proportion of students taught by the teachers with compulsory ICT skills live in Austria (on average, 6 % of the total number of students) and Luxembourg (2 %), which is only 10 % of the average for the EU

countries (Figure 2). The low level of teachers' professional development in these countries may be related to the fact that, despite the fact that ICT education is included in the curricula for training middle and senior teachers in more than 50 % of the EU countries, educational establishments are completely autonomous in this matter. It is possible to solve this problem by compulsory ICT training of teachers, which in the future will allow to more actively introduce ICT resources in everyday educational practice.

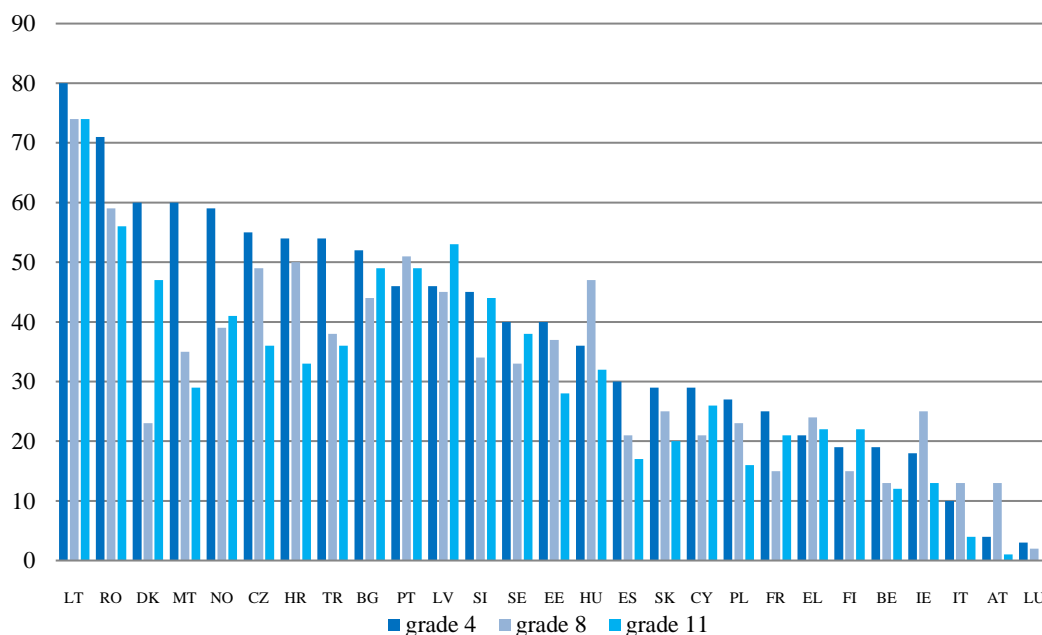


Figure 2. Teacher’s compulsory participation in ICT training (in % of students, by grade, by country, 2011 – 2012)

Lithuania and Romania keep the leading position by this indicator, regardless of the students' grade: from 74 % in grades 4 and 8 up to 75 % in grades 11 in Lithuania, as well as 59 % in grade 4, 56 % in grade 8, and 64 % in grade 11 in Romania (Figure 2). The top three in terms of the ICT competencies development include teachers teaching grade 4 students in Portugal (51 % of all students), and as for teachers of grades 8 and 11, they are from Latvia (53 % and 58 %, respectively). Such countries as Italy (10 %), Austria (4 %), and Luxembourg (3 %) where only 10 % or a lower number of students are trained by qualified teachers have a low level of ICT professional development of grade 4 teachers. The poor level of ICT professional development of grade 8 teachers is characteristic

of such countries as Italy, Belgium, Austria (13 % each), and Luxembourg (2 %), where less than 15 % of students are trained by qualified teachers. A poor level of ICT professional development of grade 11 teachers is found in Ireland (13 %), Belgium (12 %), Italy (4 %), and Austria (1 %), where less than 15 % of the students are trained by qualified teachers.

There is a considerable difference between grades 4 and 8 in terms of the ICT professional development of teachers in Germany (the proportion of students from grade 4 taught by highly qualified teachers is 60 %, and the one of students from grade 8 is only 23 %), in Malta (60 % in grade 4 and 35 % in grade 8), and in Norway (59 % in grade 4 and 39 % in grade 8). On the

contrary, in Ireland (18 % in grade 4 and 25 % in grade 8) and Hungary (36 % in grade 4 and 47 % of the students from grade 8) there is a 1.5 times excess in the proportion of students in grade 8 over students in grade 4, where there are teachers with a high level of ICT professional development.

The low level of teachers' professional development in the area of ICT causes further difficulties in introducing the resources and capabilities of ICT in the educational process. Due to this, it is necessary to develop measures on training teachers in ICT skills. Today, further education courses for teachers in the area of ICT are widely used by means of the school itself (school staff and other teachers with relevant competencies). The efficient use of ICT capabilities that allow understanding teachers' personal needs in professional development is available through online communities (blogs, forums, and social networking websites) that teachers can join. These instruments have huge advantages over offline resources. That is why it is reasonable to introduce such online platforms to the teaching practice of the entire world community of teachers.

The most popular means used by teachers for their ICT professional development over the recent two years include: personal learning of ICT in their free time, further ICT education courses organized by school staff, and teachers' participation in online communities for professional discussions with other teachers. Today, about 70 % of the students of all grades (Survey of Schools: ICT in Education, 2013) are

trained by the teachers who independently studied ICT to improve their professional development. The study of ICT indicators in primary and secondary education (Pelgrum, 2009) showed that teachers often faced difficulties in introducing ICT resources into the educational process. At the same time, in schools there is qualified administrative staff that can both support teachers from a technical point of view and train teachers to efficiently use ICT capabilities in the educational process. About 40 % of the students in grades 4 and 11 and 50 % of the students in grade 8 (Survey of Schools: ICT in Education, 2013) are taught by the teachers who have completed the further education courses organized by the school administration.

In order to improve the teachers' professional development, professional cooperation is important. It allows estimating the personal need in professional development and motivates to participate in relevant online communities to further use innovative teaching methods. Today, about 30 % of the students of all grades (Survey of Schools: ICT in Education, 2013) are taught by the teachers who have used online resources to improve their ICT development. Available online resources for teachers include online platforms, blogs, forums, social networks that allow exchanging experience and materials between teachers.

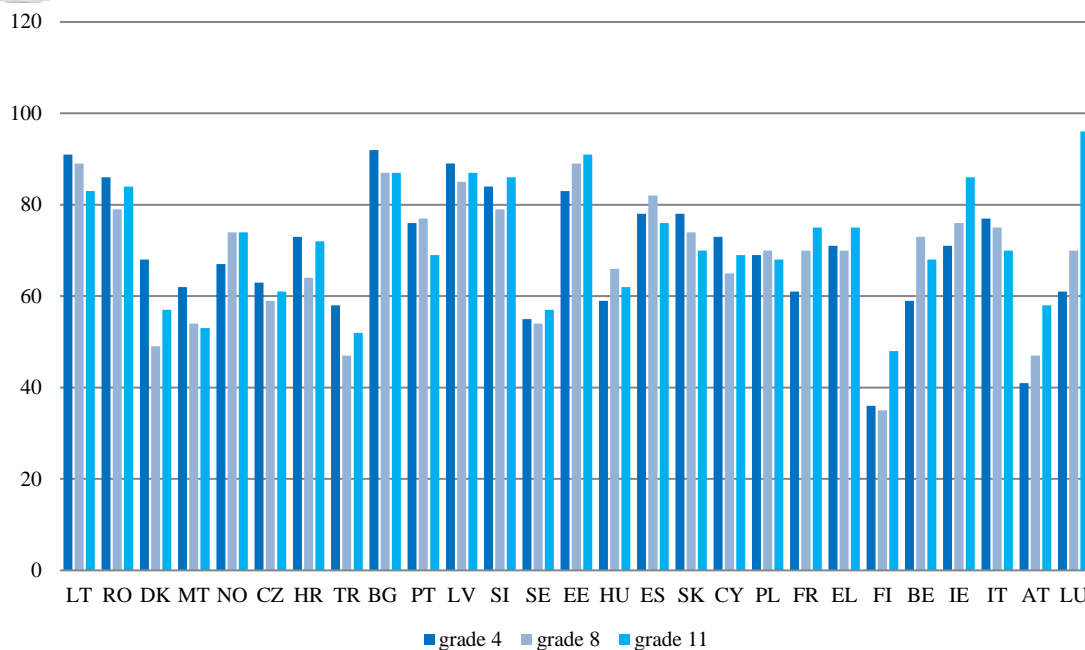


Figure 3. Teacher's involvement in personal learning of ICT in their own time (in % of the students, by grade, by country, 2011 – 2012)

Personal learning of ICT for introducing in the educational process is widely practiced by teachers in Bulgaria (where on average 89 % of the students of all grades are taught by such teachers), Lithuania and Estonia (88 % each), which is 26 % higher than the average for the EU countries. The smallest percentage of students taught by the teachers who individually study the capabilities of ICT to improve the efficiency of the educational process live in Finland (on average 40 % of the total number of students) and Austria (49 %), which corresponds to only 59 – 70 % of the average value for the EU countries (Figure 3). Despite the fact that it is important to train teachers how to use ICT resources, the Internet and basic software applications, it is necessary to pay great attention to improving the competencies related to integrating ICT into the educational process not only from the pedagogical point of view, but also in terms of a certain subject. Despite all efforts on integrating ICT in the educational process, teachers rarely use ICT in the classroom for teaching and learning. This substantiates the expansion of opportunities for professional development in the area of pedagogical use of ICT. At the first stage, this can include teaching and learning certain subjects in specialized applications.

Bulgaria, Lithuania, and Estonia keep the leading position by this indicator, regardless of the students' grade: from 87 % in grades 8 and 11 up

to 92 % in grade 4 in Bulgaria, from 83 % in grade 11, 89 % in grade 8 up to 91 % in grade 4 in Lithuania, from 83 % in grade 4, 89 % in grade 8 up to 91 % in grade 11 in Estonia. The five leaders by personal learning of ICT include the teachers who teach students in grade 4 in Bulgaria (92 % of all students), Lithuania (91 %), Latvia (89 %), Romania (86 %), and Estonia (83 %). Among the teachers of grade 8, in addition to Lithuania, Estonia (89 % of all students are taught by the teachers who have chosen to study ICT independently), and Bulgaria (87 %), the leaders are Latvia (85 %) and Spain (82 %). As for grade 11 teachers, the top five in terms of personal learning and introducing of ICT in the educational process are Luxembourg (96 % of all students), Estonia (91 %), Bulgaria (87 %), Latvia (87 %), and Slovenia (86 %).

Less than 50 % of grade 4 students taught by the teachers who personally learn and introduce ICT in the educational process live in Finland (36 % of all students) and Austria (41 %). The low level of personal learning of ICT by teachers of grade 8 is found in Finland, Turkey, Austria, and Germany, where less than 50 % of the students are taught by the teachers who use this method to improve their qualification. Less than 55 % of grade 11 students taught by the teachers who personally learn and introduce ICT in the educational process live in Finland (48 %), Turkey (52 %), and Malta (53 %).

A considerable excess of the proportion of grade 11 students over grade 4 students taught by the teachers who prefer personal learning of ICT and methods for introducing new technologies into the educational process by 57 % live in Luxembourg (61 % of grade 4 students and 96 % of grade 11 students). A considerable difference between students from grades 4 and 11 in terms of the personal learning and introduction of ICT in the educational process by teachers is observed in Austria – by 41 % (the proportion of grade 4 students taught by highly qualified teachers is only 41 %, and that of grade 11 students is 58 %), by 33 % in Finland (36 % in grade 4 and 48 % in grade 11), and by 21 % in Ireland (71 % in grade 4 and 86 % in grade 11).

Discussion

Today, the level of professional development of teachers both from the EU and other countries of the world remains quite low: only 25 % of the secondary and high school students and 30 % of the primary school students are trained by the teachers for whom the knowledge of ICT is a prerequisite for teaching. The highest proportion of students trained by the teachers for whom the use of ICT in the educational process is obligatory is in Lithuania (70 %) and Romania (65 %). The worst results were obtained in Luxembourg, Austria, and Italy.

In order to improve their professional level of development in the area of ICT, teachers most often use three resources: self-education, assistance of school staff in acquiring skills, and participation in online communities. In the EU about 70 % of the students in all grades are taught by the teachers who have been involved in personal learning of ICT in their own time. In addition to personal learning of ICT, in order to improve their professional level in ICT development (according to the study, this brings a positive result in learning for 50 % of the students), teachers use school staff and the online community (this had an effect on 30 % of the students).

The most common ICT training for school teachers is through online communities in Slovenia (teachers who have improved their skills in this way teach more than 50 % of all students). This method is the least demanded in the Czech Republic, Luxembourg, Belgium, and France (10 % or less of the students are taught by the teachers who use this method to improve their ICT skills). The method of improving education in ICT with the aid of school staff is actively used by teachers in Norway (80 % of the students

obtain education provided by this group of teachers). Teachers from France and Turkey consider this method to be the least efficient way to improve their skills (only 10 % of all students are taught by the teachers who choose this method of development).

In the EU countries, about 60 % of grades 4 and 8 students and about 45 % of grade 11 students obtain the education provided by the teachers who actively use ICT in the educational process. At the same time, 50 % of grades 4 and 8 students and 40 % of grade 11 students are trained by the teachers who over the recent two years have completed further education courses on using ICT. Teachers take an active part in the further education courses if they take place in the school where they teach, but rarely enough if these are further education courses through applications, online and multimedia courses – only 25 % of the students are taught by the teachers who improved their qualification in these courses.

In Lithuania, about 70 % of the students of all grades are taught by the teachers who have completed courses on using ICT in the educational process, while in Turkey this indicator is only 20 % of the total number of students. Estonia is distinguished as the country where on average 55 % of the students in most classes are trained by the teachers who over the recent two years have been trained to implement ICT in the educational practice through educational applications, manuals, and simulations. The worst results in terms of teacher training were obtained in France, Portugal, Denmark, Sweden, Belgium, and Luxembourg: less than 15 % of the students are taught by such teachers.

Conclusion

The results of the study show that the teachers who are the most confident in their ICT skills live in the United Kingdom, Portugal, Canada, United Arab Emirates, and Singapore. Teachers in Italy, Iceland, Japan, Malaysia, and Brazil need to develop their ICT skills most of all. A close relationship between the level of teachers' professional development and the degree of compulsory study of ICT in teachers' training in higher educational establishments has been revealed. In the countries where this discipline is obligatory in the curriculum (Germany, Lithuania, and Romania), the level of professional development of teachers in the area of ICT is more than twice higher than in the countries where ICT is not obligatory in the curriculum of future teachers (Austria, Italy, and

Luxembourg). The obtained results can be used to manage the information and digital system for ensuring the unity of education and personnel policy of educational institutions, which is part of the digital economy of countries.

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