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## DIGITALIZATION AND HUMAN CAPITAL DEVELOPMENT\*

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**Abstract.** The onset of Fourth Industrial Revolution and its related development of digitization processes has created the need to focus more attention on creating the conditions for the development of adequate human resources skills, on which the pace of innovation depends. The digital transformation of economies has become a global trend, so the need to innovate cannot be ignored if countries want to be competitive in international environment. Therefore, particular governments must respond to this situation and take relevant steps to support these processes. However, the situation in each country is diametrically different. Some of them strive to be leaders in a particular field and systematically support the development of ongoing processes. Others are more indifferent to this situation and their progress is much slower. As in the past, at the time of scientific and technical revolution, this attitude is subsequently reflected in their economic situation. There are also significant differences among EU Member States, despite the fact that the EU is trying to set certain development parameters that should be achieved in each country. The goal of this paper is to theoretically define what changes are taking place as a result of digitization, how the current situation has contributed to those changes, and which key areas should be given priority within each country. In addition, our goal is to find out how the population in Slovak Republic is developing in terms of the achieved level of education, what share of expenditures from GDP goes to education area and research and development support, as well as what is the average amount of these expenditures per capita, and thus to point out to the possible reasons of lagging innovation and modernization capacity of Slovak Republic. The method of descriptive statistics, time series analysis as well as the method of synthesis to formulate conclusions were used.

**Keywords:** digitalisation; labour market; human capital; education; research and development expenditure

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## **1. Introduction**

Digitization and the gradual transition of economies to the digital level have recently become one of the priorities of economic development in most countries. New technologies create new possibilities of operating and change all so far used activities, often even the overall structure of a society; being expected to contribute to the modernization of economies, competitiveness development and living standards raising and the overall level of well-being. The digital transformation affects all areas, including education. Outdated educational systems are going to be a serious issue being not able to prepare graduates with the required characteristics, which in turn affects the operating of all other spheres. The downside is the lack of digital skills in a relatively large part of the population. It usually refers to older generation and socially disadvantaged groups, but large differences in the level of digital skills can also be observed among younger generation as well. However, the obstacle is not only the persistence of education systems in its outdated form, but also the underfunding of key areas related to human capital development and the creation of innovations that is dependent on it. National governments have different approaches to supporting this key area in the future, and there are significant differences within Europe, especially when comparing Western European countries with those ones in Central and South-Eastern Europe. The Covid-19 pandemic and the associated measures regarding social isolation have also shown how important it is to pay attention to creating conditions for digital transformation. The forced reduction of social contacts has accelerated the pace of new digital elements implementation. Many people have been forced to adapt to these changed conditions and learn to cope with technologies they have been trying to avoid so far.

## **2. Theoretical background**

The digital economy and the ongoing processes significantly affect the functioning of all spheres within the world economy, including education systems. In many countries, however, there can be seen stagnation or too slow implementation of changes in this area. This can be a problem in the future due to the need to provide workers with new skills and the ability to take up new professions. These trends in the world therefore raise the need to focus more on human resources issue and the possibilities for their development. In general, formal education is considered to be the most important prerequisite for their development, although many studies suggest that the impact of non-formal education is not negligible, but its contribution is difficult to assess exactly. For this reason, the level of human capital is in some cases assessed only based on a survey regarding the education degree - the highest formal education achieved is determined.

The assessment on the educational level of population is the object of many researches (Šprocha, 2011; Lauko et al. 2012; Poráčová et al., 2021 and others). The authors also examine the impact of educational level on the economic growth of a society (e.g. Marquez-Ramos and Mourelle, 2019; Goczek et al., 2021 and others) and the relationship between the level of education and digital economy (Gupta, 2019; Koroleva and Kuratova, 2020; Miethlich, 2020 and others).

However, when assessing the level of education, several problems can emerge. First, the same levels of education can vary significantly and do not include the degree of human capital depreciation. Secondly, the fact that the number of people with higher levels of education in society is increasing may not be of a sufficient value unless we know in which professional fields these numbers are increasing. If this refers to areas, which will be gradually less and less necessary, the problem may be the so-called technological unemployment. The expected fast pace of technological change could make it impossible for workers to be retrained quickly for new occupations, which in turn will lead to an increase in unemployment rate (Kivarina, Makarevich, 2020). Many other areas that are linked to the economic prosperity of countries will therefore depend on a proper education system setup.

As already mentioned, as a result of ongoing digitization processes, there is a shift towards different ways of economic activity organization (Sundararajan, 2016). That is why the education systems modernization is

necessary, so it is possible to prepare people with the qualifications required by emerging new occupations. In terms of the ongoing digitization and its close connection to Industry 4.0, the Education 4.0 concept comes to the fore, which should include 4 dimensions, such as vocational, financial, business, and digital education (Sima et al., 2020). Education systems in individual countries are undergoing gradual reforms and are enriched with new elements. Nevertheless, the huge potential of digital technologies to improve education remains largely untapped (Abdovakhidov et al., 2021). New technologies not only facilitate and speed up access to information, make it easier to process and store, but also bring new elements to educational processes. If necessary, they can transfer the entire educational process to the virtual space and perform it by means of particular tools without any negative impact on its level. Nevertheless, during the current ongoing pandemic of Covid-19, there are concerns about the insufficient quality of education provided in this way, i.e., concerns if performing in this way in the long run would not lead to a decline in the level of knowledge and skills of pupils and students. Although concerns about the quality decline may be justified and need to be addressed, they cannot overshadow the enormous benefits that such training offers - it can be widely accessible to all. In a situation where, as a result of the pandemic, people were forced to reduce their social contacts to a minimum level, it was the online connection being the element that enabled the smooth continuation of ongoing processes. As far as possible, all activities were moved to this mode. At the beginning, the transition to a new way of working conditions was challenging for both sides - education providers, who in many cases did not have the necessary ICT equipment, but also for its recipients, who were also forced to learn to use ICT in a short time, so far used by them very rarely, maybe never. The crisis caused by the pandemic has accelerated the pace of digitization elements implementation in society, being considered one of its a few positives. Under its influence, many services provided via the Internet, which until then were perceived by most people only as ancillary, have become very necessary.

Regarding education systems digitization, there is a debate on the untapped technology potential, but there are also studies arguing that the effort to digitize individual processes should not be exaggerated. Before using any new trends, goals should be set to be achieved in order to avoid that technologies are implemented in areas where they are not needed at all (Abdovakhidov et al., 2020). While implementing them, the needs of teachers and pupils / students should be taken into account in particular, as well as the opinions of other experts, such as psychologists or IT specialists. It is recommended that the adoption process be gradual and new users would have enough time to adapt to the new way of working processes. This is the only way to achieve the results expected from the digital technologies implementation. If the pace of their implementation had been disproportionately fast, it could have rather provoked a wave of resistance and a negative attitude of potential users towards them.

The significance of digital technologies will gradually increase in all manufacturing and non-manufacturing sectors of the economy. This will put increased demands on higher education system in particular, as higher education is expected to generate human capital, which will be crucial for the future socio-economic development of individual countries (Ershovak et al., 2019). All developed countries are aware that the higher the level of education within a society, the more efficient economy performance, and thus the income and quality of life in the country is increasing. Therefore, investing into higher education and closely related research and development or innovation areas is becoming a priority. Even today, however, it is possible to meet with opinions that deviate from the majority and do not attach such great importance to education. For instance, already in the second half of the 20th century, Randall Collins diverged from the thesis of the interaction between economic growth and increasing the level of human capital, thus creating room for controversy as to whether innovation is a source or a consequence of countries' economic progress. He argued that even a high level of formal education brought nothing to the economy, but on the contrary, the fast pace of economic development in recent times has generated sufficient resources to invest in education, and therefore those two categories are often mistaken to be related (Collins, 1979). According to him, the increase in the number of people with a university degree is a consequence and not the cause of economic boom in individual countries. However, the world development trends show that Collins's view cannot be fully accepted, as those countries that put great emphasis on the quality of education and adapt education systems to new requirements are among the most successful and progressive ones. Of course,

these countries must have a number of other conditions in place, closely linked to each other, first of all, within the potential usage of their people.

Even today, there is a situation where the two mentioned facts are met. The Covid-19 pandemic has created the preconditions for faster digital elements implementation. On the other hand, the economic crisis, the signs of which appeared as early as 2019 and was accelerated by the pandemic outbreak, may pose a problem within the digital infrastructure development (Ganichev, Koshovets, 2021). The decline in industrial production, which occurred in most countries, also caused a decline in GDP. This, together with anti-crisis measures aimed at supporting the most affected areas, has drained a significant part of government resources, which is likely to reduce next funding for the digital infrastructure development support.

Observing the investment into human capital and education systems adaptation to the new requirements arising from the digital transformation of society is an essential issue because these processes have crucial impact on labor market performance. The attention is focused primarily on possible risks. The highlighted issues are the social inequalities intensification, the insufficient ability of some groups of workers to develop their digital knowledge and skills, and the question regarding the extent to which the digital economy creates conditions for human potential development due to automation and robotics being implemented within a large part of production processes (Davydova et al., 2020). The modernization of labour market should take all these facts into account and should aim at information transparency increasing, mobility enhancement, information technology skills improvement or human potential realization enhancement. In the long run, digitalization is expected to reduce labour demand, increase atypical forms of employment, and widen the salary gap within occupations; and this is one of the reasons why the flexibility of potential employees' incensement needs to be highlighted. In addition to the changing conditions related to labour market performance, attention should be paid to the adaptation of social security systems to these new conditions and in this context the concept of unconditional basic income as a solution to deal with the technological unemployment needs to be considered (Jepsen, Drahokoupil, 2017).

Technological unemployment appears to be the biggest threat in the digital economy, but the extent to which it will be presented is difficult to predict. Many jobs are already being lost in certain sectors, and forecasts point to an even faster pace of job losses. However, these forecasts need to be seen with some caution, as the mere possibility of automation and digitization does not mean that it will actually be reflected in all areas where its implementation is being considered, as there are many economic, legal and other regulatory constraints that cause significant time delays between the new technologies' discovery and their spread within the global economy (Islam, 2018). Although technological unemployment poses a threat, it does not necessarily mean the job loss. This is also evidenced by the development of many developed countries, in which, although many jobs have recently been displaced in certain sectors of the economy, many new ones have been created in other emerging, more promising sectors in the future. It is precisely these changes that are changing the structures of individual economies that should be the impetus to point out to the need to prepare people with new qualifications for the labour market.

In terms of labour markets performance, within individual countries there are efforts to determine the level of digital skills within the population. In Slovak Republic, the initiative is being developed in this direction mainly by the Digital Coalition - the national coalition for digital skills and professions of Slovak Republic. In 2021, for the tenth time in cooperation with other institutions (especially the Ministry of Education, Science, Research and Sport of Slovak Republic), it offers opportunities for pupils, students and teachers, as well as general public to find out the level of their digital skills bay means of the IT Fitness Test, which includes five areas: internet, security and computer systems, complex tasks, office and collaborative tools and social networks. The results from previous years show that a large part of the population still has underdeveloped classic office skills, which are one of the basic conditions to be successful on labour market. On the positive side, the test results are improving slightly each year and this trend is expected to continue in the upcoming years. In 2020, there was even

a significant improvement in digital skills. Experts explain this by saying that people have been forced to use digital technologies much more, and this has led to a bigger increase in these skills. During this period, many companies, whose approach to them was previously reserved, also realized the significance of digital technologies implementation and tried to avoid their implementation as long as possible. Although the situation has improved, the data available on Eurostat show that Slovak Republic still lags quite significantly behind many European countries regarding the digital skills level of the population. Even half of the Slovak population still does not have basic digital skills, while e.g. in Scandinavian countries or Iceland, this share is only around 20%.

### **3. Research objective and methodology**

The goal of this article is to theoretically define what changes are taking place as a result of digitization, how the current situation has contributed to those changes, and which key areas should be given priority within each country. In addition, our goal is to find out how the population of Slovak Republic is developing in terms of the achieved level of education, what share of expenditures from GDP goes to education area and research and development support, as well as what is the average amount of these expenditures per capita, and thus to point out to the possible causes of lagging innovation and modernization capacity of Slovak Republic.

Several scientific methods to process the paper were used. By means of descriptive method the phenomena and processes in the theoretical part of the paper were described. The methods of induction, deduction, analysis, or synthesis have also been used several times. It was also necessary to apply the method of abstraction, as the researched issue includes a large number of features and contexts, and in order to be able to elaborate the selected ones in depth, it was necessary to abstract them from the others. In the empirical part of the paper, we focused on quantitative research. While observing the selected indicators development, several statistical methods were applied. By means of the time series analysis, the share of expenditures on research and development was examined, along with the share of expenditures on education in the years of 2010-2019 in Slovak Republic and selected EU countries. The time series analysis to have a higher informative value, within the value of expenditures on research and development per capita, a geometric mean was also calculated, which removes the distortions caused by the existence of extreme values. Subsequently, the comparison method to compare the situation in the observed countries was used. The dependence size among the development of examined indicators was determined by the correlation analysis. The synthesis method to formulate conclusions was also used. Through the methods used, we managed to meet all the set goals.

The statistical data is drawn from the Eurostat database and from the database of the Statistical Office of Slovak Republic.

### **4. Results and discussion**

The level of education within the population, and especially working-age population, is the object of many scientific studies, which show that the share of the population with higher education is increasing in developed countries. The same scenario can be observed in Slovak Republic. Šprocha (2014) even claims that there is a historically unique increase within the level of education, it is the dynamic increase regarding the number and especially the share of university graduates within younger generations. Figure 1 shows the development of the number of university students and the structure of the population in Slovak Republic in terms of the level of education.



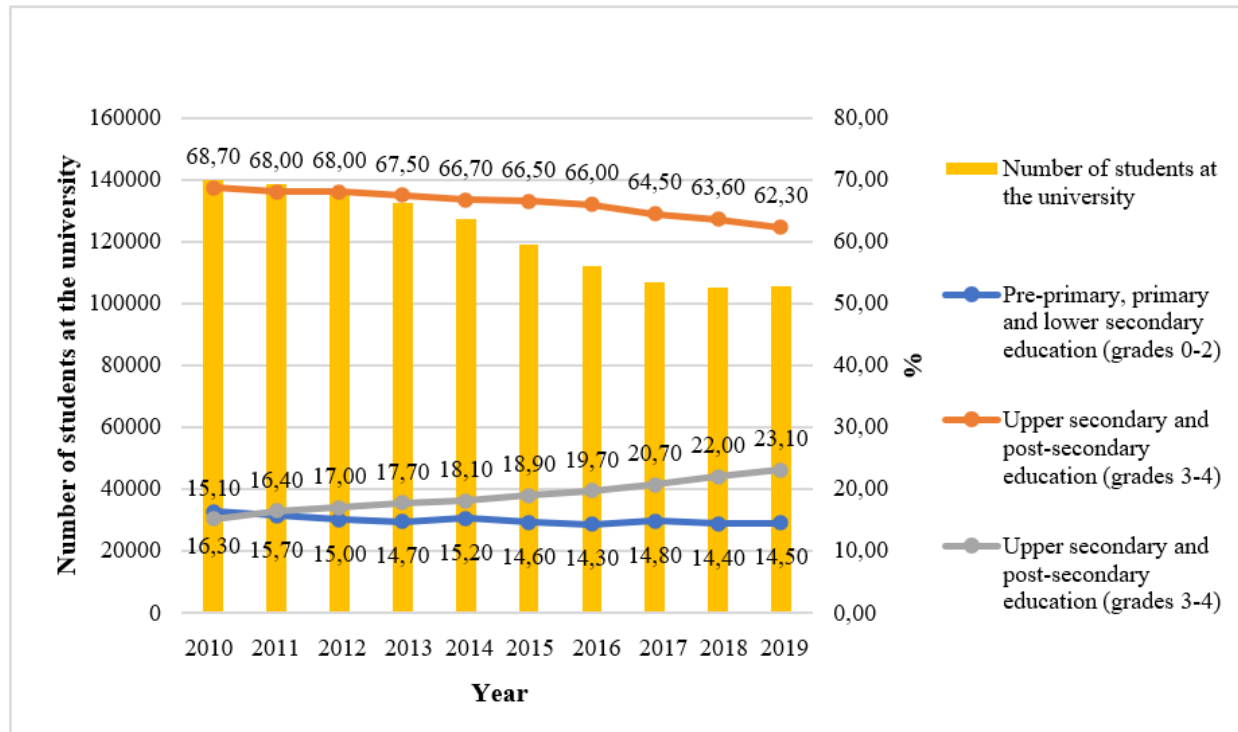
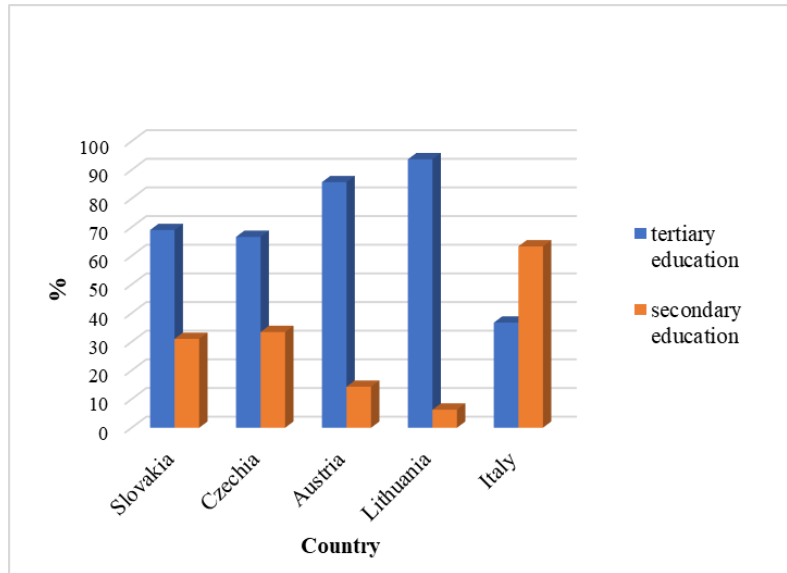


Figure 1. Number of students at universities and structure of the population of the Slovak Republic by education

Source: Statistical Office of the Slovak Republic (2021), own processing

In the observed period, the share of people with tertiary education in the population aged 15-64 increased and the share of people with upper secondary but also primary and lower secondary education decreased. Since 2010, the share of university graduates in the 15-64 age group has increased by 8 percentage points: from 15.1% in 2010 to 23.1% in 2019. On the contrary, the share of people with upper secondary and post-secondary education has decreased since 2010 from 68.7% to 62.3% in 2019, i.e. by 6.4 percentage points. The number of people with pre-primary, primary and lower secondary education also decreased, but only slightly, from 16.3% in 2010 to 14.5% in 2019 - a decrease of 1.8 percentage points in this category. Even though the share of the population with tertiary education is increasing, the number of students at universities is declining every year. However, this situation is not caused by the insufficient interest of young people to study, but especially by demographic development, or to a lesser extent by the increasing number of students going to study abroad.

Opponents of mass education at colleges and universities argue that the number of people with a university degree is increasing unnecessarily and that secondary school education would suffice for many jobs. However, in certain areas, people with a university degree are preferred. As an example, it is possible to mention the field of ICT (Figure 2).

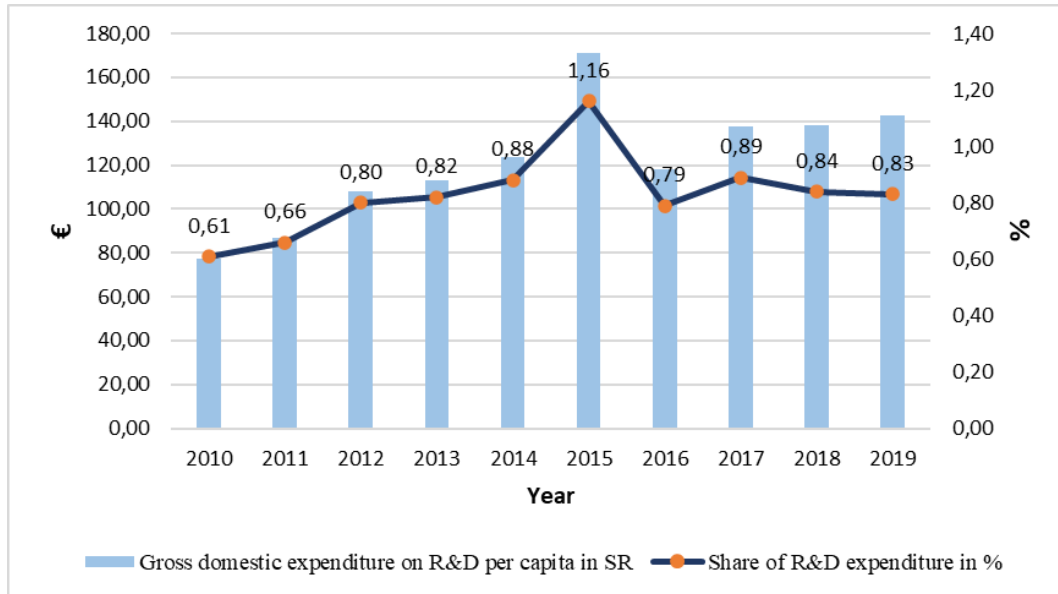


**Figure 2.** Employed ICT specialists by educational attainment level in 2020

*Source:* Eurostat (2021), own processing

In most European countries, most people working in ICT area have a university degree. Also, on job portals in job offers in this area, first or second-degree of university education is usually mentioned as a requirement for applicants. In Slovak Republic 69% of employees working in this area have a university degree, in Czech Republic it is 66.6% of employees. In most countries, this share is even higher, e.g., in Austria 85.7% and in Lithuania up to 93.7%. There are few countries in which people with a secondary education predominate in this area, and most of them are countries that are also lagging behind in terms of the innovation implementation and the pace of digitalization in the economy, e.g. in Italy, only 36.7% of ICT employees account for higher education, and 32.1% of all employees in Portugal. However, it is not necessary to look at this fact only negatively, as there are differences among countries in the achieved levels of education and the quality of graduates within individual degrees is difficult to compare on an international scale.

The digital economy and the new opportunities it creates for more efficient functioning of education systems are closely linked to the implementation of innovation. For this reason, R&D spending, which is a driver of innovation, is very often observed in individual countries. Due to the possibility of international comparison, not only the absolute share of R&D expenditure is observed, but also the development of R&D intensity. R&D intensity is expressed as a percentage of R&D expenditure to GDP. In Figure 3 we see the development of the share of expenditures on research and development in Slovak Republic and the share of expenditures on GDP.



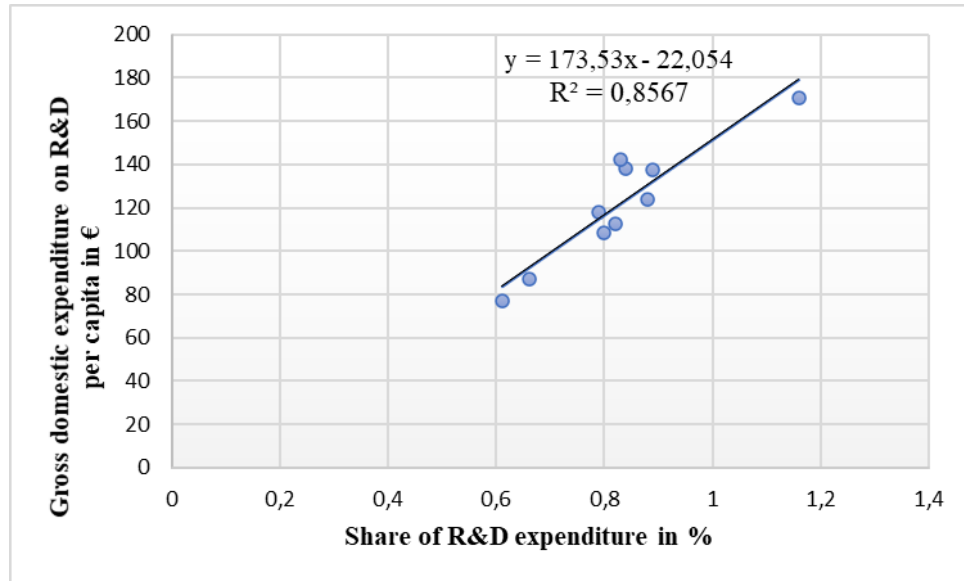
**Figure 3.** Gross domestic expenditure on research and development in SR

*Source:* Eurostat (2021), own processing

In the observed period, the research intensity in Slovak Republic increased slightly. Until 2015, the share of R&D expenditure in GDP increased every year and for the first time exceeded 1%. In the following year, however, there was a more significant decline and the research intensity in Slovak Republic got back to approximately the same value as in 2012. In recent years, it has remained at values between 0.8 and 0.9% so the EU goal to spend at least 3% of GDP on research and development will probably remain unattained for a long time in Slovak Republic.

If we look at the expenditures spent on research and development in relation to the population, in Slovakia in 2019 they accounted for almost 143 EUR per capita. The highest values were achieved in 2015 - 171 EUR per capita, while the lowest in 2010 - only about 77 EUR per capita. As no significant differences within the amount of GDP were recorded in the observed period, the amount of expenditures per capita in Slovak Republic was largely influenced by the share of expenditures on research and development in GDP. This assumption was also confirmed by a correlation analysis (Figure 4), which was used to determine the relationship between the share of R&D expenditure in GDP and its amount per capita.





**Figure 4.** Dependence between the share of R&D expenditure in GDP and its value per capita

*Source:* own processing

The calculated value of the correlation coefficient was 0.925581. This means that the dependence among the variables examined is very high and the only possible way to increase the R&D expenditure per capita is to increase the % of GDP earmarked to support this area. The coefficient of determination reached a value of 0.8567, which means that up to more than 85% of the total variability is explained by the model and a linear relationship was correctly determined among the selected variables. The regression function has the form  $y = 173.53x - 22.054$ .

Although the research intensity in Slovakia has slightly increased, Slovakia is still at the bottom of European countries rankings. The average share of research and development expenditure in EU countries has been around 2.2% in recent years (2.19% in 2019). However, there are significant differences among countries. While in some the share of R&D expenditure in GDP exceeds 3% (Sweden 3.39%, Austria 3.19%, Germany 3.17%), in others it is well below 1% (Romania 0.48%, Malta 0.61%, Cyprus 0.63%, Latvia 0.64 %, Ireland 0.78%, Slovakia 0.83%, Bulgaria 0.84% and Lithuania 0.99%).

**Table 1.** Value of expenditure on research and development per capita in € /% of GDP

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Geometric mean
<b>Czechia</b>	200	243	274	285	294	308	281	325	378	408	294
	1,33%	1,54%	1,77%	1,88%	1,96%	1,92%	1,67%	1,77%	1,90%	1,93%	1,75%
<b>Romania</b>	28	33	32	28	29	39	41	48	52	55	37
	0,46%	0,50%	0,49%	0,39%	0,38%	0,49%	0,48%	0,50%	0,50%	0,48%	0,46%
<b>Slovakia</b>	77	87	108	113	124	171	118	138	138	142	119
	0,61%	0,66%	0,80%	0,82%	0,88%	1,16%	0,79%	0,89%	0,84%	0,83%	0,82%
<b>Sweden</b>	1 271	1 397	1 465	1 508	1 411	1 504	1 537	1 615	1 545	1 579	1 480
	3,17%	3,19%	3,23%	3,26%	3,10%	3,22%	3,25%	3,36%	3,32%	3,39%	3,25%
<b>Hungary</b>	135	144	150	167	168	176	158	191	233	244	173
	1,36%	1,41%	1,49%	1,63%	1,56%	1,54%	1,33%	1,47%	1,67%	1,63%	1,50%
<b>Austria</b>	966	988	1 105	1 132	1 208	1 223	1 281	1 287	1 373	1 432	1 190
	2,73%	2,67%	2,91%	2,95%	3,08%	3,05%	3,12%	3,06%	3,14%	3,19%	2,99%

Source: Eurostat (2021), own processing

If we look at the amount of expenditure on research and development per capita (Table 1) in some other European countries (e.g. in Hungary 221 EUR, in Czech Republic 408 EUR, in Austria 1,432 EUR per capita), it is clear that Slovak Republic within the innovation capacity is lagging far behind these countries. The amount of expenditure on research and development per capita is related not only to the size of their share in GDP, but also to the level of GDP as such. In Romania the GDP per capita was the lowest within the observed countries, there is also the least investment in research and development - on average 0.46% and the average amount of expenditure per capita is only 37 EUR. Hungary has the second lowest GDP per capita within these countries, but the investment share in % of GDP is higher in the field of research and development than in Slovak Republic, so the average amount of expenditure on research and development per capita there is higher than in Slovak Republic - it is 173 EUR, being on average by 54 EUR more than in Slovakia. In Czech Republic, this was on average 294 EUR per capita during the observed period. The situation is diametrically different in Austria and Sweden, which meet the EU criterion and have spent more than 3% of GDP on R&D expenditure in recent years. In Austria, the average amount of R&D expenditure was 1,190 EUR, which is 10 times more than in Slovak Republic, in Sweden it was on average 1,480 EUR, which is even 12.4 times more.

Slovakia's lack of innovative capacity is also pointed out by its places in various rankings. For example, since 2016, the Institute for Management Development has been showing digital competitiveness in 63 countries and assessing the extent to which the country is engaged in research and digital technologies implementation, with the goal to contribute to the overall society transformation. In 2019, Slovak Republic ranked 47<sup>th</sup> spot. Within the European Union, the Digital Economy and Society Index (DESI) is compiled annually and consists of 34 indicators. This index evaluates the development of individual EU countries in accordance with the effectiveness of their transition to digital economy. Even within the evaluation of this index, Slovak Republic lags behind and ranks among the worst evaluated countries, behind the EU average.

Next, we will focus on the share of expenditure on education in GDP (Table 2) and compare the situation in Slovak Republic with the situation in other European countries, having been also included in previous analysis.

**Table 2.** General government expenditure on education (% of GDP)

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
<b>Slovakia</b>	4,6	4,3	4	4,1	4	4,2	3,9	3,9	4	4,2
<b>Czech Republic</b>	4,6	4,6	4,5	4,5	4,5	4,4	3,9	4,1	4,6	4,9
<b>Hungary</b>	5,5	5,1	4,7	4,7	5,2	5,2	5	5,1	5	4,7
<b>Austria</b>	5,1	5	5	5	4,9	4,9	4,9	4,8	4,8	4,8
<b>Romania</b>	3,3	4,1	3	2,8	3	3,1	3,3	2,8	3,2	3,6
<b>Sweden</b>	6,4	6,3	6,4	6,5	6,5	6,4	6,6	6,7	6,9	6,9
<b>EU average</b>	<b>5</b>	<b>4,9</b>	<b>4,9</b>	<b>4,9</b>	<b>4,9</b>	<b>4,8</b>	<b>4,7</b>	<b>4,7</b>	<b>4,7</b>	<b>4,7</b>

Source: Eurostat (2021)

There are no significant differences among countries regarding the expenditure amount on education in GDP as in the share of expenditure on research and development in GDP. Slovakia is approaching the EU average, which was 4.7% in 2019, of which expenditure on pre-primary and primary education accounted for 1.6% of GDP, expenditure on secondary education 1.8% of GDP and expenditure on tertiary education reached 0.8% of GDP. Slovak Republic is at a similar level as Czech Republic, Hungary and Austria, i.e. the field of education in our country is not as significantly underfunded as the field of research and development. In the observed period, the share of expenditure on education in GDP did not change significantly in any of the observed countries, it remained at relatively stable figures. Iceland (7.1% of GDP) and Sweden (6.9% of GDP) achieved the highest share of education expenditure among EU countries in 2019. This share was lowest in Ireland (3.1%) and Romania (3.6%). Bulgaria and Italy (3.9%), which were not included in the table, also spend less than 4% of GDP on education.

## Conclusions

The evidence of digital transformation can be seen in all areas of social life. It affects not only the functioning of manufacturing companies, but also the provision of services. Today, personal contact of a client with clerk is not so necessary when it comes to paperwork, but the whole process can be done electronically through ICT from the comfort of home. The same trend exacerbated by the impact of Covid-19 pandemic can be observed in the functioning of educational processes. It is obvious that personal contact will never be completely replaced by technology, as people are a social human beings and long-term separation from society often leads to psychological problems, but an adequate level of digitization brings far more positives than negatives. Therefore, the attention is rightfully focused on increasing the level of human capital, but also the development of digital skills within the population. On one hand, education systems need to be updated and able to train people with new skills. On the other hand, we must not forget to create conditions in which people will be able to apply the acquired skills. These two issues cannot be separated from each other, because only with their common development a comprehensive advance of a society can be achieved. Of course, there is no need to increase only aimlessly artificially the number of people with a university degree and to increase the share of public expenditure earmarked for education or research and development. The crucial issue is which sectors are promising and soon there will be an increased demand for them on labour market, as well as to which areas of research and development the increased expenditures should be oriented. The research limitation is that our research is based on quantitative indicators, but some authors argue that the quality of human capital must be expressed comprehensively also through qualitative indicators (Hanushek & Woessmann, 2012). Another limitation is that the impact of human capital quality on economic indicators cannot be reliably determined in this kind of research (Diebolt & Hippe, 2019).

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