Lecture Notes in Educational Technology

Dejian Liu · Ronghuai Huang ·
Bojan Lalic · Haijun Zeng ·
Nikola Zivlak *Editors*

Comparative Analysis of ICT in Education Between China and Central and Eastern European Countries

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Preface

Background

In the era of science and technology revolution driven by information technology, the degree of informatization has become an important indicator of competitiveness and modernization for a nation or a region. The quickening pace of globalization makes it inevitable for countries to engage active internationalization through education informatization, and the construction and implementation of education informatization require the global vision, open minds and strategic insights. As one of the key elements for national development, education informatization will make significant contribution in enhancing a nation's competitiveness. More and more countries have made education informatization as one of their national development strategies, pushing forward education reform and innovation to boost the industrial upgrading and the economic development, which will eventually give rise to the national competitiveness.

The "16+1" cooperation mechanism,[1] as an incubator for pragmatic trans-regions cooperation platform, created in April 2012 by China and 16 Central and Eastern European countries (hereinafter referred to as "CEECs"), including Albania, Bosnia and Herzegovina, Bulgaria, China, Croatia, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, North Macedonia, Montenegro, Poland, Romania, Serbia, Slovakia and Slovenia (hereinafter referred to as "the Participants"). With the developments in Information and Communication Technology (ICT) in China and CEECs, ICT has increasingly important roles in education including the improvement of the quality of teaching and learning, as well as the promotion of equity in education. The significant contribution of ICT in education is an enabler to realizing the purpose of the mechanism of "16+1 cooperation" between China and CEECs that has been received much global

[1]During the eighth China-Central and Eastern European Leaders' Meeting, Greece joined the China-Central and Eastern European Cooperation Mechanism as a member country officially. Since then, "16 + 1 Cooperation" has been upgraded to "17 + 1 Cooperation".

attention, It has injected fresh impetus to cooperation between them and opens up new chapter of China-CEECs cooperation.

In response to the “16+1” cooperation mechanism, and the Belt and Road Initiative proposed by President Xi Jinping in 2013, and also acknowledging the importance of long-term cooperation between China and CEECs, the importance of information and communication technologies (ICT) in building knowledge-based societies, and the importance of building worldwide capacities in the field of ICT, Beijing Normal University(BNU), University of Novi Sad (UNS), and NetDragon Websoft (ND) signed the Memorandum of Understanding, announcing the establishment of the “Joint Virtual Lab for Future Education” during the 5th Meeting of China-CEEC Higher Education Institutions Consortium held in ShenZhen, China on May 29th, 2018.

The Joint Virtual Lab for Future Education aims to promote multilateral cooperation in the area of research, innovation and technology between China and CEECs, beginning with Serbia and later extending to the other 16 countries involved in 16+1 Cooperation Mechanism. It focusing on, but not limited to teacher training, educational resources, models of ICT-Based teaching, ICT Infrastructure, and Policy Analysis and Planning.

Referring to the “16+1” Cooperation Framework, Budapest Guidelines for Cooperation and the Importance of building worldwide capacities in the field of ICT, The Comparative Analysis of ICT in Education between China and Central and Eastern European Countries have been delivered as a tangible academic achievement of The Joint Virtual Lab for Future Education with aiming at providing suggestions for China-CEECs’ cooperation in the field of education and information technology through analyzing and summarizing the development of education and education informatization of China and CEECs. More than 20 international experts in the fields of education technologies from universities and Ministry of Education of 17 CEECs are invited to participate. Experts from 18 countries (including China with CEECs) will provide reports on the state-of-the-art of ICT in education in their own country.

The Comparative Analysis of ICT in Education between China and Central and Eastern European Countries is focused on the basic national education snapshot and localized education resources development for education informatization. It enhance the modernization of education in both China and CEECs, the report will provide the feeling about landscape and state-of-the-art, support to establishing an academic exchange platform for education informatization within CEECs, improving basic educational conditions, and achieving the deep integration of information technology and education at an early date, promote multilateral academic cooperation in the area of research, innovation and technology between China and CEEC through establishing a academia platform as the foundation of the Education Informatization.

Outline of This Report

In this report, each chapter will be generated by the case study of each country. Each of them explores country snapshots on the ICT in Education respectively. It well set the context for an introduction to examples of what policies have been made and what measures have been taken for educational inclusiveness, educational equity and educational quality.

The content of each chapter will be centered on four major parts, namely, overview of the country, overview of the educational development, new progress of ICT in education, and policy and strategy of ICT.

Overview of the Country

In this section, each country has introduced the status quo of the development, which is supposed to include, but not limit to the following facts:

- The history and geography of each country
- Population situation
- Political system
- The current situation of economic development
- The status quo of science and technologies
- The status quo of social and cultural development, including languages
- The relationship with China under the "16+1" cooperation framework.

Overview of the Educational Development

In the overview of the educational development section, each country has expressed a detailed description of the development of education, by listing infographic such like:

- Education system and policy
- Students and teachers' profiles
- Enrollment rate and retention rate
- Government expenditure on education
- Educational research
- Teachers' professional development.

New Progress of ICT in Education

In this section, it introduces the new progress of the ICT development of education in 18 countries, including:

- Infrastructure (Campus network access, Computer-student ratio, etc.)
- Educational resources (Digital educational resources, Open educational resources, etc.)

- Learning and teaching (Information technology-assisted teaching, Courses about Information technology, etc.)
- The ability for faculty to use ICT to teach
- The ability for students to use ICT to solve problems.

Policy and Strategy of ICT

It is believed that these sharing of developments and trends will serve as a groundwork for inspiring and innovative integration of ICT into educational processes and provide the reference for the China –CEEC cooperation in educational informationalization under the framework of “16+1” cooperation mechanism.

The Comparative Analysis of ICT between China and CEECs will be discussed in the last chapter by comparing statistics in a holistic perspective in order to demonstrate a snapshot of ICT in Education and short conclusions have pulled all of these information and ideas together, including outcomes and achievements, challenges and strategies, and a suggestion for the future cooperation of ICT in education between China and CEECs.

In a nutshell, this report mentioned a number of potential impacts in terms of teacher training, educational resources, models of ICT-Based Teaching, ICT infrastructure, Policy Analysis and Planning. It also reveals that main achievements and challenges remain at this point. The Report shows that, despite progress made towards ICT in Education, areas of concern remain in these regions, including education quality and equity.

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Chapter 1
Report on ICT in Education in China

Yunwu Wang

1.1 Overview of the Country

1.1.1 The Geography

China is located in the east of Asia and the west coast of the Pacific Ocean. The land area is about 9.6 million square kilometers, the eastern and southern continental coastlines are more than 18,000 km, and the inland and coastal waters are about 4.7 million square kilometers. There are more than 7600 small islands in the sea area, of which Taiwan Island is the largest with an area of 35,798 km^2. China borders 14 countries and 8 countries at sea. The provincial administrative divisions are 4 municipalities directly under the Central Government, 23 provinces, 5 autonomous regions, 2 special administrative regions, and the capital of Beijing.[1]

1.1.2 Population Situation

China was founded in Beijing on October 1, 1949. China is a unified multiethnic country composed of 56 ethnic groups, with the Han nationality accounting for 91.51% of the total population. By the end of 2017, the total population of China mainland was 1390.08 million, and the permanent population of middle cities and towns was 813.47 million, accounting for 58.52% of the total population.[2] There are more than 80 languages in China. Mandarin is the official language.

[1]Chinese Government Network (2019a).

[2]Chinese Government Network (2019b).

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1.1.3 Current Situation of Economic Development

China is one of the four ancient civilizations with a long history and culture. It is the third-largest country and the second-largest economy in the world, the world's largest trading country, the world's largest foreign exchange reserve country, the world's largest steel producer and the world's largest agricultural country, the world's largest total grain producer, and one of the fastest growing countries in the world. China's "reform and opening-up policy" implemented in 1978 profoundly changed China and brought about tremendous changes in China. At the beginning of the reform and opening-up in 1978, China's economic scale was only 367.9 billion yuan; by 2017, China's GDP had reached 82.71 trillion yuan, which has become the second-largest economy in the world. The proportion of China's total economic output in the world economy rose from 1.8% in 1978 to 16% in 2017, second only to the United States. China's economic growth over the past 40 years has created a miracle. With the rapid growth of China's economy, China has made many brilliant achievements in energy, transportation, post and telecommunications, science, education, culture and health, infrastructure construction, and other basic industries. China's green development and sustainable economic transformation and upgrading have achieved initial results.[3] Over the past 40 years of reform and opening-up, China has exerted a great influence on the world economy. Reform and opening-up have made China a world factory. Made in China has brought many benefits to global consumers. China's market has created a huge space for global economic development. China's consumer market has become the fastest-growing market in major economies. China has gradually developed from a beneficiary of international public goods to a provider of global public goods under the responsibility of a responsible big country.[4]

1.1.4 China-CEEC "16+1" Cooperation Framework

In September and October 2013, Chinese President Xi Jinping put forward the cooperation proposal to build the new Silk Road Economic Belt and the twenty-first Century Maritime Silk Road (hereinafter referred to as "the Belt and Road Initiative"). The Belt and Road Initiative borrows the historical symbols of the ancient Silk Road, holds high the banner of peaceful development, and actively develops economic cooperation and partnership with the countries along the border, and jointly creates a political mutual trust, economic integration, cultural inclusion interest community, destiny community and responsibility community, which aims at building a new mode and path of globalization development, emphasizing equality and mutual benefit and sharing with each other, and is committed to building a new "human destiny community" and a new thinking mode of global governance. From joining the world trade organization to building the "The Belt and Road," it has made a

[3] Jianping and Bo (2018, pp. 13–16).

[4] Jinping (2019).

significant contribution to the Asian financial crisis and the international financial crisis, and has contributed more than 30% to the world economic growth for many years. It has become the main stabilizer and power source of world economic growth, and has promoted the lofty cause of mankind and peace and development.[5]

"The Belt and Road" is a win-win road to promote common development and achieve common prosperity. It is a way to enhance understanding of trust and enhance all-round friendship. China has shown a high degree of sincerity in cooperation, winning the enthusiasm of more and more countries and international organizations to participate in the "The Belt and Road" construction, and promoting the development of economic globalization. By the end of 2018, more than 100 countries and international organizations all over the world have actively supported and participated in the construction of "the Belt and Road." In the important resolutions of the UN General Assembly and the UN Security Council, the contents of "the Belt and Road" construction were fully recognized.[6]

In 2015, the *Medium-term Plan for China-Central and Eastern European Countries Cooperation* was published in China. "16+1 cooperation" has further promoted the development of relations between China and the Central and Eastern European countries and promoted the all-round and balanced development of China–EU comprehensive strategic partnership. From 2015 to 2020, China and 16 countries in Central and Eastern Europe will further release their potential for cooperation and strengthen cooperation in 9 areas: economy; interconnection; capacity and equipment manufacturing; finance; agriculture, forestry and quality control; science and technology, research, innovation and environmental protection; culture, education, youth, sports and tourism; health; and local areas.

1.2 Overview of the Educational Development

In the past 40 years of reform and opening-up, China has made remarkable achievements, created one miracle after another in the history of human education, and mapped an unprecedented history of human education. In 1978, only 60.5% of primary schools were promoted to junior middle schools, 856 thousand students and 10 thousand postgraduates were enrolled in colleges and universities. In 2018, there were 514 thousand schools at all levels in China, with 270 million students. The scale of education ranked first in the world. From 165 thousand graduates in 1978 to 8.2 million in 2018, the number of graduates from general institutions of higher learning has increased by nearly 50 times. At present, all kinds of education at all levels in China have achieved leapfrog development. The overall level of education has entered the ranks of the world and is moving from a big educational country to a powerful educational country.

[5] Jinping (2018).

[6] See Footnote 3.

1.2.1 Education System and Policy

1.2.1.1 Education System

The Ministry of Education, as the administrative department of education under the State Council, is in charge of the national education work, making overall plans and coordinating the management of the educational undertakings throughout the country. The municipalities directly under the Central Government have educational committees, provinces, autonomous regions have educational offices, and local municipalities, districts, and counties have corresponding educational bureaus or offices.

In the twenty-century, the Chinese government has placed education in a strategic position of giving priority to development. It has put forward the strategic policy of "rejuvenating the country through science and education." It has continuously deepened the reform of the educational system, strengthened quality education, and insisted on popularizing 9-year compulsory education and eliminating illiteracy among young and middle-aged people as the top priority of its educational work. "Facing modernization, the world and the future" is not only the direction of China's education development, but also the guide for education reform and construction. Governments at all levels, while increasing investment in education, encourage nongovernmental multichannel and multiform school running.

Education in China is divided into the following five stages: (1) Pre-school education refers to the educational process of children aged 3-6 in kindergartens. (2) Primary education refers to the process of primary education for children aged 6–12. (3) Secondary education refers to the process of receiving education in secondary schools between the ages of 12 and 17. (4) Higher education refers to specialized, undergraduate, and postgraduate education following secondary education. (5) Continuing education, including adult technical training, adult nonacademic higher education, and literacy education.

1.2.1.2 Education Policy

After 1976, China established a new development line centered on economic construction. In 1983, Deng Xiaoping put forward the task of educational modernization in his inscription "Education should be geared to modernization, the world and the future." In 1985, the *Decision of the Central Committee of the Communist Party of China on the Reform of the Educational System* put forward for the first time that 9-year compulsory education should be popularized in a planned and systematic way throughout the country. In 1986, the *Compulsory Education Law of the People's Republic of China* clearly defined the timetable for achieving the goal of "two bases" in the form of law, that is, to basically popularize 9-year compulsory education and basically eradicate illiteracy among young and middle-aged people by the year 2000. In 1993, the *Outline of China's Educational Reform and Development* put forward that "high school education should be actively popularized in metropolitan areas and coastal economically developed areas, that large and medium-sized cities should basically meet the requirements of early childhood education, and that rural areas should actively develop pre-school education for one year." In 1999, the *Decision on Deepening Educational Reform and Promoting Quality Education in an All-round Way* put forward "expanding the scale of education and higher education in high schools, widening the way of talents' growth and slowing the pressure of entering schools." In 2010, the *Outline of the National Medium and Long Term Education Reform and Development Plan (2010–2020)* put forward that "by 2020, pre-school education will be basically universal; 9-year compulsory education will be consolidated and improved; high school education will be universal, with a gross enrollment rate of 90%; higher education will be popularized, with a gross enrollment rate of 40%; illiteracy among young and middle-aged people will be eradicated." In 2017, the *13th Five-Year Plan for the Development of National Education* adjusted the target of gross enrollment rate of higher education to 50% by 2020. This means that by 2020, China's education will enter an era of full popularization. Pre-school education, compulsory education, high school education, and higher education will all be popularized.

1.2.2 Students and Teachers' Profiles[7]

In 2017, there were 513.8 thousand schools at all levels, an increase of 2105 over the previous year, an increase of 0.41%; 270 million students at all levels, an increase of 5455.4 thousand over the previous year, an increase of 2.06%; 16,268.9 thousand full-time teachers, an increase of 487.2 thousand over the previous year, an increase of 3.09%.[8]

There are altogether 177.6 thousand private schools at all levels and in all kinds of education, 51,204.7 thousand students are enrolled. Among them, 160.4 thousand private kindergartens with 25,723.4 thousand children in kindergartens, 6107 private primary schools with 8141.7 thousand students, 5277 private junior middle schools with 5776.8 thousand students, 3002 private high schools with 3062.6 thousand students, 2069 private secondary vocational schools with 1973.3 thousand students, 747 private colleges (including 265 independent colleges and 1 adult college) with 6284.6 thousand students, 747 graduate students, 1223 students in school. There are also 800 private institutions of higher education with 744.7 thousand registered students.

[7]All statistical data did not include Hong Kong Special Administrative Region, Macao Special Administrative Region, and Taiwan Province. Because of rounding, some data are not equal to the sum of subitems.

[8]Ministry of Education (2019a).

1.2.2.1 Elementary Education

In 2017, there were 255 thousand kindergartens and 46,001.4 thousand children in kindergartens. There are 4192.9 thousand kindergarten staff and 2432.1 thousand full-time teachers. There are 218.9 thousand schools in the compulsory education stage, with 33,137.8 thousand million students, 145 million students, and 9493.6 thousand full-time teachers. There are 100,937 thousand pupils in primary schools, 5645.3 thousand teachers and staff in primary schools, and 5944.9 thousand full-time teachers. There are 44,420.6 thousand junior high school students, 4078.1 thousand junior high school faculty and staff, and 3548.7 thousand full-time teachers. There are 2107 special education schools, 578.8 thousand students, and 56 thousand full-time teachers.

1.2.2.2 Secondary Education

There are 24.6 thousand schools and 39,709.9 thousand students in high school education in China. There are 13.6 thousand high schools in China, 23,745.5 thousand students, 2665.1 thousand faculty members, and 1774 thousand full-time teachers. There are 392 adult high schools, 39.4 thousand students, 3174 staff, 2421 full-time teachers. There are 10.7 thousand secondary vocational schools, 15,925 thousand students, 1079.7 thousand staff, 839.2 thousand full-time teachers. The situation of secondary vocational schools, students, staff and full-time teachers is shown in Table 1.1.

There are 3346 general secondary vocational schools with 7129.9 thousand students, 396.8 thousand staff, and 301.6 thousand full-time teachers. There are 3617 vocational high schools with 4140.6 thousand students, 343.8 thousand staff,

Table 1.1 Situation of secondary vocational education schools, students, staff, and professional teachers (Ministry of Education 2019a)

	Number of schools	Number of students in school (thousands)	Number of staff (thousands)	Number of full-time teachers (thousands)
General secondary professional schools	3346	7129.9	396.8	301.6
Vocational high school	3617	4140.6	343.8	286.1
Technical school	2490	3382.1	268.6	198.8
Adult secondary professional school	1218	1272.4	59.7	44.8

and 286.1 thousand full-time teachers. There are 2490 technical schools with 3382.1 thousand students, 268.6 thousand faculty members and 198.8 thousand teachers. There are 1218 adult secondary professional schools, with 1272.4 thousand students, 59.7 thousand staff and 44.8 thousand full-time teachers.

1.2.2.3 Higher Education

In 2017, there were 2631 general institutions of higher learning (including 265 independent colleges), an increase of 35 over the previous year, an increase of 1.35%. Among them, 1243 undergraduate colleges and universities, 6 more than the previous year; 1388 higher vocational (specialized) colleges and universities, 29 more than the previous year. There are 282 adult colleges and universities, two fewer than the previous year; 815 postgraduate training institutions, of which 578 are ordinary universities and 237 are scientific research institutions.

Of the 2639.6 thousand graduate students, 362 thousand are doctoral students and 2277.6 thousand are master students. There are 27,535.9 thousand students in the general college, 5441.4 thousand students in the adult college. There are 2443 thousand faculty members, 1633.2 thousand full-time faculty members in general colleges and universities.

1.2.3 Enrollment Rate and Retention Rate

In 2017, the gross enrollment rate of preschool education reached 79.6%, 2.2% higher than the previous year. The consolidation rate of 9-year compulsory education is 93.8%. The net enrollment rate of primary school-age children was 99.91%, and the gross enrollment rate of junior high school was 103.5%. The gross enrollment rate in senior high school is 88.3%, which is 0.8% higher than the previous year. The gross enrollment rate of higher education reached 45.7%.

1.2.4 Government Expenditure on Education

The total investment of national education funds has increased rapidly. The details from 1992 to 2017 are shown in Fig. 1.1. In 1992, the total investment in education was only 86.7 billion yuan, reaching 4255.7 billion yuan in 2017, an increase of 48 times. In 2017, China's total investment in education was 4255.7 billion yuan, an increase of 9.45% over the previous year's 3886.6 billion yuan. The national financial expenditure on education was 3420.7 billion yuan, an increase of 8.95% over the previous year's 3139.6 billion yuan, accounting for 4.14% of GDP. Since 2012, it has remained above 4% for 6 consecutive years.

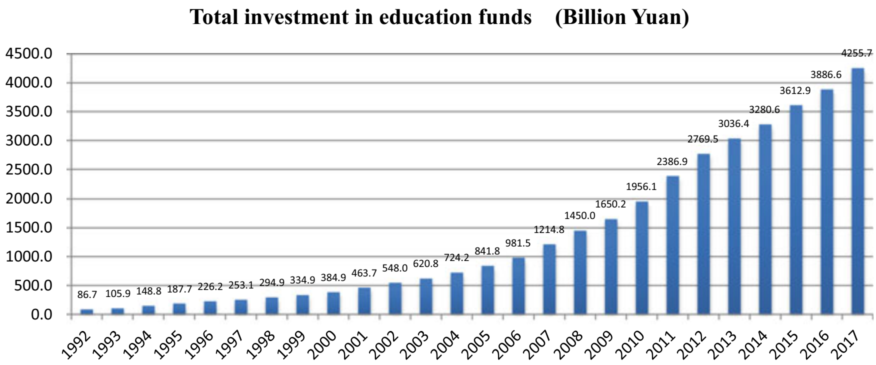

Fig. 1.1 Total investment in education funds (Billion Yuan)

In 2016 and 2017, the total investment in preschool education, compulsory education, high school education, higher education, and other education funds is shown in Table 1.2.

In 2016 and 2017, the total expenditure of per capita education funds for kindergartens, general primary schools, general junior middle schools, general high schools, secondary vocational schools, and general colleges and universities is shown in Table 1.3.

Table 1.2 Statistics on the total investment of education funds at all levels in China from 2016 to 2017 (Billion Yuan) (Ministry of Education 2019d)

	2016	Growth in 2016 over 2015(%)	2017	Growth in 2017 over 2016(%)
Total investment in education funds	3886.6	7.57	4255.7	9.43
Total investment in preschool education funds	280.2	15.48	325.5	16.11
Total investment in compulsory education funds	1760.3	9.76	1935.8	9.96
Total investment of education funds in senior high schools	615.5	6.75	663.7	7.82
Total investment in higher education funds	1011.0	6.22	1110.9	9.72
Total investment in other education funds	219.5	−7.78	219.8	−0.13

Table 1.3 Statistics of per capita expenditure on education funds for students at all levels in China from 2016 to 2017 (Yuan) (Ministry of Education 2019d)

	2016	Growth in 2016 over 2015(%)	2017	Growth in 2017 over 2016(%)
Kindergarten	8626	15.97	9970	13.21
General primary school	11,398	8.88	12,177	6.82
General junior middle school	16,010	10.50	17,547	9.60
General high school	16,781	11.34	18,575	10.70
Secondary vocational school	16,985	8.03	18,364	8.11
General colleges and universities	30,457	3.35	33,481	9.75

1.2.5 Education Research

In the middle and late 1950s, China began to establish some institutions specializing in educational science research. Educational scientific research institutions mainly include the *National Institute of Education Sciences*, provincial and municipal Academies of Educational Sciences (institutes), and educational scientific research institutions established by universities. The *National Institute of Education Sciences* is a state-level comprehensive educational scientific research institute directly under the Ministry of Education. It has the *National Office for Education Sciences Planning*, the postdoctoral research workstation and the training platform for visiting scholars. It has established 20 experimental zones and several experimental schools for the comprehensive reform of education in the eastern, central, and western regions of the country. It has established a long-term cooperation mechanism with UNESCO, the World Bank, and other international organizations, universities, and think tanks in the United States, Japan, South Korea, and other countries. Provincial and Municipal Academies of Educational Sciences (institutes) focus on the application of educational science research, and mainly study the practical problems of education in the region. Institutions of higher education scientific research mainly serve to improve the teaching of pedagogical subjects and train educational professionals.

Educational research programs include national educational science planning project, Ministry of Education humanities and social sciences research project, provincial and municipal educational science planning project, and national educational technology research program. Doctor of Education and Master of Education are the fresh forces engaged in educational research. In 2017, there were 180,208 graduate students in education, including 6880 doctoral students and 173,328 master students; 55,115 graduate students enrolled in education, including 1585 doctoral students and 53,530 master students; 33,932 graduate students in education received diplomas, including 1028 doctoral students and 32,904 master students.[9]

[9]Ministry of Education (2019b).

1.2.6 Teachers' Professional Development

1.2.6.1 Teachers' Education and Training Policy

In order to promote teachers' professional development, the Ministry of Education has issued a series of teacher education policies. On January 1, 1994, the newly revised *Teachers' Law of the People's Republic of China* was implemented. In 2004, the Ministry of Education issued the *Educational Technology Competency Standard for Primary and Secondary School Teachers (Trial Implementation).* In 2012, the Ministry of Education issued *Kindergarten Teachers' Professional Standards (Trial Implementation), Primary School Teachers' Professional Standards (Trial Implementation)* and *Middle School Teachers' Professional Standards (Trial Implementation).* In 2013, the Ministry of Education issued *Professional Standards for Teachers in Secondary Vocational Schools (Trial Implementation), Interim Measures for Teacher Qualification Examination in Primary and Secondary Schools, Interim Measures for Regular Registration of Teacher Qualifications in Primary and Secondary Schools and Professional Standards for Principals of Compulsory Education.* In 2014, the Ministry of Education issued *Information Technology Application Ability Standards for Primary and Secondary School Teachers (Trial Implementation)* and *Information Technology Application Ability Training Course Standards for Primary and Secondary School Teachers (Trial Implementation).* In 2015, the Ministry of Education issued the *Professional Standards for Headmasters of Ordinary High Schools, Professional Standards for Headmasters of Secondary Vocational Schools and Professional Standards for Headmasters of Kindergarten Headmasters.*

In February 2018, the Ministry of Education and other five departments issued the *Action Plan for the Revitalization of Teacher Education (2018-2022).* They proposed that "after about five years' efforts, a number of high-level and distinctive teachers' education colleges and specialties should be well established, and the teacher training system should be basically sound, laying a solid foundation for the long-term sustainable development of teacher education in China." In September 2018, the Ministry of Education issued *Opinions on Implementing the Outstanding Teacher Training Plan 2.0,* which put forward that "by 2035, the comprehensive quality, professional level and innovative ability of normal school students will be significantly improved, laying a solid foundation for training and bringing up millions of backbone teachers, hundreds of thousands of outstanding teachers and tens of thousands of educator-type teachers."[10]

In April 2019, the Ministry of Education issued *Opinions on Implementing the National Project for Improving the Information Technology Application Ability of Primary and Secondary School Teachers 2.0*, in order to improve the information technology application ability of primary and secondary school teachers nationwide and build a new mechanism for the development of teachers' information literacy.

[10]Ministry of Education (2019c).

1.2.6.2 Teachers' Education and Training Systems

China attaches great importance to the professional development of teachers. *The Ministry of Education, the Department of Education, the Bureau of Education,* and universities have established institutions to promote the professional development of teachers. *The Ministry of Education* has set up a *Teacher Work Department*, which is responsible for formulating policies and regulations on teacher education and teacher management, standards for qualifications of teachers at all levels, and for coordinating, planning, and guiding the construction of teachers in schools at all levels throughout the country. *The Department of Education* has set up a *Teachers' Office (Teachers' Work and Teachers' Education Office)*, which is responsible for overall planning and guiding the construction of school teachers, undertaking the overall coordination of teacher training at all levels and in all types of schools, and participating in guiding the work of teacher education. The Education Bureau has set up a teaching and Research Department (Teacher Development Center) to undertake the research work of local basic education teachers. Colleges and universities usually set up teacher development centers to promote teachers' professional development from four aspects: teaching, research, service, and management.

1.2.6.3 Teachers' Education and Training Programs

In order to encourage excellent students to engage in the teaching profession, in 2007, the Ministry of Education decided to implement free education for normal students in six normal universities directly under the Ministry of Education (Beijing Normal University, East China Normal University, Northeast Normal University, Central China Normal University, Shaanxi Normal University, and Southwest University). In 2013, Jiangxi Normal University became a public-funded teacher training university. In 2015, Fujian Normal University became a public-funded teacher training university.

In 2007, the Ministry of Education approved the establishment of the National Network Training Center for College Teachers, aiming at college teachers, mainly using digital and network technology, through the provincial and municipal subcenter system throughout the country, to organize and carry out training with curriculum teaching, professional construction, and teacher development as the main content. In addition, China has also built many network resource platforms for teacher training, as shown in Table 1.4.

In 2010, the National Training Plan for Primary and Secondary School Teachers (referred to as the "National Training Plan") implemented by the Ministry of Education and the Ministry of Finance is an important measure to improve the overall quality of primary and secondary school teachers, especially rural teachers. The "National Training Program" includes "Model Training Program for Primary and Secondary School Teachers" and "Key Teachers Training Program for Midwest Rural Areas." The central government has invested 550 million yuan to support the implementation of the "National Training Plan." Through innovative training mechanisms and

Table 1.4 Research platform for teachers' professional development

	Research platform for teachers' professional development	Website
1	China teacher training network	http://www.teacherclub.com.cn
2	Chinese teacher education training network	http://www.unionedu.org.cn
3	Higher education institutions teacher online training center	http://www.enetedu.com
4	National network for continuing education of primary and secondary school teachers	http://www.teacher.com.cn
5	One teacher and one excellent class, one lesson and one famous teacher	http://1s1k.eduyun.cn/portal/html/1s1k/index/1.html
6	National public service platform for educational resources	http://n.eduyun.cn/index.php?r=portal/site/index

the combination of off-the-job research, centralized training, and large-scale long-distance training of key teachers, the central and western rural compulsory education backbone teachers have targeted professional training. This project is the largest teacher training program in China. In addition, there are also teacher training projects that the Ministry of Education cooperates with enterprises, such as the Ministry of Education-Lego "Innovative Talents Training Plan" teacher training project, Intel Future Education Project, etc.

1.3 New Progress of ICT in Education

1.3.1 ICT's Contribution to Education

In the past 40 years of reform and opening-up, China has made remarkable achievements in the development of educational informatization and created a miracle in the history of human educational informatization. China's educational informatization has created a modern educational environment for one-fifth of the world's population, and has made important contributions to promoting the balanced development of global education, promoting human lifelong learning, and improving the quality of the population. As a representative developing country, China's typical experience of promoting educational development by informationization of education is being recognized and used for reference by the international community, especially for developing countries to provide models and paths for the development of informationization of education. Compared with developed countries, China has made remarkable achievements in the construction of educational informatization with less investment, which can be regarded as a miracle in the history of educational informatization.

After 40 years of construction and development, China's educational informatization has made outstanding achievements in the strategies and policies of educational informatization, educational informatization infrastructure, digital educational resources, application level of educational informatization, educational informatization industry, laws and standards of educational informatization, and educational informationization talents. It has made outstanding achievements in literacy education, enlarging the overall scale of education, and improving the quality of education. It has made important contributions to promoting educational equity, developing lifelong education, expanding educational openness, and supporting economic and social development. Educational informationization plays a vital role in realizing the sharing of high-quality educational resources, promoting the balanced development of education, and leading educational innovation and change.

In the past 40 years of reform and opening-up, educational informatization has undergone a process of development from scratch to strong. The development of China's education cannot be separated from the support of educational informationization, which stimulates the motive force of educational innovation and change. Educational informationization is not only the promoter of educational reform and development, but also the leader of educational reform and development. Educational informationization is an important part of national informationization. It is a strategic choice for the development of China's education to realize the modernization of education driven by educational informationization. At present, China is in the transitional period from a big educational country to a powerful educational country. The great "Chinese education dream" has a long way to go. The future development of educational informationization shoulders the historic task of helping China transform from a big educational country to a powerful educational country, promoting the cultivation of innovative talents adapted to the era of artificial intelligence, and realizing the "Chinese educational dream."

1.3.2 ICT Infrastructure

1.3.2.1 General Situation of Infrastructure Construction of ICT

Significant achievements have been made in the construction of educational information infrastructure. From "broadband network school-to-school" to "high-quality resources class-to-class" to "network learning space for all," educational informationization gradually moves from campus to class, and then to teachers and students. The development of campus information has experienced the development from campus network, digital campus to intelligent campus. Intelligent classroom is gradually replacing traditional classroom and multimedia classroom. Intelligent campus is taking the place of digital campus, and further integration and innovation with real campus has become the only way to achieve intelligent education. The intelligence level of campus infrastructure such as intelligent teaching building, intelligent school hospital, intelligent office, intelligent library, intelligent venue, intelligent dormitory, and intelligent restaurant has been significantly improved. Intelligent campus plays an increasingly important role in promoting the transformation of knowledge dissemination to knowledge creation.

In recent years, more and more schools are equipped with educational media such as computers, notebooks, video booths, LCD televisions, projectors, multimedia central control systems, touch-in-one computers, electronic whiteboards, tablets, mobile terminals, and smart blackboards. Educational media are becoming more and more diverse. Educational media tend to be intellectualized and intelligent. Its interactive and data storage and analysis functions are becoming more and more powerful. Traditional classrooms and laboratories are being replaced by intelligent subject classrooms, which are more and more conducive for learners to acquire diversified, personalized, intelligent, and situational learning experience. The rapid development of intelligent classroom, campus, and education will create a convenient, comfortable, and efficient intelligent learning environment for learners.

1.3.2.2 Campus Network Access

China Education and Research Network (CERNET) and education satellite broadband transmission network complement each other, and have basically formed a backbone network of education information covering the whole country and "the integration of heaven and earth." Established in 1994, CERNET is a nationwide academic computer network, which is invested by the state and managed by the Ministry of Education. Tsinghua University and other universities are responsible for the construction and operation of CERNET. The overall goal of CERNET construction is to use advanced and practical computer technology and network communication technology to realize computer networking and information resource sharing between campuses, and to connect with the International Academic Computer Network (IN TERNET) to establish a fully functional network management system.

As of June 2016, the proportion of Internet access in primary and secondary schools in China was 87.5%, which was 5.3% higher than that in 2014. Among them, the proportion of schools with bandwidth over 10 M is 64.3%, which is 23.3% higher than that in 2014. Beijing, Jiangsu, Shanghai, Zhejiang, Guangdong and Xinjiang Production and Construction Corps, and other provinces have fully realized the school "broadband network" coverage. The proportion of primary and secondary schools equipped with multimedia teaching equipment in general classrooms in China is 56.6%, which is 17.4% higher than that in 2014. Zhejiang, Xinjiang, and other places have included "broadband network school-to-school" as the basic school-running standard, which has effectively promoted the preparation of information infrastructure. Through cooperation with enterprises, Guangdong and other places adopt PPP (public–private partnership), BOT (build-operation-transfer), and other modes to solve the problem of School-to-School communication in primary and secondary schools. In 2019, China strives to achieve an Internet access rate of over

97% in primary and secondary schools and an export bandwidth of over 100 Mbps (mega/second).

1.3.2.3 ICT Development Indicators

China has made remarkable progress in the development of information technology, and its global ranking has been greatly improved. According to the national information development index, China's ranking rose rapidly from 36th in 2012 to 25th in 2016, surpassing the evaluation level of G20 countries for the first time. China's informatization development has made considerable progress in terms of industrial scale, informatization application efficiency, and so on, and has already occupied the leading position in the world.[11]

As of June 2018, the number of IPv6 addresses in China was 23,555 Block/32, an increase of 0.53% in half a year. China's international export bandwidth is 8826,302 Mbps, with a half-year growth rate of 20.6%. The scale of Chinese netizens reached 802 million, with a penetration rate of 57.7%. In the first half of 2018, 29.68 million netizens were added, an increase of 3.8% compared with the end of 2017. The scale of Chinese mobile netizens reached 788 million, and the proportion of netizens accessing the Internet through mobile phones reached 98.3%.[12]

1.3.3 Digital Educational Resources

1.3.3.1 General Situation of Digital Educational Resources

Digital education resources gradually meet the individual needs of learners. China has gradually left the era of scarcity of educational resources, and educational resources have entered an era of abundance. Teachers and students farewell to the era of only textbooks and reference books, ushering in a variety of digital education resources in different forms. Educational resources are changing from meeting popular learning needs to meeting individual learning needs. Paper resources are being replaced by digital resources, three-dimensional resources, virtual reality resources, augmented reality resources, 3D resources, and holographic resources.

Education informationization has changed the form of curriculum resources, teaching resources from paper textbooks to electronic textbooks, PPT, APP, online courses, MOOC, micro-courses, and so on. The functions of interaction, data analysis, and visual analysis of courses are gradually enhanced. The integration of online education and traditional education has broken the boundaries between in-class and out-of-class. Online and offline mixed learning is gradually normalized.

[11] China Internet Informatization Center (2016).

[12] China Internet Informatization Center (2018).

Educational informationization enriches the form of learning resources. Individualized learning resources, generative learning resources, simulation learning resources, mobile learning resources, and intelligent learning resources supported by internet of things, big data, holographic technology, naked-eye 3D, artificial intelligence, are becoming the future development direction of learning resources, providing a personalized, intelligent, and pleasant learning experience for learners.

1.3.3.2 Public Platform of Educational Resources

By 2016, 23 provinces have basically built public service platforms for educational resources, 15 provinces have built provincial education data centers in an all-round way or basically. The application of information technology in teaching is basically universal. The cases of integration and innovation are constantly emerging. The information technology security system has been initially established, and the education information system covering urban and rural areas has initially formed. The National Public Service Platform for Educational Resources (http://www.eduyun.cn/) sponsored by the Ministry of Education of the People's Republic of China covers all subject curriculum resources of elementary school, junior high school, and senior high school.

1.3.3.3 Teaching Center Basically Achieve Full Coverage of Digital Education Resources

By 2016, 64,000 teaching centers across the country have completed the construction task of "full coverage of digital education resources in teaching centers" project, and realized the equipment allocation, resource distribution, and teaching application in place. Among them, 25,000 teaching centers are connected to the Internet, while the others can receive digital education resources by satellite reception; teaching centers have equipped 64,000 sets of multimedia teaching equipment; 345,000 teachers in teaching centers have received special training by all staff, and have the basic information technology application ability. 72% of teachers have used relevant equipment and resources to carry out teaching.[13]

1.3.3.4 Open Educational Resources

In 2011, the Ministry of Education issued the *Opinions of the Ministry of Education on the Implementation of the National Quality Open Course Construction*, and decided to carry out the construction of the National Quality Open Course. National excellent open courses include excellent video open courses and excellent resource sharing courses. They aim at popularizing and sharing high-quality curriculum resources,

[13]Ministry of Education (2016).

Table 1.5 China open education resource platform

	Open education resource platform	Website
1	iCourse	http://www.icourses.cn/home
2	MOOC China	http://www.mooc.cn
3	China University MOOC	https://www.icourse163.org
4	Excellent course	http://www.jingpinke.com
5	Netease open course	https://open.163.com
6	Tencent classroom	https://ke.qq.com
7	Sina open course	http://open.sina.com.cn

embody modern educational ideas and laws of education and teaching, display advanced teaching concepts and methods of teachers, serve learners' self-learning, and disseminate through the network. Excellent video open course is a free and open network video course and academic lecture for scientific and cultural quality education for college students and the public at the same time. Excellent resource sharing course is a kind of network sharing course, which serves college teachers and students as the main body, while facing social learners, such as basic courses and professional courses.

China Open Education Resource Platform includes iCourses, MOOC China, etc. See Table 1.5.

1.3.4 ICT Supported Learning and Teaching

1.3.4.1 General Situation of ICT Promotes Teaching and Learning

Educational informatization is gradually integrated with management, teaching, teaching research, and scientific research. The integration of education informationization and education management promotes the level of education management and the flattening of education management. The development of educational big data promotes the scientificalization, precision, and visualization of educational management and decision-making. From computer-aided education, computer-aided teaching, to information technology and curriculum integration, information technology and curriculum integration, education informatization plays an increasingly important role in changing the way of teaching and learning. Mixed learning, computer-supported collaborative learning, web-based learning, E-Learning, mobile learning, simulation learning, virtual learning, micro-curriculum learning, and flipped classroom learning are being adopted by teachers and students. New ideas, new theories, new media, new technologies, policy guidance, and so on have given birth to a variety of teaching and learning methods. In the future, the change of learning style will tend to be diversified, individualized, active, informationized, ubiquitous, and intelligent.

The integration of information technology and curriculum can provide an ideal teaching environment for the creation of a new teaching structure. The integration of information technology into teaching and research makes it easier and faster for teachers to carry out teaching and research across regions and domains, breaking the traditional face-to-face teaching and research model. Information-based teaching and research has gradually become a necessary teaching and research ability for teachers and researchers, and improving their information-based teaching and research literacy has become a new challenge for teachers and researchers to improve their literacy. Informatization improves the speed of literature retrieval, expands the scope of literature retrieval, expands the academic horizon of researchers, and speeds up the evolution of knowledge updating. The age of the library's access to paper documents is gradually fading, and skilled use of periodical databases has become an important way to discover new research topics.

1.3.4.2 Information Technology-Assisted Teaching

Primary and secondary schools throughout the country take "One Teacher and One Excellent Class, One lesson and One Famous Teacher" as an important grasp to fully mobilize the enthusiasm and creativity of primary and secondary school teachers, promote the deep integration of information technology and classroom teaching in primary and secondary schools, as well as the reform of education teaching mode, and improve the quality of education. Teachers and students in primary and secondary schools generally use online learning space to carry out teaching and learning. The proportion of teachers using information facilities to carry out normal teaching has increased year by year.

Teachers widely use information-based teaching platform for collaborative teaching and research, lesson preparation, course recording, after-class guidance, examination papers, marking tools, homework evaluation, students' personalized academic diagnosis, student management, course scheduling system, classroom production, resource sharing, and other functions. From October 2014 to the end of February 2019, 16,974,713 lessons were shared. Office software, micro-class production software, homework together, questionnaire stars, homework boxes, WeChat, QQ, and other information-based software are often used by primary and secondary school teachers. Moso Teah, KeTangPai, YuKeTang, and Edmodo are often used as classroom teaching support tools by university teachers.

The new teaching mode supported by information technology is constantly emerging, and the application mode of information technology is gradually deepening. The innovative construction and application of "Delivery Classroom, Famous Teacher Classroom and Famous School Network Classroom" have continuously expanded the coverage of high-quality resources.

1.3.4.3 Courses About Information Technology

The Chinese government attaches great importance to the popularization of information technology education and has formulated appropriate policies and standards in a timely manner. At present, information technology courses are generally offered in primary and secondary schools, and basic courses of computer application in universities are generally offered in colleges and universities.

In 2000, the Ministry of Education issued the *Circular of the Ministry of Education on the Popularization of Information Technology Education in Primary and Secondary Schools*. It was decided that it would take 5–10 years from 2001 to popularize information technology education in primary and secondary schools (including secondary vocational and technical schools) in order to promote the modernization of education by information technology. In order to better promote information technology education, the information technology curriculum has been included in the compulsory curriculum of primary and secondary schools, and the project of "broadband network school-to-school" has been launched in an all-round way. Meanwhile, the construction of information technology education resources and information technology education teachers has been strengthened.

In 2000, the Ministry of Education issued the *Guidance Outline for Information Technology Curriculum in Primary and Secondary Schools (Trial Implementation).* In December 2016, the Ministry of Education issued the *Information Technology Curriculum Standards for Compulsory Education in Schools for Mental Retardation.* This standard is a selective course learning standard for training students' information technology ability in schools for mentally retarded students. It is one of the first set of systematic learning standards for disabled students in China.[14] In 2017, the Ministry of Education issued the *Information Technology Curriculum Standards for Senior High Schools (2017 Edition).*

1.3.5 ICT Integration into Practices

1.3.5.1 The Ability for Faculty to Use ICT to Teach

Teachers' information technology application ability has been generally improved. Under the overall guidance of the Ministry of Education, all parts of the country actively promote the training of teachers' information technology application ability. Teachers' informationization literacy has been greatly improved, and informationization-supported teaching has gradually become the norm. Teachers have significantly improved their ability to use digital tools and software for teaching. Universities and primary and secondary school principals have generally promoted the leadership of informationization, and a number of specialist principals have

[14]Chaohui (2018, pp. 29–32).

emerged, which play an important role in promoting the process of informationization in school education. Education is a significant improvement in digital learning ability. More and more teachers are skilled in using digital tools and software.

1.3.5.2 The Ability for Students to Use ICT to Solve Problems

With the popularization of information technology education in primary and secondary schools, students' information literacy has improved significantly. More and more students have mobile terminals such as smartphones, tablets, notebooks, and so on. Blended learning is gradually becoming the main learning mode in universities, primary and secondary schools. Students improved their ability of using information tools and technologies to solve problems. Students can use information to carry out collaborative learning, inquiry learning, research learning, and so on. With the implementation of STEAM and Creator Education, learning guided by innovation is gradually favored by students.

1.3.6 Future Development of ICT in Education

With the advent of the era of artificial intelligence and wisdom, the demand for education will change. People are looking forward to a better education. Education in the new era is facing many new demands, such as the paradigm of education shifting from focusing on the goal to focusing on the ability, the concept of teachers need to match with the curriculum reform, the need to alleviate the structural shortage of teachers, the change of the ability structure of teachers in the information age, the change of teaching situation in the information age, and so on. In the future, the channels of learning will be broadened, the objectives of education and training will be changed, the content of courses will be changed, and the way of learning will be fundamentally changed. The internet provides conditions for individualized learning and individual learning, and changes the relationship between teachers and students. Education urgently needs to face the new situation and demand, change the talent training mode, make full use of intelligent technology to accelerate the reform of talent training mode and teaching method, and build a new education system including intelligent learning and interactive learning.

The development of new technologies such as educational robots, educational data, artificial intelligence, internet of things, learning analysis technology, and blockchain technology has brought new opportunities for the future development of educational informatization. In the future, the development of educational informationization will focus on promoting the deep integration of information technology and education, creating a wise learning environment, building large educational resources, improving the information literacy of teachers and students, transforming the mode of talent cultivation, educational service, and educational governance from the integrated application to the innovative development. In order to promote education informationization from "quantitative change" to "qualitative change," stimulate the reform of education system, realize the integration, innovation, and development of education informationization, produce the integration effect of technology and education, and cultivate innovative talents with global awareness and global vision. The intelligent education system built on the campus of wisdom has become an important transforming force for nurturing and enlightening human wisdom and transmitting educational wisdom. Under the background of global education governance toward "common interests," the future development of education informatization will be more conducive to promoting inclusive development of education and providing precise services for building an open and flexible all-round lifelong learning system.

1.4 Policy and Strategy of ICT

1.4.1 Policies Related Educational Informationalization in Recent Years

Over the past 40 years of reform and opening-up, China's education informatization strategy and policy have gradually matured and improved, experiencing the development process from "patting the head decision-making" to "scientific decision-making." Prediction technologies such as internet, big data, system simulation technology are gradually becoming powerful support tools for the development of education informatization strategy and policy. China's strategic planning and policies for education informatization are becoming more scientific and precise, and more and more attention has been paid to its effective implementation.

Over the past 10 years, the Ministry of Education has issued the *Ten-Year Development Plan of Education Informatization (2011–2020), the Thirteenth Five-Year Plan of Education Informatization, and the Action Plan of Education Informatization 2.0*, which have pointed out the direction and objectives for the development of education informatization and played an important role in promoting the process of education informatization.

At the national strategic level, more and more attention has been paid to education informationization. The outline of national economic and social development plan, national informationization strategic plan, and national education strategic plan all describe education informationization. Educational informatization has been incorporated into the outlines of the seventh, tenth, eleventh, twelfth, and thirteenth national economic and social development plans. Education informatization has been incorporated into the *National Information Development Strategy (2006–2020).* Educational informationization has been incorporated into the national educational development strategies such as the *Outline of the National Medium and Long-Term*

Education Reform and Development Plan (2010–2020), and the *13th Five-Year Plan for the Development of National Education.*

Educational informationization has gradually been incorporated into the legalization and standardization, and the development of educational informationization has gradually realized "laws to follow" and "standards to follow." Educational informationization standards play an important supporting role in ensuring the healthy development of educational informationization. *The Education Law of the People's Republic of China (Amendment 2015)* clearly stipulates that "the state should promote educational informatization, speeds up the construction of educational information infrastructure, promotes the popularization and sharing of high-quality educational resources by using information technology, and improves the level of education and teaching and educational management." In 2012, the Ministry of Education promulgated seven industry standards of educational informatization, such as the *Educational Management Information: Basic Code of Educational Management*. In 2017, the Ministry of Education issued three standards of the *Metadata of Teaching Resources in Basic Education*, and two standards of the *Interactive Electronic Whiteboard* series. Beijing Educational Informatization Industry Alliance led the development of a series of standards for educational informatization groups.

1.4.2 ICT Financing Resource

Over the past 10 years, the Chinese government has vigorously supported the development of education information industry, which has ushered in a brilliant stage of development. Hotspots such as "internet + education," artificial intelligence, big data, internet of things, educational robots, smart campuses, smart education, and so on have stimulated the driving force of the development of education information industry.

China has increased its financial investment in education informatization year by year. From 2012 to 2020, the estimated financial investment in education informatization is shown in Fig. 1.2. In 2020, the overall market scale of education informatization is expected to exceed 600 billion yuan. The average annual investment in the construction of educational informatization in colleges and universities is about 10 million yuan. According to the calculation of an average of 10 million yuan per year per university, the number of domestic universities will reach about 2800 by 2020, and the investment of information-based universities in China will reach about 28 billion yuan by 2020.[15]

The investment of educational informatization funds has gradually been incorporated into the routinization, and the funding guarantee system of educational informatization has been gradually established. The investment mechanism of educational informatization funds is composed of financial budget funds, special funds from higher authorities, self-financing funds from schools, and social participation

[15]Zhiyan Consulting (2019).

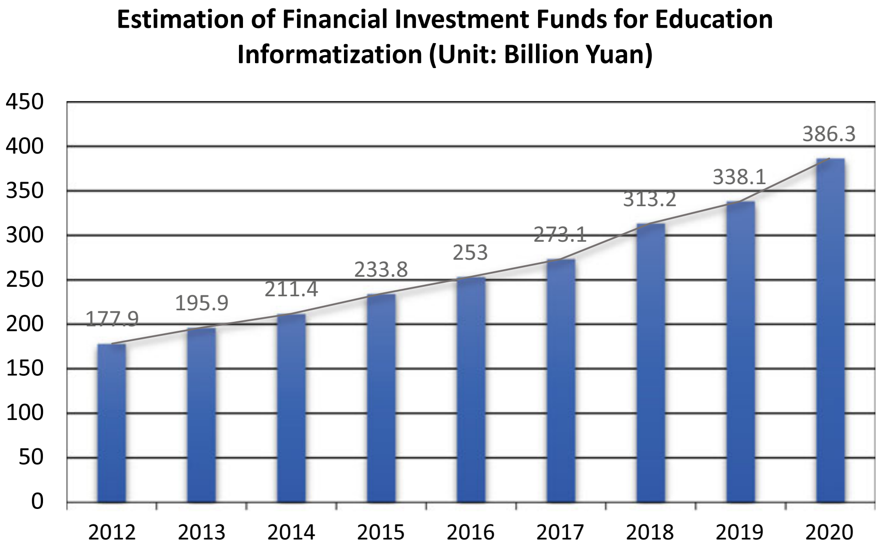

Fig. 1.2 Estimation of financial investment funds for education informatization (2012–2020)

funds. The special funds for educational informatization are mainly used in hardware construction, system development, teacher training, information consumption, equipment operation and maintenance, etc.

Taking Jiangsu province as an example, Jiangsu province has established a policy support mechanism to strengthen supervision. The provincial government has incorporated the construction of education informatization into the key supervision content, and regularly carried out special supervision of education informatization. The province brings educational informationization into the monitoring index system of educational modernization construction to promote the municipal and county governments to further strengthen the main responsibility of educational informationization construction. Jiangsu province proposes that principals should pay attention to information construction personally. Schools should extract more than 5% of public funds for information resources renewal, daily operation, and maintenance. Priority should be given to the investment of information construction in the reconstruction of weak schools and the construction of standardized schools.

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Chapter 2
Report on ICT in Education in Albania

Research Group of Smart Learning Institute

2.1 Overview of the Country

2.1.1 The Geography

Albania is a small, upper middle income country with a population of almost three million located in South East Europe, in the Western Balkans. The country has long coastlines with both the Adriatic and Ionian Sea. Following recent administrative territorial reforms, the country now has 12 regions and 61 municipalities which are responsible for the provision of public services including education, at the local level. The capital city, Tirana, is the largest city and epicenter of political, economic, and cultural life, thus hosting many public institutions.

2.1.2 The Political System

Albania is a parliamentary democracy established under the Constitution that was renewed in 1998. The country is a member of many multilateral organizations including, but not limited to the North Atlantic Treaty Organization (NATO), the United Nations (UN), the World Bank (WB), the Organization for Security and Co-operation in Europe (OSCE), the Council of Europe (CoE), and the World Trade

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Organization (WTO). Albania is a non-member partner country with the Organization for Economic Co-operation and Development (OECD). Albania applied for candidacy to the European Union (EU) in 2009 and gained official EU candidate status in June 2014. This was an important landmark for a country that only two decades earlier was one of the poorest and most isolated states in Europe, emerging from communist rule (see European Forum for Democracy and Solidarity 2014).

2.1.3 The Current Situation of Economic Development

Though Albania's economy has shown relative strength in recent years, there are still concerns over issues such as social disparities, gender inequality, the freedom of the press and other media, and environmental sustainability. Over the past decade, Albania has stayed committed to its liberal economic policies, which first denoted the start of the post-communist period in the 1990s. While the real GDP growth rates dropped from 7.5% in 2008 to the moderate 1.6% in 2012, Albania was still successful in translating the sustained growth into some enhanced well-being (Republic of Albania Council of Ministers 2013, p. 5). The Human Development Report of 2016 ranked Albania's Human Development Index as seventy-fifth (in the "high" category) out of 188 participating states (UNDP 2016). Albania has outperformed other countries and ranks higher than average with respect to its standing on converting wealth into better living standards (Republic of Albania Council of Ministers 2013, pp. 6–7). This may be viewed as particularly important in the context of efforts to reduce youth unemployment and implement education sector reforms.

Albania has also taken significant measures to reduce and ultimately bridge the infrastructure gap, by channeling a good share of its capital expenditure (up to over 50%) to the transport sector (Republic of Albania Council of Ministers 2013, pp. 9–10). Ideally, road improvements, especially away from major cities, can be translated into socially meaningful investments and also help the education system advance.

In addition, Albania has attracted significant Foreign Direct Investments (FDI). For example, in 2010, Albania was ranked eighteenth in the list of more than 140 countries rated for their FDI flows. In the first quarter of 2015, FDI grew by 53% compared to the previous year (World Bank 2015, p. 49). Exports also increased, and the business climate has substantially improved. The introduction of a fat-rate corporate income tax of 10% and reduction of the social insurance contributions to 15% have eased the fiscal burden and reduced the labor costs in the economy (Republic of Albania Council of Ministers 2013, p. 10). While the investments and net exports have served as drivers for the economy, private consumption has been contracting. The expansion trend for public investments has also slowed due to the recent efforts on fiscal consolidation (World Bank 2015, p. 49).

2.1.4 *The Status Quo of Technologies*

While the right to freedom of the press and media is stated in the Constitution, in reality, it is often compromised in favor of various political and economic interests. This issue is increasingly under scrutiny as the country seeks to join the European Union. According to the 2016 Annual Press Freedom Index, Albania was ranked eighty-second, which was 14 points higher than its 2011 ranking (UNESCO 2015b, p. 14). However, according to a 2016 Freedom House report, Albania ranks as "partly free," falling at the midpoint between most and least free (i.e., 15/30 in the legal environment).

Improvements in ICT and the general Internet connectivity of Albania have been steady. During the period of 2000–2008, the number of Internet users grew exponentially from 2500 to 750,000 users. The national coverage of mobile phones has reached over 90% of the population.

2.2 Overview of the Educational Development

2.2.1 *Education System*

Preschool (or pre-primary) education in Albania includes kindergartens and preparatory classes, and is intended for children aged 3–6, but is not compulsory. The preparatory classes provide preschool education to children of the age of five who have missed the opportunity to engage in pre-primary schooling before. According to national statistics, the enrollment rate in preschool education for the academic year 2014–2015 was 81%. The MES has indicated that there is a broad-based recognition that quality intervention in early childhood has a high rate of return on primary education (MES 2014a, p. 14). Children above the age of six are entitled to basic education, comprising the schooling at both the primary/elementary and lower secondary levels. The structure is currently "5+4" with basic education encompassing nine years of mandatory schooling intended for students up to 16 years old. All those who have not completed basic education and are above the age of 16 may complete it in part-time schools (MES 2014a, p. 14).

Upon completion of compulsory basic education, students face two main options with regard to continuing their studies in the upper secondary education: the options are either academically oriented gymnasiums or Vocational Education and Training (VET) programs. Since the academic year of 2009–2010, VET has been offered through three different levels of schooling. The two-year programs, comprising the first level, aim at equipping students with basic skills of semi-skilled workers and culminate in awarding a basic vocational training certificate. The one-year programs at the next level are meant to train technicians with an award of a certificate of professional training. VET programs following at the third level last for one extra year and pave a way to higher education (MSWY 2014, p. 11).

In Albania, VET graduates are fewer in numbers and have different gender composition compared to their peers in gymnasiums. For instance, in 2012, almost 41,000 students graduated from gymnasiums, of which young women represented about 50% of the pool. In the same year, less than 2900 students graduated from vocational schools, of which less than 30% were young women. One of the primary reasons given for fewer graduates in VET is the lesser attractiveness of the vocational track to young people (MSWY 2014, p. 11). Thus, one of the key objectives in the vocational sub-sector is to increase the share of young people who choose the vocational track from 14 to 25%. At the same time, the national strategic objectives imply that the employment rate for VET graduates will be expected to grow to 40%, with the share of women making up around 75% in the total pool of graduates with then secured jobs (MEI 2015, p. 640). Overall, the labor skill shortage has been reported as a severe constraint for businesses in Albania. There is growing evidence to an inadequate supply of skills in the labor market, which, according to the World Bank, is largely due to the lack of preparation and training available in the pre-university education system (World Bank 2015, p. 28).

The higher education system of Albania has been aligned with the principles of the Bologna Declaration (as the key guiding document of the Bologna Process), and normally assumes three-year bachelor's degree programs followed by one to two years of master's degree studies and three years of doctoral studies. The most recent reforms in higher education have been associated with the improvement of governing architecture, funding, and general organization of higher education institutions. The overarching reform has aimed at improving the quality of both the teaching and scientific research streams. In terms of funding mechanisms, as a result of the reform, the government plans to establish a National Agency for Financing of Higher Education, which will be the main hub for the distribution of public grants in the system (MEI 2015, p. 639). One of the key issues of higher education is the rather low attainment rate in Albania compared to the EU27 average (14.3% vs. 35.7%, calculated as a percentage of 30–34 year olds with completed university or university-like education) (MSWY 2014, p. 20).

2.2.2 Students and Teachers' Profiles

While schools in Albania have made tremendous progress in recent years, Albania remains a low-ranked country as far as PISA results are concerned. In Table 2.1, Albania's mean scores in reading, mathematics, and science from PISA in 2000, 2009, 2012, and 2015 are listed; in Table 2.2, Albania's mean scores are compared with the benchmark of the OECD average and the 2015 top performer, Singapore. Albania is gradually improving its educational performance on PISA, and this represents one indication of improvement in students' learning outcomes.

The teacher workforce in Albania has seen a number of shifts over the last decade. As reported in the Strategy for Pre-University Education Development, 2014–2020,

Table 2.1 Albania's PISA performance by discipline and year

Albania	2000	2009	2012	2015	Average three-year trend
Reading	349	385(+36*)	394(+9)	405(+11*)	+10*
Mathematics	381	377(−4)	394(+17*)	413(+19*)	+18*
Science	376	391(+15*)	397(+6)	427(+30*)	+18*

Sources World Bank (2012), OECD (2013a, 2016a)
Note: change in score from previous round is in parentheses, with *indicating that the change is statistically significant

Table 2.2 Albania's 2015 PISA performance compared to other mean scores

PISA 2015 results	Singapore's mean scores	OECD mean scores	Albania's mean scores
Reading	535	493	405
Mathematics	564	490	413
Science	556	501	427

Sources OECD (2016a)

37,943 teachers were employed in Albania's public and private pre-university education systems of whom 90% held jobs in public schools during the 2014–2015 period (MES 2014a). It is the central government that pays public teachers' salaries. Teachers' terms of employment are outlined in collective agreements negotiated between the government and teachers' unions. The most recent collective agreement covered the period from May 2010 to December 2014, and a new contract has been signed as of 2016 (Kontrata Kolektive e Punes 2016). Appointment and dismissal provisions for teachers and school leaders are set out in the Law on the Pre-University Education System and related administrative instructions. Their working hours are set out in Administrative Instruction 44, and their roles and responsibilities are described in the Normative Provisions of the Pre-University Education System (ACCE 2015).

There are indications that the teaching workforce in Albania may be younger than the average in OECD countries (Abdurrahmani 2013; OECD 2014b). At all educational levels, particularly at the primary level, female teachers outnumber male teachers. According to UIS, as of 2013, 83.6% of primary teacher, 65.2% of lower secondary teachers, and 63.6% of upper secondary teachers were women. Whilst imbalanced, this is consistent with the typical gender distribution of teachers in the European Union (EU), where men make up an average of 32.2% of the teaching workforce at the lower secondary level (European Commission 2015). Nonetheless, some authors note that this gender imbalance has not always characterized the teaching force in Albania; for instance, data from INSTAT shows that, in 1991, the percentage of female teachers was 55% (out of 28,789 teachers, 15,826 were women) which then rose to 63% by 1999 (INSTAT Statistical yearbook 1991–1999, p. 152, ctd. in Çobaj 2015, p. 4).

Çobaj (2015, p. 5) notes that this gender imbalance is particularly problematic when it comes to the representation of women in school leadership positions; for example, “in nine-year schools, women constitute 75% of teachers, but only 43% of school principals, whereas men constitute 25% of teachers, but 58% of school principals.” In the PISA 2012 study, principals reported that 83.9% of teachers in their schools had a qualification equivalent to the International Standard Classification of Education (ISCED) 5A level (a bachelor’s or master’s degree), slightly below the OECD average of 85.5% (OECD 2013b). As of 2012–2013, fewer primary teachers had university degrees (80% overall; 76% in villages) than lower secondary teachers (90% overall; 87% in villages) or upper secondary teachers (98% overall; 99% in villages) (ACCE 2013) (see Table 2.3). This is consistent with Albania’s PISA 2009 results, which showed that more students in rural schools were experiencing a shortage of qualified teachers than urban students (24.7% vs. 14.5%) (World Bank 2012).

Table 2.3 Number of teachers in Albania’s public and private pre-university education systems by gender, educational qualification, and location, 2012–2013 school year

Educational Qualification	Public				Private			
	Total	Female	Village	Female	Total	Female	Village	Female
Primary education								
Secondary degree	4595	2979	3410	1965	116	104	7	6
Pedagogical degree[a]	3759	2500	2825	1672	94	88	6	6
University degree	18,857	13,880	10,577	7034	1695	1423	123	98
Total	23,452	16,859	13,987	8999	1811	1527	130	104
Lower secondary education								
Secondary degree	1382	701	1010	425	24	13	1	0
Pedagogical degree[a]	781	356	639	250	11	6	0	0
University degree	12,384	8137	7004	4047	1071	839	75	51
Total	13,766	8838	8014	4472	1095	852	76	51
Upper secondary education (General/Gymnasiums)								
Secondary degree	93	67	17	6	9	5	0	0
University degree	5287	3395	1956	1033	1477	974	57	34
Total	5380	3462	1973	1039	1486	979	57	34

[a]Pedagogical degrees were issued by Albania’s three pedagogical secondary schools, which trained future preschool and primary teachers in the twentieth century (OECD 2002). The required academic qualification to become a teacher has since increased

Source ACCE (2013)

In 2013, the average student–teacher ratio in Albania was significantly higher than the OECD average at the primary level (19:1 compared to 15:1) and upper secondary level (19:1 compared to 14:1) and roughly equivalent at the lower secondary level (13:1 and 13:1) (World Bank 2014). At all levels, the ratios were higher in the cities: 25:1 at the primary level, 17:1 at the lower secondary level, and 23:1 at the upper secondary level (ibid.). Overcrowding is a problem in urban and suburban classrooms. Outside of the cities, Albania has over 1000 micro-schools with small student populations (MES 2014a).

Between 2013 and 2020, MES has projected a decrease in the number of public primary students and teachers by 7.4 and 1%, respectively, while the number of public secondary students and teachers is projected to increase by 3.8% and 1%, respectively (MES 2014a, p. 174). In the future, MES plans to increase teachers' work time and limit the size of the teaching population (ibid.). This explains the minimal projected increase in the number of secondary teachers in the future.

As of the 2013–2014 school year, there were 2548 principals working in Albania's schools (MES 2014a). The UNESCO review team heard conflicting reports about their present and future supply. Some stakeholders stated that teachers continue to want to be principals. Others said that this was not the case because there is no financial incentive to take on the added responsibilities of the role. The country's teacher and principal salary scheme indicates that starting salaries for principals are not considerably higher than the current average teacher salary (Republic of Albania 2013).

2.2.3 Enrollment Rate and Retention Rate

Since the collapse of communist rule in Albania, the country has been struggling to maintain the near-universal enrollment rates in basic education. As of 2014, Albania's education system including preschool was serving approximately 585,945 students. This represents a decline in the student body from nearly 700,000 students in 2007. Some of this decline can be attributed to demographics and migration. According to UN estimates, the youth population in the age group of 19 and below has been projected to decrease from 32% (as recorded in 2010) to 24% of the total population in 2025 (World Bank 2012, p. 10).

2.2.4 Government Expenditure on Education

In Albania, historically, the government's education spending has been low, and over the past 15 years, it has by and large remained predominantly below 3.5% of GDP. By 2007, one year before the global financial crisis and economic recession, the respective share barely reached 3.27%. Only in 2013, 3.5% of GDP was recorded (UIS 2015a). At the same time, the private/household spending on education as a share of GDP has been on the increase since 2011 and, by upholding the trend, amounted to 0.9% at the end of 2015 (MSWY 2014, p. 20).

Comparatively, in terms of the education expenditure as a percentage of GDP, Albania's indicator is above Romania (which between 2009 and 2013 witnessed a sharp decline from 4.24 to 2.99%), yet below Slovenia's rate of 5.66% of GDP OECD 2014a, p. 5), and far below Finland which spends almost 7.2% of its GDP on education (UIS 2015a). These figures provide a good indication of the general range among countries in terms of the percent of GDP allocated to education.

An analysis of the structural distribution of funds in accordance with the approved programs and the areas administered by the MES is illuminating. The expenditure on basic education consumes more than 60% of the total MES budget. For education at the secondary level, the government expenditure per student in Albania as a percentage of GDP per capita fell to a level of 5.9% in 2013 (UIS 2015b). The allocations to higher and vocational education sub-sectors taken together comprise 20% of the total budget.

2.2.5 Education Research

In the last two decades, an increasing number of scholars have tried to assess the effects of ICT on learning outcomes (e.g., Angrist and Lavy 2002; Woessman and Fuchs 2005; Leuven et al. 2004; Luu and Freeman 2011; Machin and McNally 2006; Malamud and Pop-Eleches 2010; Rouse and Krueger 2004). However, so far, there is no definitive evidence of a substantial impact of ICT on students' learning. The presence of mixed results revealing insignificant, positive, or even negative impacts of ICT on students' learning is certainly due in part to the complexity of this relationship, but also to the fact that it has been studied within different disciplines from pedagogy, sociology, and computer sciences to economics, and even within the same discipline using different methodologies (e.g., Biagi and Loi 2013, p. 31).

A recent international workshop organized by the Norwegian Center of ICT in Education on the effects of ICT on learning outcomes highlighted that focusing on traditional subjects and associated effects may sometimes lead to other broader applications, impacts, and benefits being missed (Loi and Berge 2015). For instance, the Danish experience suggested that technology helps teachers to differentiate their teaching, improves their motivation, and frees up time enabling teachers to focus their efforts where they are more needed. Furthermore, in some countries, ICT is increasingly used to provide children with opportunities to learn in a creative way instead of media providing the information. In addition, there is some evidence (e.g., Dykes 2015) that "learning through creating" is an important strategy for the effective integration of ICT into education. Finally, the workshop concluded suggesting that when looking at new ways to integrate ICT into education, it is indispensable to adopt a multiple-stage approach that evaluates the effects at each phase of the implementation process, including exploration, innovation, and scaling. Clearly, this is a time-consuming and expensive process. Therefore, to gather evidence and to sustain the research in the field, it is advisable to secure an adequate amount of dedicated funds, that is, funds that are independent from the political cycle of a country (Loi and Berge 2015).

According to recent research conducted by the OECD, the introduction of digital technologies in schools has not resulted in what was promised, e.g., improved efficiency through better results at a lower cost (OECD 2016b, pp. 67–110). Teachers throughout Europe do not feel sufficiently skilled to use ICT effectively, at best using digital technologies to complement prevailing teaching practices. Indeed, the OECD (2016b, p. 85) found that

> Schools and education systems are not yet ready to realize the potential of technology and the appropriate conditions will need to be shaped if they are to become ready. Gaps in the digital skills of both teachers and students, difficulties in locating high-quality digital learning resources and software, a lack of clarity over learning goals, and insufficient pedagogical preparation on how to blend technology meaningfully into teaching have driven a wedge between expectations and reality.

When considering the effects of ICT in education, it is recommended to adopt a more transversal or holistic approach (Scheuermann and Pedró 2009). This approach should consider not only the effects of new technologies on students' learning outcomes but also their impact on skills, such as problem solving, students' and teachers' digital competences, motivation and recognition, as well as teachers' time management. Many of these skills are directly in line with curricular goals and objectives in Albania.

2.2.6 Teachers' Professional Development

Teachers play a significant role in the effective use of ICT for educational purposes. Initial teacher education, in-service and pre-service teacher training, and Continuing Professional Development (CPD) all contribute to building teachers' digital competencies. These can include developing ICT skills for coding and the web, the skills to teach ICT as a subject, and the skills to use ICTs to support teaching and learning in other subjects.

Computer and/or tablet access is a necessary but not sufficient condition for ICT use in learning and teaching. The availability of both pedagogical and technical support at the school level is important to ensure that teachers actually use ICT in their teaching. School-level leadership must therefore make provision of such support a high priority within its goals for learning and teaching in the school.

According to the CBR (IED 2015, p. 46) and based on the UNESCO review team interviews, teachers in Albania are not prepared for the use of technology in teaching. The skills that teachers have to develop during their initial teacher training to use technology in the classroom for pedagogical purposes include basic knowledge of the computer; internet navigation; use of electronic billboards; creating digital teaching materials; communicating through electronic mail; and knowledge of the basics for creating and editing web pages.

Furthermore, according to the UNESCO review team's interviews with school principals, teachers, and students, despite recognizing the need for more skilled teachers, national plans for improving teachers' ICT skills and digital competencies should be improved. Enhancing teachers' professional development is crucial to helping teachers transform their positive opinion about ICT use into competencies and effective practice in the classroom. Professional development for teachers should give priority to developing pedagogical rather than merely technical ICT skills.

To improve teachers' ICT skills, the on-going Higher Education Reform in Albania states that teachers have to acquire basic ICT skills during their initial training (MES 2014a). Teachers currently have limited possibilities to acquire ICT skills as part of their Continuing Professional Development (CPD) because educational institutions in general, and schools in particular, do not have the resources to finance such initiatives. Collaborations could promote EU initiatives like the eTwinning project and encourage projects at the local level. The development of collaboration initiatives among teachers and schools should be supported as a strategy to create high-quality digital resources in the Albanian language.

2.3 New Progress of ICT in Education

2.3.1 History of ICT in Education in Albania

University education in Albania started in 1951 with creation of the Polytechnic Institute, transformed in the State University of Tirana in 1957. Considering computers and computer networking, it started in 1971 with creation of the first Center of Mathematical Calculus, firstly as department of University of Tirana, and latter part of Academy of Sciences. The Center was equipped with computers of second generation and used for application of mathematical methods in different areas of human activity. The first generation of specialists got training in programming and applied mathematics abroad. The same curricula were introduced in the course of mathematics of specialty in University of Tirana, and in few other engineering courses. Some short-term courses were organized for specialists from different fields, in order to facilitate the collaboration between the Center and other institutions.

The next jump forward was initiated by creation, as a project funded by UNDP, of the Institute of Informatics to date mainframes, and a metropolitan network was built in Tirana, connecting different ministries and faculties. With the new infrastructure, new knowledge was necessary; the Center helped many specialists of different fields to improve the quality of their work and their doctorates using computers as supporting tool. A great number of specialists were trained abroad, and the Chair of Informatics was created at University of Tirana, Faculty of Natural Sciences. The task of this Chair was organization of full five-year course in Informatics, as well as short- and medium-term courses for specialists of other areas.

Besides INIMA, competence on digital technologies and online systems was increased in the Institute of Nuclear Physics (under the Academy of Sciences) in Tirana. Radical changes of nineties were reflected in the education system. Training on ICT was offered by many organizations, and departments of ICT were created in several universities. Radical changes happened in the Department of Electronics of the Faculty of Electrical Engineering at the Polytechnic University of Tirana, with creation of three teaching directions—electronics, telecommunication, and computer engineering.

In beginning of year 2000, Albanian universities started to adopt the Bologna system. In 2007, there was an important event—creation of the Faculty of Information Technology in Polytechnic University of Tirana, joining together departments of electronics, telecommunication, and computer engineering from the Faculty of Electrical Engineering labs. Government launched also the master plan for introduction of IT education and Internet connectivity for all schools countrywide.

In Albania, the Ministry of Education and Sports has been under the jurisdiction over 2125 schools, 1749 primary schools, and 376 secondary schools. Each school has a dedicated broadband connection, but it is only in the computer labs. The internet connection enables the students and teachers to use different sources of information and in particular to work with curriculum projects. ICT curriculum in 2006 was held only in high school, and in 2014 was expanded to basic education, starting in 3rd grade and extending up to 12th grade. ICT in education was one of the main directions set out in National Strategy 2008–2013 and supported by the Word Bank project, Excellence and Equity in Education Program. Today in our pre-university education system, we have 1496 computer labs, divided by category. Five desktops for pupils and one for teachers for schools with up to 300 students; ten desktops for students and one for teachers for schools from 300 to 600 students; and 15 desktops to students and one for teachers for schools with over 600 students, in the way that to cover the all country rural and urban areas.

2.3.2 Infrastructure

Investment in infrastructure and innovation is a crucial driver of economic growth and development. School infrastructure includes suitable spaces to learn for all students. This is one of the most basic elements necessary to ensure access to education. Facilities may be inadequate in many ways, including being overcrowded or dangerous or lacking in adequate learning facilities. In addition, access to the Internet has become crucial to ensure equal access to information and knowledge, as well as to foster innovation and entrepreneurship.

In addition to the development of Albania's physical infrastructure, the need to strengthen educational institutions through the development of the capacities of teachers and school leaders represents another crosscutting dimension that was evident throughout the EPR. In each of the three policy domains, stakeholders highlighted the ways in which educational reforms and improvements hinged upon the development of improved infrastructure alongside new teaching and leadership competencies. For example, Policy Issue 1.2 and Recommendations 1.3.1; 1.3.2; 2.1.5; 2.2.3; 3.3.3; and 3.5.2 all highlight the need to prepare teachers to effectively teach the new curriculum.

ICT plays a critical role in enabling inclusive education and sustainable development by providing people not only with access to information and services but also with opportunities to participate and contribute to the knowledge society. The Government of Albania should capitalize on ICT's transformative potentials in education by strategically and effectively using ICT to improve governance, access to resources, capacity building, teachers' professional development, and quality of learning. The government of Albania should strengthen the educational institutions and invest in better infrastructure as well as improve the coverage of education services in all geographical areas to help address the education needs of the rural populations and disadvantaged groups. Targeted support to higher education institutions would help to address critical needs in human resource development and strengthen institutional governance across the education system, including higher education particularly as it pertains to the education of future teachers and education professionals.

2.3.3 Educational Resources

Policies aimed at promoting the use of ICT in education often focus on investment in infrastructure, equipment, and in-service training of teachers. However, in order to look at the added value that ICT can bring to teaching and learning, attention should be paid to the development and publication of digital learning resources. The investments cited above only pay off if teachers and students also have good quality digital learning materials. To some extent, such materials can be found for free on the Internet, but due to language issues and the need to have learning materials that are "contextualized" and adapted to the national curricula, Albania also needs to invest in developing digital learning materials for its students and teachers. A step in this direction is that, based on the new reform of curricula, textbooks for 10th and 11th grade students now have digital content developed from education publishers. Furthermore, a new curriculum for ICT as a subject within computing and programming for 10th, 11th, and 12th grade students is being introduced, commencing with grade 10 in 2016/17.

The investment in the digital learning resources can be done by developing national model content for providers of digital content based on public investment or procurement from educational publishers in the private sector. Albania should develop a national hub or repository for digital learning materials, such as Open Education Resources (OERs) or commercial resources that could stimulate the use of ICT. Such a repository or one-stop-shop would enable teachers to find existing materials and high-quality digital content in the Albanian language, in accordance with the national curriculum. This could be done by following UNESCO's advice for policy development and teacher development (UNESCO 2015e), and by implementing the Paris OER Declaration of 2012, which states that a common national repository or a one-stop-shop for digital learning materials should be established where teachers could search for their needs by grade level and subject, thus stimulating the use of such materials. In addition to this, teachers will need assistance in developing the skills and knowledge required to work with the digital content presented in new texts to address the new curriculum.

2.3.4 Learning and Teaching

Stakeholders in Albania expressed concern that ITE programs are not supporting the country's education reform efforts. Recent research found that programs do not provide sufficient preparation in the pre-university curriculum and that course delivery is still characterized by teacher-centered methodology (e.g., lectures), rather than the student-centered techniques. Teachers are now expected to use these techniques in classroom (Abdurrahmani 2013; European Commission 2013).

Due to the new competency-based curriculum, teachers in Albania are being asked to shift from a teacher- and examination-centered culture to a learner-centered culture that assumes that all students can learn if they are engaged and appropriately supported. Such a culture measures success based on the student's actual progress toward the learning goals and competencies, rather than whether or not the student achieved a particular standard. For many teachers, this new approach is a significant shift in values as well as in teaching practice. Research has demonstrated that in many low- and middle-income countries, and in post-communist countries as well, pedagogical practices have persisted in being teacher-dominated, lecture-driven, and quite formal, with a focus on factual and procedural knowledge to prepare for traditional formal examinations (Altinyelken 2015). In circumstances where the reformed curriculum requires a significant pedagogical shift on the part of at least a portion of the teaching force, sustained professional learning is a requirement for success. Thus, the development of teachers' pedagogical skills should be addressed in ITE programs.

Studies also suggest that Albania's ITE programs do not sufficiently prepare teachers in students' assessment, lesson planning, classroom management, and teaching students with special education needs and students from diverse backgrounds (Vula et al. 2012; European Commission 2013a). Preparation in the latter area is even more important now because the government is hoping to create a more inclusive education system for the increasing numbers of families who are attempting to reintegrate into Albania after living in Greece or Italy (European Commission 2013). Although this is the government's aspiration, students from diverse or disadvantaged backgrounds are not yet fully included in the country's schools.

As previously noted on teacher professional learning to implement the new curriculum, teachers need more than presentations and documents to understand, adopt, and practice the new pedagogy. The best professional learning for the implementation of effective inclusion practices is a form of collaborative inquiry, where teachers work together on changing their practice, and monitor the effects of their efforts on the achievement, behavior, and attitudes of their students over time.

2.3.5 ICT Integration into Practices

The government of Albania has recognized that the public education system is critical to the society and has embarked on a path to prepare students to excel in an information-based, technologically advanced society, to create technologically savvy citizens and prepare children for higher education and the labor market (MSHIAP n.d). By 2012, there were about nine students per computer per school in Albania against an OECD average of 4.7. Between 2009 and 2012, the number of students per computer per school slightly decreased in Albania (−0.2), whereas it increased at the OECD level (+0.5). During the same time frame, the share of school computers that are connected to the Internet passed from 41.3% to 70.3%; values are still well below the OECD average (97.5%), but showing the highest increment (+29%) among the countries that took part in PISA 2012 (+1.3%).

As a result of national policies supporting the economic development of rural areas of the country, between 2009 and 2012, a large number of schools located outside the main urban centers gained access to the Internet. Consequently, the number of students in rural area schools without computers connected to the Internet declined rapidly (OECD 2015).

Although improving rapidly, infrastructure provision varies considerably across schools, and the lack of it is still an obstacle to greater use of ICT for educational purposes in Albania. To use ICT in teaching and learning implies having access to digital devices, whether it is a computer, a tablet PC, a mobile phone, or an interactive whiteboard, and having a stable, reasonably fast connection to the Internet (MSHIAP n.d, p. 17). A reliable Internet connection enables students and teachers to use different sources of information and in particular to work with curriculum projects. In terms of its relevance in the subject areas of the curriculum, the UNESCO review team found that, until 2006, ICT as a distinct subject was taught only at the upper secondary level, whilst in 2014 it was expanded to the basic education level from grade 3 to grade 12.

The UNESCO review team also found that pre-university schools in Albania do not have a specific budget to purchase technology equipment; thus, MES supports schools to purchase desktops, laptops, printers, and photocopy with project funding or from other local and foreign donors (IED 2015). As a consequence, there is no central plan for the acquisition, maintenance, and replacement of this equipment.

Thus, schools purchase or replace the existing equipment when they have the funds to do so rather than when it is needed and acquire the equipment that they can purchase given the available funds rather than the equipment that fits their needs the best. At the same time, ICT maintenance is not performed regularly but only when there are available funds.

In conclusion, Albania's education system has gradually improved its integration of ICT into education, yet the use of ICT in schools remains in its infancy, and experiences vary. The provision of ICT and Internet connectivity to all primary and secondary schools in Albania aims at increasing the quality and relevance of education, the effectiveness of education delivery, as well as facilitating greater access to information and services by marginalized groups and communities. Despite the significant policy strategies on ICT, many challenges remain. Policy and actions should find the right balance between implementing central educational goals and adapting to the particular needs of regions and schools. It is important to build consensus among all stakeholders, as they are more likely to accept change if they understand the rationale and potential usefulness of reforms. Leadership in the use of educational technology requires a map and a compass to guide decision-making and action plans. To be truly useful, such roadmaps need to strike a delicate balance: they must incorporate a contextual understanding of real-world technologies, but remain grounded in pedagogical frameworks that guide their application.

2.4 Policy and Strategy of ICT

2.4.1 ICT Financing Resource

As part of the broader public governance system in Albania, the education sector continues to function as a somewhat centralized model of inter-governmental networks. The administration at the regional level remains connected to the ministerial level in Tirana, namely the Ministry of Education and Sports (MES) and the Ministry of Finance, and is largely dependent on the central level. Local authorities do have the vested powers to establish schools and assign children to them accordingly; however, at the time of this EPR, the local expenditure for education comes directly from central government funds. The revenues generated by the local governments remain very limited (OECD 2003, p. 46; see also Schmidt-Neke 2007, p. 18).

2.4.2 Policies-Related Educational Informationalization

In the framework of legislative and strategic documentation of government of Albania, there are two key groups of documents directly related with the ICT education in the country:

1. Cross-sector Strategy for the Information Society
2. Master-plan for E-Schools Program in Albania.

The Cross-sector Strategy for the Information Society considers the improvement of ICT infrastructure for fast broadband Internet services countrywide. One of principal objectives of the strategy is education in all its aspects:

- Equipment of all schools with computer labs and broadband Internet within 2013, with 25 pupils for one computer in 2010;
- Introduction of elements of ICT in elementary schools, improving teaching of ICT in high school following EU standards, and training of teachers;
- Connection of all universities and research centers with the GEANT via a national fiber backbone;
- Disseminating and teaching the wide public for better acquaintance of ICT, to make people able to use the technology and be active in a society based on Information;
- Realization of the Master-Plan for E-Schools.

The Master-plan for E-Schools Program in Albania is a specific document for introduction within 2008 in all schools of the country teaching elements of informatics, based on new curricula, PC labs, and Internet connectivity. Improvement of teaching of informatics in pre-university education system is expected to increase the use of IT in every aspect of the life considering the concept of information society, also to improve university and post-university teaching and research as a result of better prepared new students entering universities.

After many years of tentative from key IT academic people, the signature of an agreement with the Italian government for creation of an inter-university services center has created conditions for building of the National Research and Education backbone in the country; the work is progressing under the joint attention of Ministry of Education and Science of Albania and Delegation of Italian Collaboration for Development of Albania.

Implementation of these strategies would make possible the intensification of usage of up-to-date technologies and consolidation of knowledge database for education of students. Actually, the curricula used in schools has little differences with those applied in other countries, as it results from communications with Albanian students doing their studies abroad, in particular, in Italy. Development of e-content and videoconferencing technologies would improve collaboration with foreign universities, in order to better face challenges of the future. Improvement of curricula following recommendations of UNESCO and strengthening the work for teaching of software technologies and programming would open wider perspectives for new generations.

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Chapter 3
Report on ICT in Education in Bosnia and Herzegovina

Dragoslav Vasiljević

3.1 Overview of the Country

3.1.1 History and Geography

Bosnia and Herzegovina is a country in the southeastern part of Europe, located in the west of the Balkan Peninsula. The main and also the largest city of the state is Sarajevo. According to the final results of the 2013 Population Census, the population is 3,531,159.[1]

After elections in 1990, Bosnia and Herzegovina declared its sovereignty in October 1991, followed by a referendum for the disassociation of Yugoslavia. The war broke out in Bosnia and Herzegovina and it ended in 1995. On November 21, 1995, a peace agreement was signed in the city of Dayton, USA, which ended a three-year war (final agreement was signed in Paris on December 14, 1995).

3.1.2 Political System

There are three constituent peoples in Bosnia and Herzegovina, Bosniaks, Serbs and Croats. By its state organization, Bosnia and Herzegovina is unique in the world. Its design is of a republican character, although BiH does not function or is defined as a republic due to the complexity of the units to which it is divided (entities and

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[1] Agency for Statistics of Bosnia and Herzegovina. Available via http://www.bhas.ba/?option=com_content&view=article&id=52&itemid=80&lang=en. Accessed March 2019 (Online document).

D. Liu et al. (eds.), *Comparative Analysis of ICT in Education Between China and Central and Eastern European Countries*, Lecture Notes in Educational Technology,
https://doi.org/10.1007/978-981-15-6879-4_3

cantons). It consists of two entities: the Republic of Srpska, the Federation of Bosnia and Herzegovina, the District of Brčko.

The Presidency of Bosnia and Herzegovina consists of three members, one representative of each constituent people. The Parliamentary Assembly is the highest legislative body of Bosnia and Herzegovina. It consists of two houses: the House of Peoples and the House of Representatives.

3.1.3 Current Situation of Economic Development

In 2017, the estimated economic growth rate of around 3% in relation to the previous year is a continuation of the economic recovery trend in BiH, which is largely the result of favorable economic trends in EU countries and to a lesser extent in the countries of the region. The nominal gross domestic product (GDP) of Bosnia and Herzegovina (in millions of KM, 1 km is about 0.5 EURO) for 2017 was 31,862.[2]

The average number of employed persons in BiH in the period I-XII 2017 is 746.3 thousand, which is 2.8% more than that in the same period of the previous year. Although the number of employees in BiH increased in almost all areas of activity, the most significant growth was in the area of industrial production, trade, hotels and restaurants.

While official data on investments for 2017 are currently not available, the assumption is that BiH's investments that account for around 20% of GDP have stagnated so that their contribution grows neutrally. Overall, investments in BiH did not recover from the pre-crisis period when they amounted to 26.5% of GDP.

When it comes to economic developments in Bosnia and Herzegovina for 2017, based on available data with certainty, it can be concluded that they were in the sign of an external sector, where the foreign trade of goods is particularly high. Namely, during the year 2017, according to the BIHAS data, Bosnia and Herzegovina recorded double-digit growth rates of total trade, exports and imports of goods. The increase in export demand and the prices of certain export products (metals and energy) resulted in an increase in BiH. of goods exports of 17.4% compared to the previous year.

3.1.4 The Status Quo of Science and Technologies

Education in BiH does not change even 20 years after the end of the war. The teaching methods in the primary and secondary schools are that teaching staff still teach, and children write and then reproduce through written or oral examination. Grades are

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[2] *Environmental and social management framework for Bosnia and Herzegovina.* Available via https://www.vladars.net/sr-SP-Cyrl/Vlada/Ministarstva/mps/Documents/Sava%20Drina%20ESMF%20for%20BiH%20draft%20for%20consultation%20Dec%2025%202019_078189335.pdf. Accessed March 2019 (Online document).

the only indicators of their work, and they are given only by a person who is teaching a particular subject.

In 2008, the Council of Ministers of BiH adopted the Strategies directions of education development in Bosnia and Herzegovina with an implementation plan, 2008–2015. Today is 2019, the current state of education is similar to 2007, although a mentioned document was created as a desire to change the existing situation.[3]

Academy of Sciences and Arts of Bosnia and Herzegovina is the highest scientific and artistic institution in Bosnia and Herzegovina. In 1966, NDBiH has been reformulated in ANUBiH. The task of the Academy was to take care of the overall development of science and arts, to organize scientific research, and to publish the work of its members and associates.

Problem of Bosnia and Herzegovina, which has a huge effect on science, is the departure of young and educated people, which significantly reduces it quality of human resources in BiH. According to the Global Competitiveness Report 2017,[4] BiH is in the category of Higher education ranked in position 91 of 137 countries; quality of math and science education: 97/134; availability of latest technologies: 82/137; quality of scientific research institutions: 106/137. Overall, the Global Competitiveness Index is 103/137.

The scientific and technological system in BiH has several dedicated research institutes (for example, in metallurgy and agriculture), and a limited number industrial laboratories and universities. 3088 persons are employed in research and development activities. The largest number of employees belongs to researchers (58.2%). 1481 research works were published, of which the largest number of papers belongs to development research (59.1%), applied research (3.1%) and fundamental research (9.7%).

3.1.5 The Status Quo of Social and Cultural Development

Instrumentalization of culture in the production, distribution and consumption of products and services is very important for building comparative and competitive advantages of particular sectors and economies. Culture as a generator of jobs implies a change in public policy toward artists and cultural workers. It is necessary to support the development of crafts, cultural tourism and the provision of continuous cultural activities that can be built around the already established festivals in BiH. Cultural industries are a special economic sector that can help strengthen regional potentials. Cultivating a wide range of activities from books, films, audiovisual domains, to craft products and designs, cultural industries are closely related to the issue of

[3] *Osnovno obrazovanje u Bosni i Hercegovini—kvalitet, kreativnost i inovativnost Sarajevo*, Juli 2010. Available via http://www.cpu.org.ba/media/8348/CPU-Osnovno-obrazovanje-u-Bosni-i-Hercegovini-kvalitet-kreativnost-inovativnost.pdf. Accessed March 2019 (Online document).

[4] Schwab,K. (2018). *The global competitiveness report 2017–2018 world economic forum.* Available via https://www.weforum.org/reports/the-global-competitiveness-report-2017-2018. Accessed April 2019 (Online document).

preserving and enhancing cultural diversity. Cultural production has become one of the main economic factors in the world. The relationship between cultural and economic development and its impact on the labor market is increasingly becoming the field of discussion at the European level. In 2015, cultural activities contributed 5.72% to 48 gross domestic product (GDP) in Bosnia and Herzegovina, which indicates that culture is responsible for an important part of state production, and helps to generate income and maintain the living standards of its citizens. 32% of this contribution can be attributed to direct cultural activities, and 68% can be attributed to support for these activities. The contribution of culture to GDP is underestimated; for this indicator, only private and formal cultural activities are taken into account, and the indirect and induced influences of the cultural sector are excluded. Most of the share in GDP (64%) refers to support for cultural activities. Central cultural activities, such as broadcasting, architectural activities, advertising and newspaper publishing, account for 1.83% of GDP. Given the weakened state of the economy, the impact of this sector on GDP is satisfactory.

Bosnia and Herzegovina is a trilingual state where most of the population speaks one of the three official languages. Minorities living in Bosnia and Herzegovina use their languages in mutual communication. In the territory of Bosnia and Herzegovina, the official languages are Serbian, Bosnian and Croatian. All three languages are mutually understandable and very similar, since they are based on the same (Štokavian) dialect. Official letters of BiH are Latin and Cyrillic. Mostly used foreign languages are English, German, Russian and French, but English is most widely used. In the curriculum in schools in BiH, the learning of two foreign languages, most often German and English, is obligatory. The latest data show that the number of BIH. Citizens who speak one or more foreign languages is increasing. 35% of BIH citizens speak English language.

3.1.6 The Relationship with China Under the "16+1" Cooperation Framework

In Table 3.1 are shown Chinese investments in the 16 CEECs (except Greece) in the period from 2009 to 2014. Share of total Chinese investments for BiH is very small (0.36%). Investment growth from 2009 until 2014 is 3.55%.[5]

The trade between China and the 16 CEE countries is more complementary than competitive, implying a bigger room for trade expansion. In 2016, using China as the benchmark, the average trade complementarity index between China and the CEE was 0.3733, with the most complementary country being Czech, with which the trade complementarity index was 0.4712, and the least complementary country being Albania, with which the trade complementarity index was 0.2926; the average

[5]Xin, C., & Zhigao, H. E. (2018). *16+1 cooperation and China-EU relationship*. Budapest: China-CEE Institute Nonprofit Ltd. Available via https://china-cee.eu/wp-content/uploads/2018/11/161-cooperation.pdf. Accessed April 2019 (Online document).

Table 3.1 Chinese investments in the 16 Central and Southeast European countries in 2009 and 2014

	2009	2010	2011	2012	2013	2014	2009–2014 growth (%)	Share of total Chinese investment in CEE (2014) (%)
Hungary	97.41	465.70	475.35	507.41	532.35	556.35	471.14	32.79
Poland	120.30	140.31	201.26	208.11	257.04	329.35	173.77	19.41
Czech Republic	49.34	52.33	66.83	202.45	204.68	242.69	391.87	14.31
Romania	93.34	124.95	125.83	161.09	145.13	191.37	105.02	11.28
Bulgaria	2.31	18.60	72.56	126.74	149.85	170.27	7271.00	10.04
Slovakia	9.36	9.82	25.78	86.01	82.77	127.79	1265.28	7.53
Serbia	2.68	4.84	5.05	6.57	18.54	29.71	1008.58	1.75
Lithuania	3.93	3.93	3.93	6.97	12.48	12.48	217.56	0.74
Croatia	8.10	8.13	8.18	8.63	8.31	11.87	46.54	0.70
Albania	4.35	4.43	4.43	4.43	7.03	7.03	61.61	0.41
Bosnia–Herzegovina	5.92	5.98	6.01	6.07	6.13	6.13	3.55	0.36
Slovenia	5.00	5.00	5.00	5.00	5.00	5.00	0.00	0.29
Estonia	7.50	7.50	7.50	3.50	3.50	3.50	−53.33	0.21
Macedonia	0.20	0.20	0.20	0.26	2.09	2.11	955.00	0.12

Stock/USD million

Source Xin, C., & Zhigao, H. E. (2018). 16+1 cooperation and China-EU relationship. Budapest: China-CEE Institute Nonprofit Ltd. Available via https://china-cee.eu/wp-content/uploads/2018/11/161-cooperation.pdf. Accessed April 2019 (Online document).

trade specialization coefficient was 0.2409, with the most competing country being Czech with which the trade specialization coefficient was 0.3983, and the least competing country being Montenegro, with which the trade specialization coefficient was 0.0729. Coefficient of Specialization and Trade Complementarity Index for Bosnia and Herzegovina are 0.1929 and 0.3389, respectively.

According to Chinese Ambassador in Bosnia and Herzegovina Chen Bo,[6] Bosnia achieved yet another success on the bilateral cooperation plan following the end of the "16+1" Summit in Sofia. The "'16+1' prime ministers' Summit was marked by the Visa Abolition Agreement between governments of Bosnia and China, an agreement in the field of agriculture between competent institutions of our two countries as well as the Loan Agreement for the construction of Block 7, of the Tuzla Thermal Power Plant," the Ambassador said. "The two countries initiated a procedure on the signing of an agreement on cooperation in the field of civil aviation which will create the condition for the introduction of a direct airline between Bosnia and China. The two

[6]Bosnia is the winner of the '16+1' Summit, N1. http://ba.n1info.com/English/NEWS/a271474/Bosnia-is-the-winner-of-the-16-1-Summit.html. Accessed 22 Apr 2019.

Table 3.2 Coefficient of specialization (CS) and trade complementarity index (TCI) of trade between China and CEE countries (2016)

Country code	Country	CS	TCI
8	Albania	0.1404	0.2926
70	Bosnia–Herzegovina	0.1929	0.3389
100	Bulgaria	0.2667	0.3654
191	Croatia	0.2708	0.4098
203	Czech Republic	0.3983	0.4066
233	Estonia	0.3101	0.4712
348	Hungary	0.3359	0.4122
428	Latvia	0.2843	0.3679
440	Lithuania	0.3068	0.3547
499	Montenegro	0.0729	0.4333
616	Poland	0.379	0.3296
642	Romania	0.3111	0.4181
688	Serbia	0.0761	0.3008
703	Slovakia	0.3251	0.459
705	Slovenia	0.0328	0.3104
807	TFYR of Macedonia	0.1505	0.3021

Source Xin, C., & Zhigao, H. E. (2018). 16+1 cooperation and China-EU relationship. Budapest: China- CEE Institute Nonprofit Ltd. Available via https://china-cee.eu/wp-content/uploads/2018/11/161-cooperation.pdf. Accessed April 2019 (Online document).

sides have initiated a procedure related to the issuance of a license to export dairy products from Bosnia to the Chinese market."

Companies from the two countries that took part in the Summit signed two cooperation agreements concerning road infrastructure, worth over BAM 2 billion (around EUR 1 billion) The first is the construction of the Banjaluka–Prijedor–Novi Grad highway in the Republika Srpska entity and the second is the construction of the Vukosavlje-Doboj highway and its Vukosavlja-Brcko branch. In both of these projects, the Chinese investors will act as direct investors.

3.2 Overview of the Educational Development

3.2.1 Education System and Policy

Bosnia and Herzegovina education system is organized into four main levels: preschool, primary, secondary and higher education. Educational institutions are mainly public and private.[7]

Preschool education is an integral part of the educational system in BiH and in the year prior to enrollment in primary school, it is compulsory for all children of preschool age.

Primary education lasts 9 years and is compulsory for all children. It starts in the calendar year in which, until 1 April, the child has reached 6 years of age.

Secondary education is accessible to all, in line with their performance in primary school, personal interests and abilities.

Access to higher education is granted to all those who have completed 4 years of secondary school in Bosnia and Herzegovina. According to official statistics, there are 10 public and 39 private higher education institutions in BiH.

The institutional picture of the education sector in Bosnia and Herzegovina is a reflection of the state organization defined by the Constitution of BiH, entities and cantonal constitutions, and the Statute of the Brčko District and on which the competences in the field of education are legally defined.

Pursuant to the Law on Ministries and other bodies of the BiH Administration, the Ministry of Civil Affairs of BiH is in charge of carrying out tasks and performing tasks in the jurisdiction of BiH and related to the establishment of basic principles of coordination of activities, harmonization of the plans of the entity authorities and defining the strategy on the international plane, among others, for the field of education.

There are a few ministries of education: Ministry of Education and Culture of Republika Srpska, Ministry of Education of Federation of BiH, Ministry of Education of Brčko District and ministries of education in cantons.

At the level of BiH, four framework laws have been adopted:

1. Framework Law on Higher Education in Bosnia and Herzegovina;
2. Framework Law on Preschool Education in Bosnia and Herzegovina;
3. Framework Law on Secondary Vocational Education and Training in Bosnia and Herzegovina and
4. Framework Law on Primary and Secondary Education in Bosnia and Herzegovina.

Educators in preschool education, teachers in primary and secondary education are educated in accordance with targeted educational level, i.e. age of the children

[7] *Osnovno obrazovanje u Bosni i Hercegovini—kvalitet, kreativnost i inovativnost Sarajevo*, Juli 2010. Available via http://www.cpu.org.ba/media/8348/CPU-Osnovno-obrazovanje-u-Bosni-i-Hercegovini-kvalitet-kreativnost-inovativnost.pdf. Accessed March 2019 (Online document).

with whom they work. In BiH, they are highly qualified (completed an appropriate study programme at the higher education).

Teachers in BiH are employed in public and private institutions, and their qualifications and professional development are regulated by legislation and regulations.

3.2.2 Enrollment Rate and Retention Rate

3.2.2.1 Preschool Education

In 2016/2017 school year, in the territory of BiH, there were 332 preschool institutions with 24,918 children. Compared to the previous school year, the number of preschool institutions is 4.7% higher, the number of children in preschool institutions increased by 8.8%, and the number of employees is 7.2% higher.

3.2.2.2 Primary Education

In the school year 2016/2017, in the territory of BiH, there were 287,729 pupils enrolled in 1842 schools, which was 3613 pupils less or 1.2% lower in comparison with the previous year. At the beginning of the school year 2016/2017, there were 23,824 teachers included in the education process out of which 17,045 or 71.5% were women.

3.2.2.3 Secondary Education

In the school year 2016/2017, in the territory of BiH, there were 126,824 pupils enrolled in 311 schools, which was 6404 pupils less or 4.8% lower in comparison with the previous year. In the school year 2016/2017, there were 12,652 teachers included in the education process, out of which 7653 or 60.5% were women.

3.2.2.4 Higher Education

In the academic year 2016/2017, there were 100,333 students enrolled in winter semester of the first cycle of higher education, including integrated studies, out of which 89,715 students were enrolled in all study years, while 10,618 were candidates for graduation. In 2016, there were 15,266 students who graduated/completed academic or professional studies, which was 4.4% lower in comparison with the previous year. Out of the total number of graduated students, 58.8% were female.

In Bosnia and Herzegovina, early school leaving rate is less than 10%.

3.2.3 Government Expenditure on Education

Education system in BiH is financed from entity, cantonal and municipal budgets. The share of education in financing from the state budget is very small. Republika Srpska allocates about 4% of its GDP for education, Federation of BiH issues about 6% of GDP while Brčko District for education allocates 11.2% of the total budget of the District. Fragmentation of the education system is reflected in this segment as there are significant differences in funding (average allocations per student) as well as differences in salary levels and compensation of employees in the education sector throughout the country. About 88% of the total budget funds for education is spent on salaries and benefits of employees, 8% for material costs and only 4% is allocated for capital investments.

In Bosnia and Herzegovina in 2017, the budget allocation of institutions that fund R&D activities is 13,952,461 km. The budget funds of the institutions were allocated mostly for higher education by 77.8%. The planned budget for research and development in 2018 was 15,642,795 km. According to socioeconomic goals, most of the funds are planned for research in education (50.6%). Of the total amount in research in the education sector, funds of 7.9 million KM were planned, projects research in the sector of General Knowledge Improvement 3.026 million KM. The above data refers to allocations for research and development from the budget of the institutions of Bosnia and Herzegovina, Entity institutions and the District of Brčko.[8]

3.2.4 Teachers' Professional Development

Continuing professional development is carried out through training programmes, retraining and evaluation. Evaluation elements of professional development of teachers include participating in professional development as established by the Ministry of Education, participation in training conducted by professional institutions and associations, and professional training through monitoring of contemporary literature and magazines. Professional training is evaluated as regular and occasional. Only teachers who regularly attend professional development programmes may be promoted into mentors and advisers.

Agency for preschool, primary and secondary education in BiH has developed a Model for improving the system of continuing professional development of educators, teachers and professional associates in Bosnia and Herzegovina. The Model includes directions for professional development in order to achieve their goals and ambitions, as well as raising awareness of educators and how to accomplish the assigned tasks and to enhance the professionalism and competence.

Teacher and educator standards have also been developed as a tool for monitoring their professional development.

[8]Agency for Statistics of Bosnia and Herzegovina. http://www.bhas.ba/saopstenja/2018/RDE_03_2017_Y2_0_BS.pdf. Accessed March 2019.

3.2.5 Quality Assurance in Education

In the area of higher education at this moment, there are no institutional structures that are particularly concerned with the quality of education at this level, although there are standard bodies (councils, commissions) that deal with questions of quality and analysis of the state in higher education universities and competent ministries.

In the area of preschool, primary and secondary education, the situation is different. Monitoring the quality of education and support for its development is achieved through the work of pedagogical institutes and Agency for Standards and Assessment in Education for the Federation of Bosnia and Herzegovina and the Republic of Srpska.

3.2.5.1 Pedagogical Institutes

In Bosnia and Herzegovina, there are currently eight pedagogical institutes, namely Republic Pedagogical Institute of the Republika Srpska, the Institute for Education and six pedagogical institutes in the Federation of Bosnia and Herzegovina.

Except for three institutes (Pedagogical Institute in Bihać, Pedagogical Institute in Mostar and Institute for Education in Mostar), all other institutions operate within the ministries of education.

It is planned to establish an institute in the Brčko District.

Existing pedagogical institutes perform various tasks: the development of curricula, introduction of new approaches and methods in the educational process, implementation of teacher training, control and evaluation of the work of teachers and schools, etc. Most of the institutes are dominated by professional ones' supervision, while support for the development of quality in education is suppressed in the second plan. How institutions function is not precisely defined and often overlaps with the functions of ministries education.

Agency for Standards and Assessment in Education for the Federation of Bosnia and Herzegovina and the Republic of Srpska was founded in 2000 by decisions of the Government of the Federation of Bosnia and Herzegovina and Government of Republika Srpska.

3.3 New Progress of ICT in Education

3.3.1 Educational Background in Bosnia and Herzegovina

Before the war, the country had been a part of a big country Yugoslavia which was well known for its great educational system which produced many world-known experts and people with high level of general knowledge. Now, after suffering many losses in infrastructure, the country is still considered to be in a transitional process toward market economy and with its economy still on the loose ground, the educational process is also suffering. One important fact that is characterizing this country's education system is an existence of three different curricula on all levels of education. This is the result of a political structure of the country which is a big obstacle for the education system. The curriculum is not harmonized, and all three parts of the country are introducing changes by themselves, without any thinking of the effect and the status of the other parts. There are no joint intentions to improve the education on a national level which is automatically eliminating the synergy effect and practically preventing the healthy growth of the nation.

Looking at the elementary and secondary levels of education in Bosnia and Herzegovina, it is evident that the teachers are still resorting to the traditional methods and techniques of teaching. Chalk and talk is the common way of transferring knowledge. The war has made the continuous professional development of the teachers impossible and caused the lack of the qualified teaching workforce. The positive aspect is the presence of the necessary equipment. Almost all of the secondary schools are fully equipped and the elementary level schools also possess the basic equipage. Although the hardware requirements had been fulfilled, the lack of trained teachers is still present and the equipment is not well utilized in the standardized teaching process.

All three parts of the country introduced some improvements into the curriculum, but they mostly concerned the modernization of the curriculum itself and none of them made any relation to the ICT supported learning on a national level. The teachers need to learn how to properly utilize ICT, create interactive environment, use the existing resources that are already available and create interactive learning materials by themselves. All the initiatives for a change in this direction were reduced to individual efforts.

The education system, based on the concept of targeted secondary schools, is significantly different from modern processes, such as computer and web based-learning, distance learning and knowledge-based learning. However, there is no determination to develop a teaching staff capable of supporting an educational process based on the use of ICT, which is able to support student and student incentives on the use of ICT. The current reform of education places the focus on the administrative element, and on the unification of certain content. Regardless of the importance of these reforms, ICT have been completely ignored and not given an appropriate priority.

Qualitative analyses of the education sector, and the use of ICT in the school system, almost never existed. The first more serious analysis is given in the "e-readiness report" from UNDP.[9] A survey conducted for this report, which covered a total of 269 educational institutions of different types, from primary and secondary schools to faculties, revealed the following situation.

[9]E-readiness Report, UNDP. http://www.dep.gov.ba/dokumenti_politika/srednjorocna_razvojna_strategija/?id=20. Accessed 22 Apr 2019.

Table 3.3 Number of computers in educational institutions (In the analysis of the ICT sector in BiH, most of the materials used by the UNDP IKT Forum—expert studies prepared for public discussion, were used, on July 25, 2002)

	Number of schools	Number of computers	% Of institution type	% Of total computers	Average
Total	269	4795	100	100	17.83
Primary schools	133	1289	49.44	26.28	9.69
Secondary schools	77	1258	28.62	26.24	16.34
Universities	59	2248	21.93	46.88	38.10

3.3.1.1 Computer Literacy

45% of employees are able to use the computer, and only 5% of professional IT staff are employed in the IT sector or equivalent services. Compared to the total number of teaching staff, there is a very low percentage of teachers using ICT in teaching. There are few examples of using the Internet as a delivery infrastructure for teaching content, or the use of local networks, intranets and web portals in the classroom. There are no specially designed training courses for teachers or their preparation for the use of ICT in the educational process. Due to the great dynamics of changes in ICT, our educational system, due to continuous experiments and curriculum revisions, is not able to follow world trends.

3.3.1.2 Number of Computers and Equipment of Institutions

There is a big difference in the average number of computers in educational institutions, where faculties have two times more computers from primary and secondary schools (Table 3.3).

3.3.1.3 Quality and Usability of Equipment and Software

Pentium II processors are used in about 33% of all computers in educational institutions. Half of the computers in primary schools belong to the category of computers with Pentium I and Pentium II processors. Secondary schools have the highest value in the Pentium I category—which is less than the overall average, while the faculties for their part have the best technical equipment and the highest (66%) of computers in the Pentium II, Pentium III and Pentium IV categories. Only about a quarter of educational establishments have a server configuration. Computer networks exist in all types of educational institutions. At colleges, 61% are networked, in secondary schools 20% and in primary schools 10% of computers. Applications on the MS Windows platform represent the dominant part (66%) of applications that are used on computers in educational institutions. Of the 513 registered applications, nearly a third goes to MS Office.

3.3.1.4 Internet Connection

Of the 61% of institutions that have an Internet connection, only 4% of them are connected to the Internet by a cable connection of 2–11 MB. School institutions that have access to the Internet (a total of 164 schools) use as many as 15 different ISP companies. Two large Internet operators, BiHNET and HPT, serve as much as 66.40% of all school facilities. The structure of telecom, ISP and equipment costs, service providers and qualified staff is very important.

At the World Economic Forum in Davos, out of 131 countries in 2007, BiH according to the Global Competitiveness Index (GCI) is ranked 106th, out of 125 countries in 2006, it occupied 89th place, and in 2005 out of 117 countries, it occupied 88th place. There is noticeable fall in this report (Diagram 3.1).

Today's situation is much better comparing the period 10 years ago. Very important role in noticeable improvement of ICT application have ministries of education in both parts of Bosnia and Herzegovina. The use of information communication technologies in the Republic of Srpska has been significantly improved. Experts believe that much more investment is needed in this area to bring the Republic of Srpska closer to the developed digital world. Significant progress is noticeable in the application of ICT in republic administration, local self-government, health care

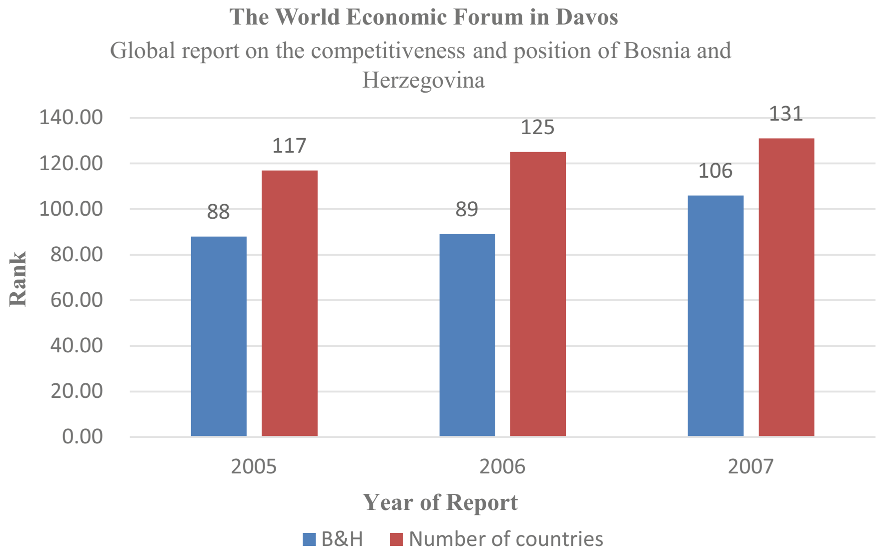

Diagram 3.1 Global competitiveness index of Bosnia and Herzegovina (Blue color: Bosnia and Herzegovina ranking; Red color Total number of countries. According to data from 2007)

and education. Huge progress in the field of ICT is in scientific research and at universities. According to certain indicators, most of ICT is applied in small and medium-sized enterprises. Table 3.2 shows the statistics on the use of the Internet in 2017 for some countries, including Bosnia and Herzegovina. From Table 3.4, we can see significant progress in the use of the Internet, i.e. approximately 70% of the population uses Internet.

The analysis mentioned above is the only one that has been done so far, where the results from the whole of Bosnia and Herzegovina are used as a sample. After this analysis, the only relevant data available and which can contribute to this report are the data of the Statistical Office of the Federation of Bosnia and Herzegovina. Table 3.5 shows the state of equipment of primary schools with computer equipment.

Table 3.4 Internet stats and Facebook usage in March 2017 in Europe (Internet World Stats 2019)

Internet Stats and Facebook Usage in Europe
March 2017 Statistics

Europe	Population (2017 Est.)	Internet users, Mar 31, 2017	Penetration (% Population)	Users % in Europe	Facebook June 30, 2016
Albania	2,911,428	1,823,233	62.6	0.3	1,400,000
Andorra	68,728	66,728	97.1	0.0	42,000
Austria	8,592,400	7,135,168	83.0	1.1	3,600,000
Belarus	9,458,535	5,786,572	61.2	0.9	840,000
Belgium	11,443,830	10,060,745	87.9	1.6	6,500,000
Bosnia–Herzegovina	3,792,759	2,628,846	69.3	0.4	1,500,000
Bulgaria	7,045,259	4,155,050	59.0	0.7	3,300,000
Croatia	4,209,815	3,133,485	74.4	0.5	1,800,000
Cyprus	1,187,575	844,680	71.1	0.1	800,000
Czech Republic	10,555,130	9,323,428	88.3	1.5	4,600,000
Denmark	5,711,837	5,479,054	95.9	0.9	3,700,000
Estonia	1,305,755	1,196,521	91.6	0.2	620,000
Faroe Islands	48,335	47,515	98.3	0.0	33,000
Finland	5,541,274	5,107,402	92.2	0.8r	2,7000,000

Table 3.5 Statistical data for computers in education of Federation Bosnia and Herzegovina (According to Institute of Statistics of FBIH 2018)

Equipment for computers	11,734
With Internet access	8378
For schools' administration	3454
For schools' administration with Internet access	2806
For students	8280
For students with Internet access	5572
Number of students on one PC	1582

3.3.2 Informational Technology Assist Teaching

Depending on the intensity and method of using ICT in education, the following forms of e-learning are distinguished:

- classical classes—classes in a classroom where only a teacher uses a computer, where lessons are followed with computer presentation of educational content (f2f—face to face);
- ICT-supported teaching and learning—most often in computer classrooms, where the teacher uses the electronic board and computer screens in front the students, teaches for exams, assigns tasks, supervises and helps pupils via a computer network;
- hybrid or mixed instruction (hybrid, mixed mode or blended learning)—in part;
- takes place in a real classroom, and in part students take part in classes "from home" by learning from educational materials distributed to the computer network—it is also called virtual classroom;
- online classes or so-called pure e-learning (fully online)—ICT is taught entirely organized at a distance; takes place exclusively through electronic technology, computer and other telecommunication networks, computers, mobile phones, etc.

A typical e-learning system that students and pupils use in BiH is a web application that users access through a web browser on their computers. Users can access the e-learning system from any computer as long as they have access to the Internet. It's common that such systems are installed on the web servers located in a school, faculty or, in turn, at another organization. Systems provide the opportunities to create e-learning courses that provide them to place sharing materials, online discussions, quiz solutions, homework assignment tasks and the like. Of the current e-learning systems, Learning Management System (LMS) and Learning Content Management System (LCMS) are most commonly used. While LMS systems handle processes in the learning environment, LCMS systems handle the processes of creating and delivering content learning, i.e. combine the administrative and business dimension of traditional LMSs. Some of the most used e-learning systems in BiH are Moodle and Claroline.

All types of previously mentioned classes of teaching are actively applied in BiH as well in all educational institutions.

Some of the educational institutions in BiH that use the Moodle platform are listed below:

Banja Luka College (https://e-nastava.blc.edu.ba/login/index.php)

- Faculty of Philosophy in Sarajevo (http://biser.ff.unsa.ba/);
- Faculty of Economics in Sarajevo (https://enastava.efsa.unsa.ba/login/index.php);
- Primary school "Suljo Čilić" in Jablanica (http://suljocilicdl.com/);
- Faculty of Electrical Engineering in Banja Luka (https://el.etfbl.net/login/index.php);
- An interactive portal for the education of children in the diaspora (https://www.dopunskanastava.mcp.gov.ba/?redirect=0);

- Faculty of Mechanical Engineering in Zenica (http://mf.unze.ba/moodle/login/index.php), Secondary Electrotechnical school in Tuzla (http://www.etsedu.org/moodle/login/index.php);
- Full list of all registered instances that use Moodle is on the link.[10]

Some of the projects implemented in BiH that contribute to ICT development are listed below.

The Ministry of Education and Culture of RS, in cooperation with the company “Lanaco”, launched the program of computerization of primary and secondary schools. The goal is that each student has access to the Internet. Depending on the number of students, each school will receive a certain number of IT cabinets. On 300 students, an IT cabinet with 16 computers, a printer, and Internet connection is planned. Teaching would be conducted with multimedia contents. Electronic diaries will be introduced in the school.

The Ministry of Education and Culture of Republic of Srpska started the third phase of the “Dositej” project in August 2018, within which the remaining 62 elementary schools will be equipped with e-learning classrooms, thus creating the conditions for teaching in all primary schools in the Republic of Srpska in the most modern way. Project implies[11]

- Procurement of 7100 PCs (for pupils) and 560 laptops (for teachers), which will be deployed in 45 schools in Republic of Srpska;
- Equipping 284 classrooms (electrical installations, space for storing and charging computers, network equipment and infrastructure, and setting up PCs);
- This means that each of these classrooms, intended for e-learning, will have 25 PCs;
- Teacher training (learning about twenty-first century learning, PCs and working with “eLearning Class” software).

The Ministry of Education and Culture of the Republic of Srpska in cooperation with the British Council in August 2018 launched the “School for the twenty-first Century in the Western Balkans” program. This program will be implemented in 15 primary schools in the Republic of Srpska in order to improve the critical-thinking skills in solving problems and increasing digital literacy among teachers and students through teaching and extracurricular activities. The program implies the division of certain computers into these primary schools in Republika Srpska.

The Government of the District of Brčko, in January 2008, adopted the Internal Policy for the Development of the Information Society of the Brčko District of BiH. It is a basic and framework document for the development of the information society of the District of Brčko. Based on this document in the further development and construction of the information society, it will be possible to adopt laws, regulations,

[10]Registered Moodle sites, Moodle.net. https://moodle.net/sites/index.php?country=BA. Accessed 24 Apr 2019.

[11]*Obuka nastavnika i IT administratora.* LANACO Informacione tehnologije d.o.o 2012. Available via http://stanojeviczeljko.rs.ba/literatura/DositejObukaFaza1.pdf. Accessed March 2019 (Online document).

as well as to plan the strategy and activities of further development. The Brčko District of BiH will, by accelerated use of modern information and communication technologies, build a modern economy and society in which information, knowledge and human resources are vital.

EuroClio HIP BIH has designed the project "Improving the Key Competencies of Teachers in the Tuzla Canton area" through training on the use of ICT tools in the teaching of history that was realized in March and April 2017 in cooperation with the Ministry of Science, Education, Culture and Sports of the Tuzla Canton and the Pedagogical Institute of the Tuzla Canton. The project is supported by the Federal Ministry of Education and Science. The goal of the project is to train history teachers for the use of ICT technologies in the teaching of history, and to enhance competencies in using historical sources in active learning methods. For this purpose, EuroClio HIP BIH organized two one-day training seminars for groups of 25 teachers from the Tuzla Canton area. Each of the training parts of the lecture is designed, and the active part in which the participants will work on the creation of one lesson using electronic resources, tools and web applications, photographs, films, historical maps and other materials can be used in the teaching of history.

The application of ICT in education and training is usually determined by the content of student and computer communication, so it can globally be learning about computer, learning from computer, and learning with computer. The education system in BiH is predominantly retained on the modality of learning about the computer. The other two forms: learning from computer and learning with computer are still little explored and applied in the BiH education system.

3.4 Policy and Strategy of ICT

The education as well as ICT in Bosnia and Herzegovina is largely financed by public funds of the entities, cantons, District of Brčko and the municipal budgets, depending on the jurisdiction. This means that, in terms of location, Bosnia and Herzegovina has thirteen separate budgets for education: two at entity level, one in District of Brčko and ten cantonal budgets. There is still no strategy for the development of information communication technologies in society as well as in education. Investment in the ICT sector in education is also not clearly defined. Most projects contributing to the development of the ICT are individual, financed by the work of local ministries or private institutions. Considering that Bosnia and Herzegovina is not a member of the European Union, there are also no ways to obtain funding for the development of education from EU funds.

The Agency for Information Society of the Republic of Srpska (AIDRS) is the institution responsible for monitoring the development of the information society and promotion of the use of information and communication technologies. AIDRS has a wide range of responsibilities. Among them, these two are connected with ICT in education:

- Promoting the information society within the educational system reform and coordination of the implementation of state projects related to the participation of ICT in the educational process;
- Accreditation of educational and testing centers, in cooperation with the Ministry of Education and Culture of the Republic of Srpska, which enable the certification of citizens in the ICT field through the form of post-education and lifelong learning.

Below are some of the projects financed by ministries in the field of ICT in education.

Information Management System in Education (EMIS) was developed for the needs of the Ministry of Education and Culture of RS and primary and secondary schools (at the same time, it was implemented for the territory of the Federation of BiH). This software system enables the creation of an aggregated database, at the ministry level, from detailed school databases and the formation of numerous reports (statistical and/or financial) by various criteria: database on students, departments, employees, space and inventory, and finances. The goal of EMIS is to improve the system of information, planning and financing of education, which encourages more efficient and effective management of educational resources.

E-diary (application made on Microsoft Platforms, using Microsoft tools) is modularly organized for parents, professors, school administrator and ministry administrator. The application allows parents to see the grades and absences of students, and only the Ministry through this application has the ability to view the summary reports that are necessary for the implementation of the educational process.

Strategic Partnership Agreement between the Government of Republic of Srpska and Microsoft BiH, within which 1300 keys for academic licenses were granted free of charge to higher education institutions, primary and secondary schools by Microsoft, legalizes Microsoft software in educational institutions.

The project "Video Conference", in which eight primary schools, in the Ministry of Education and Culture of Republic of Srpska and Pedagogical Institute installed equipment that enables audio-video communication of all ten locations at the same time. When selecting schools, it was taken care that the entire territory of the RS was covered geographically.

IT training, aimed at raising the level of IT knowledge for 11,000 workers (teaching and extracurricular staff) in elementary and secondary schools in Republic of Srpska (training and testing), were completed by the end of May of the school year 2010/2011. The training program is based on the use of the MS Office package, and the use of the Internet and e-mail as part of the educational process.

Chapter 4
Report on ICT in Education in the Republic of Bulgaria

Siyka Chavarova-Kostova

4.1 Overview of the Country

4.1.1 History and Geography[1]

Bulgaria is a country in the South-Eastern part of the European continent, on the Balkan Peninsula. The eastern part of the country borders is on the Black Sea. Bulgaria borders are with Romania to the north, with Turkey and Greece to the south and with Serbia and North Macedonia to the west. Bulgaria is a member of the European Union since 2007, a member of NATO since 2004 and a member of the Council of Europe since 1991.

There are some data for the first inhabitants on the territory of contemporary Bulgaria "since the earliest historical times—the Stone Age and the Copper-stone Age". In Bulgaria was discovered "the oldest golden treasure in the world, discovered near Varna". Thracians who lived here during the Bronze Age left "a rich cultural heritage—tombs, temples and treasures. It is believed that the mythical Thracian singer Orpheus lived in the Rhodope Mountains".

The architectural view of these lands was changed since the late first century AD when they "became part of the territory of the Roman Empire, a large-scale construction began; new towns appeared in place of the old Thracian settlements". Nowadays "many architectural and archeological monuments from this period are preserved"—ancient Roman theaters, stadiums, and ruins of the towns. The period after the Roman Empire is related to status of these lands in the frame of the Byzantine Empire.

[1]Data is mainly from A brief history of Bulgaria. http://bulgariatravel.org/data/doc/ENG_49-Istoria_na_Bulgaria.pdf. Accessed April 2, 2019.

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Bulgaria as a state was founded in 681 under the leadership of Khan Asparuh. The first Bulgarian capital was Pliska—in the northern-east part of the contemporary Bulgarian territory. Christianity was adopted as the official religion of Bulgaria in 864. It is assumed that this is the beginning of the construction of the "unified Bulgarian nation" on the base of the "unified Bulgarian nation" as a collection from Proto-Bulgarians and Slavs—the main ethnic groups that created the new nation.

At the end of the IX century, the Slavic/Cyrillic alphabet was created and was disseminated from the brothers Cyril (Constantine the Philosopher) and Methodius. After, "the Cyrillic alphabet spread from Bulgaria to other Slavic countries such as Serbia and Russia".

Bulgaria had lost its independence in 1018 after wars with Byzantium. The Second Bulgarian Kingdom was founded in 1186 and the town Tarnovo became its capital city.

In the period between 1396 and 1878, Bulgaria was in the frame of the Ottoman Empire. The restoration of the Bulgarian state was in 1878 after the war between Russia and Turkey.

After the Berlin Congress (1878), Bulgaria was divided into Principality of Bulgaria and Eastern Rumelia with a governor appointed by the Sultan. In the next year—1879—the first Constitution of Bulgaria was created. 1885 was the year of the unification of the Principality of Bulgaria and Eastern Rumelia and September 6 is "the day of the Bulgarian unification". The full independence from Turkey was proclaimed in 1908 and it was the beginning of the Third Bulgarian Kingdom.

After the Second World War, in 1946 Bulgaria changed its status from monarchy to Republic. At the end of 1989 new political changes started and the constitution was changed.

4.1.2 The Population Situation[2]

The official data from the last census in Bulgaria (in 2011) shows that "the population of Bulgaria is 7,364,570. 3,777,999 people are women (51.3%) and 3,586,571 people are men (48.7%)".

More people live in urban areas—5,339,001 person (72.5%); and 2,025,569 person live in rural areas (27.5%).

Bulgarian population lives in 255 cities and 5,047 villages. 17.5% of the population lives in the district of Sofia capital—1,291,591 persons. 33.6% of the population "lives in the seven biggest cities, where the population is over 100,000". "62.2% of the population in the country is at working age, i.e. 4,576,904 persons. 52.5% of them are men and 47.5% are women. The bigger share of the population at working age lives in the urban areas—75.8%, and 24.2% in rural."

[2]Data is mainly from 32. 2011 Population Census—main results, Nazionalen statisticheski institut, Republika Balgaria (National Statistic Institute. Republic of Bulgaria). http://www.nsi.bg/census2011/PDOCS2/Census2011final_en.pdf. Accessed April 3, 2019.

The ethnic structure—the biggest is the Bulgarian ethnic group—has 5,664,624 persons (84.8% of the population). The second is the Turkish ethnic group—588,318 (8.8%); the third is the Roma ethnic group—325,343 (4.9%).

Religions—the religious denomination is a question on which the share of non-responded persons is 21.8%, the Eastern Orthodox—76%, Catholics—0.8%, Protestants—1.1%, Moslems—10%. The data is from the person who has responded to this question.

4.1.3 The Political System[3]

Bulgaria is a republic. The political system of Bulgaria is based on the Constitution from 1991. According to the Constitution, Bulgaria is "a republic with a parliamentary form of government". "The power of the State" is "divided between legislative, executive and judicial branches". "Political pluralism" is the main principle for the "political activity in the Republic of Bulgaria". The National Assembly is built on the base of election "for a term of four years".

The head of the State is the President that "shall embody the unity of the nation and shall represent the State in its international relations". The President is "elected directly by the voters for a period of five years".

The main responsibility to "direct and conduct State's domestic and foreign policy in accordance with the Constitution and the laws" is of the Council of Ministers that "shall ensure the public order and national security and shall exercise overall guidance over the state administration and the Armed Forces". The head of the Council of Ministers is the Prime Minister that "shall head, coordinate and bear responsibility for the overall policy of the government" and "shall appoint and remove the deputy ministers".

4.1.4 The Current Situation of Economic Development

The Ministry of Economy is responsible for the economic development of Bulgaria. "The main mission of the Ministry of Economy is to develop and carry out clear and transparent economic policy that protects the national and public interest and is based on the European principles. ME is working to create a competitive low-carbon economy, which will guarantee growth and development of Bulgaria. Among our tasks are also the promotion and acceleration of investments, innovations and competitiveness." The Strategic Goals of the Ministry of Economy are:

[3]CONSTITUTION OF THE REPUBLIC OF BULGARIA PROM. SG 56/13 JUL 1991, AMEND. SG 85/26 SEP 2003, SG 18/25 FEB 2005, SG 27/31 MAR 2006, SG 78/26 SEP 2006—CONSTITUTIONAL COURT JUDGMENT NO.7/2006, SG 12/6 FEB 2007, National Assembly of the Republic of Bulgaria. https://www.parliament.bg/en/const. Accessed 3 Apr 2019

- "Convert Bulgaria into an attractive long-term investment destination;
- Protection of consumers' interests;
- Convert Bulgaria into a front door for goods and investments from East Asia and China into the European Union;
- Fostering investment in priority sectors that create high value addition and increase the overall competitiveness of the economy;
- Improving the competitiveness of the Bulgarian companies by implementing an effective regulatory framework, low taxes, built and well-developed transport and energy infrastructure, encouraging the export and increasing the amount of the investments in research and development;
- Support the business through financial resources from the Operational Program "Competitiveness" in full compliance with the principles of transparent and effective funds management."[4]

Current situation of economic development of Bulgaria could be presented by data from the National Statistical Institute: "In the fourth quarter of 2018 GDP at current prices amounted to 29,813 million BGN. In Euro terms GDP reaches 15,243 million EUR in total and 2,168 EUR per person. According to the seasonally adjusted figures, the GDP growth rate in the fourth quarter of 2018 is 3.2% compared to the same quarter of the previous year and 0.8% compared to the third quarter of 2018. In 2018 GDP at current prices amounts to 107,925 million BGN. In EUR terms GDP is 55,181 million EUR or 7829 EUR per person. GDP for 2018 increases in real terms by 3.1% compared to 2017."[5]

4.1.5 The Status Quo of Science and Technologies

The development of science and technologies is determined from the development of the higher education institution and scientific organizations that are accredited from the National Evaluation and Accreditation agency.

Procedures for the program accreditation of professional fields and doctoral programs are based of the Classifier of higher education areas and professional fields. There are 9 areas with different numbers of professional fields:

1. Pedagogic sciences;
2. Humanities;
3. Social and economic sciences and law;
4. Natural sciences, Mathematics and Informatics;
5. Technical sciences;

[4]Mission and goals, Ministry of Economy, Republic of Bulgaria. https://www.mi.government.bg/en/pages/mission-6.html. Accessed April 4, 2019.

[5]Gross domestic product for the fourth quarter of 2018 and 2018 (preliminary data). National Statistical Institute. http://www.nsi.bg/sites/default/files/files/pressreleases/GDP2018q4_en_HDRSIJD.pdf. Accessed April 21, 2019.

6. Agrarian sciences and veterinary medicine;
7. Heath care and sport;
8. Arts;
9. Security and defense.[6]

The development of science depends on the expenditures for research and development as a percentage of the GDP. The next data illustrate the increase of the investment in research and development from 2000.

EU target: 3.0% of the GDP to be invested in R&D
National target: 1.5% of the GDP to be invested in R&D

R&D Expenditure as a Percentage of GDP

	2000	2001	2002	2003	2004	2005	2006	2007	2008
EU (28)	1.77	1.79	1.79	1.79	1.75	1.74	1.76	1.77	1.83
Bulgaria	0.50	0.45	0.47	0.48	0.47	0.45	0.45	0.43	0.45

2009	2010	2011	2012	2013	2014	2015	2016	2017[a]	2020
1.93	1.92	1.97	2.00	2.02	2.03	2.04	2.04	2.07	3.00
0.49	0.56	0.53	0.60	0.64	0.79	0.96	0.78	0.75	1.50

[a]Preliminary data
Source For EU (28)—Eurostat
Source For Bulgaria—NSI, Statistical survey on research and development activity (R&D)

"Definition: The indicator is defined as the percentage share of Gross domestic expenditure on research and experimental development (R&D) in GDP.

Research and experimental development (R&D) comprise creative and systematic work undertaken in order to increase the stock of knowledge—including knowledge of humankind, culture and society—and to devise new applications of available knowledge. R&D activity covers basic research, applied research and experimental development.

The indicator 'R&D expenditure' is defined as all expenditures for R&D performed within a statistical unit, whatever the source of funds. Total intramural R&D expenditure (GERD) comprises current costs and capital expenditure on R&D." (National Statistical Institute, 2020)

[6]https://neaa.government.bg/images/Legislation/Decrees/DECREE-No_125-of-the-Council-of-inisters-of-24-June-2002.pdf. Accessed April 3, 2019.

4.1.6 *The Status Quo of Social and Cultural Development*

The social and cultural development of Bulgaria are regulated from the Ministry of Labor and Social Policy and the Ministry of Culture.

Main policy areas of the Ministry of Labor and Social Policy are “Labor, Employment, Pensions, Working abroad, Children and family, Social inclusion, Social assistance, Social services, Persons with disabilities, Demographic policy, Equal opportunities, International activities, Public consultations”.[7]

Data from “Labour force survey 2018, Main results” of the National statistical institute show that:

- “In 2018, the number of **economically active population aged 15–64** was 3239.6 thousand and represented 71.5% of population in the same age group.
- The **total number of employed persons** was 3152.7 thousand, representing 52.4% of population aged 15 and over. Of them 1685.3 thousand (53.5%) were men and 1467.3 thousand (46.5%) were women.
- There were 3068.9 thousand **employed persons aged 15–64**. **The employment rate for the same age group** was 67.7% (71.5% for men and 63.9% for women).
- **The employment rate for the age group 20–64 years** was 72.4%, by 1.1 percentage points higher compared to 2017. The employment rate (20–64 years) increased by 1.2 percentage points for men and by 1.0 percentage point for women, achieving 76.5% and 68.3% respectively.”[8]

The directorates of the Ministry of Culture that reflect main topics of the official Bulgarian policy regarding cultural development are “Theaters, Music Hall and Circus Arts; Music and Dance; Cultural Heritage, Museums and Arts; Inspectorate for Protection of Cultural Heritage”. (National Statistical Institute, 2020)

Some data from the National statistical institute illustrate results reflected development of some areas of the cultural activity in Bulgaria in the last years.

Theaters[a]						
	2012	2013	2014	2015	2016	2017
Theaters—number	74	75	72	75	75	74
Dramatic	38	36	35	37	36	35
Opera and ballet	7	7	7	7	7	7
Operetta	2	2	2	2	2	2
Puppet	21	24	22	22	23	23
Dramatic-puppet	6	6	6	7	7	7
Capacity—number	28,530	29,034	27,219	29,970	29,090	29,370

(continued)

[7]Ministry of Labor and Social Policy, The Republic of Bulgaria. https://www.mlsp.government.bg/index.php?section=HOMEN2&lang=_eng. Accessed April 2019.

[8]Labour force survey 2018, Main results. National Statistical Institute. http://nsi.bg/sites/default/files/files/pressreleases/LFS2018_en_TN8WI1W.pdf. Accessed April 21, 2019.

(continued)

Theaters[a]						
	2012	2013	2014	2015	2016	2017
Dramatic	16,016	15,365	14,048	17,102	16,061	16,780
Opera and ballet	4401	5643	4442	4340	4430	4405
Operetta	1460	1457	1573	1573	1535	1540
Puppet	2925	2955	3490	3279	3369	2950
Dramatic-puppet	3728	3614	3666	3676	3695	3695
Theater performances—number	13,267	14,463	14,694	14,168	15,162	15,333
Dramatic	5970	5988	5964	5637	6110	6146
Opera and ballet	703	927	1076	1101	1130	1122
Operetta	236	269	281	255	390	365
Puppet	4760	5875	5841	5313	5545	5774
Dramatic-puppet	1598	1404	1532	1862	1987	1926
Average number of performances per theater—number	179	193	204	189	202	207
Staging—number	1470	1636	1559	1620	1646	1743
of which: new	399	366	352	347	331	366
Theater attendance—thousands	1922	2178	2302	2169	2295	2222
Dramatic	1070	1154	1160	1060	1196	1137
Opera and ballet	220	259	337	354	332	307
Operetta	72	90	88	66	86	94
Puppet	363	464	479	424	426	426
Dramatic-puppet	197	210	237	264	256	258
Average number of attendances						
Per theater—thousands	26	29	32	29	31	30
Per performance—number	145	150	157	153	151	145

[a]Theatres. National Statistical Institute. http://nsi.bg/en/content/4645/theaters.Accessed 21 Apr 2019

Music and dance formations						
						(Number)
	2012	2013	2014	2015	2016	2017
Music and dance formations	59	58	59	56	58	54
Performances	2665	2061	2267	2531	2334	2342
Per formation	45	36	38	45	40	43
Attendances	979,044	671,263	735,110	782,310	756,109	781,513
Per performance	367	326	324	309	324	334

[a]Philharmonic orchestras; Ensembles for folk songs and dances; Orchestras (Music and dance formations in 2017. National Statistical Institute. http://nsi.bg/en/content/4647/music-and-dance-formations. Accessed April 21, 2019)

Libraries by type in 2017[a]

Type of library	Libraries—number	Library collection—in thousands		Readers in thousands	Library collection loaned—in thousands	
		Total	Of which: books		Total	Of which: books
Total	47	34,054	18,895	248	6233	4349
National Library 'St. St. Cyril and Methodius'	1	8121	1818	9	359	57
Non-specialized libraries of a learned character	26	11,819	10,038	134	3584	2821
Public libraries	4	1019	955	10	260	185
Libraries at institutions of higher education	12	6600	4639	86	1738	1221
Special libraries	4	6495	1445	9	292	64

[a]Libraries by type in 2017. National Statistical Institute. http://nsi.bg/en/content/4593/libraries-type. Accessed April 21, 2019

4.1.7 *The Relationship with China Under the "16+1" Cooperation Framework*

In July 2018, the 7th Summit "16+1" was held in Sofia. Leaders of the countries from Central and Eastern Europe and China, and hundreds of businessmen participated. The main theme of the plenary meeting was "Keeping open and pragmatic cooperation for inclusive prosperity".[9]

In October 2018, in Sofia, the 4th meeting of local leader under the "16+1" initiative was held by the Ministry of the Bulgarian Presidency of the Council of the European Union and the Head of the Region of Sofia. The Prime Minister Boyko Borissov opened the forum "where representatives of local authorities and more than 300 representatives of businesses from China, Bulgaria and countries from Central and Eastern Europe were present".[10]

[9]Sreshta na varha "16+1" v Sofia. DarikNews. (Summit meeting '16+1" in Sofia) https://dariknews.bg/novini/bylgariia/sreshta-na-vyrha-161-v-sofiia-2107973. Accessed April 4, 2019.

[10]For the first semester of 2018 the trade with China has increased by 22% in comparison to the same period of 2017 and exceeds 1.135 billion USD, Ministry of Economy, Republic of Bulgaria. https://www.mi.government.bg/en/news/for-the-first-semester-of-2018-the-trade-with-china-has-increased-by-22-in-comparison-to-the-same-p-3573.html. Accessed April 4, 2019.

4.2 Overview of the Educational Development

4.2.1 Education System and Policy

Bulgarian education system is based on the new Preschool and School Education Act that regulates the foundations of its structure and function. The Act defines the principles, objectives of the preschool and school education, state education standard, basic educational institutions, the status of children and pupils, parents, teachers, directors and other pedagogical staff, management structure, public councils, quality management, financing and property, etc.[11]

4.2.2 Students and Teachers' Profiles

Data from the National Statistical Institute of the Republic of Bulgaria presents a detailed picture of the number of pupils and students by level in the Bulgarian educational system.

Pupils and Students By Level of International Standard Classification of Education (ISCED 2011)

	(Number)
	2017/18[a]
Total	1,210,704
Pre-primary education (ISCED-0)	220,877
Primary education (I–IV grade, ISCED-1)	262,735
Lower secondary and Upper secondary education (V–VII and VIII–XII grade, ISCED-2, 3)[b]	466,794
Vocational training for adults—first-level professional qualification (ISCED-2)	10,369
Vocational training for adults—second-level professional qualification (ISCED-3)	6313
Vocational training for adults—third-level professional qualification (ISCED-3)	6189
Post-secondary non-tertiary education (ISCED-4)	1047
Vocational training for adults—fourth-level professional qualification (ISCED-4)	45
Tertiary education (ISCED-6, 7, 8)	236,335
Educational-qualification degree 'Professional bachelor' (ISCED-6)	8527
Educational-qualification degree 'Bachelor' (ISCED-6)	146,564
Educational-qualification degree 'Master' (ISCED-7)	74,680
Educational and scientific degree 'Doctor' (ISCED-8)	6,564

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[11]Zakon za preduchilishtnoto I uchiishtnoto obrazovanie. (Preschool and school education Act.) http://www.mon.bg/upload/12190/zkn/PUO/br_180717. Accessed April 3, 2019.

(continued)

	(Number)
Of which in private	**64,117**
Pre-primary education (ISCED-0)	4007
Primary education (I-IV grade, ISCED-1)	3885
Lower secondary and Upper secondary education (V–VII and VIII–XII grade, ISCED-2, 3)[b]	5901
Vocational training for adults—first-level professional qualification (ISCED-2)	8513
Vocational training for adults—second-level professional qualification (ISCED-3)	5598
Vocational training for adults—third-level professional qualification (ISCED-3)	5181
Post-secondary non-tertiary education (ISCED-4)	611
Vocational training for adults—fourth-level professional qualification (ISCED-4)	45
Tertiary education (ISCED-6, 7, 8)	30,376
Educational-qualification degree ‘Professional bachelor’ (ISCED-6)	1622
Educational-qualification degree ‘Bachelor’ (ISCED-6)	20,335
Educational-qualification degree ‘Master’ (ISCED-7)	8126
Educational and scientific degree ‘Doctor’ (ISCED-8)	293
	(Number)
	2017/18 1
Total	1,210,704
Pre-primary education (ISCED-0)	220,877
Primary education (I–IV grade, ISCED-1)	262,735
Lower secondary and Upper secondary education (V–VII and VIII–XII grade, ISCED-2, 3)[b]	466,794
Vocational training for adults—first-level professional qualification (ISCED-2)	10,369
Vocational training for adults—second-level professional qualification (ISCED-3)	6313
Vocational training for adults—third-level professional qualification (ISCED-3)	6189
Post-secondary non-tertiary education (ISCED-4)	1047
Vocational training for adults—fourth-level professional qualification (ISCED-4)	45
Tertiary education (ISCED-6, 7, 8)	236,335
Educational-qualification degree ‘Professional bachelor’ (ISCED-6)	8527
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Educational and scientific degree ‘Doctor’ (ISCED-8)	6,564
Of which in private	**64,117**
Pre-primary education (ISCED-0)	4007
Primary education (I–IV grade, ISCED-1)	3885
Lower secondary and Upper secondary education (V–VII and VIII–XII grade, ISCED-2, 3)[b]	5901
Vocational training for adults—first-level professional qualification (ISCED-2)	8513

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	(Number)
Vocational training for adults—second-level professional qualification (ISCED-3)	5598
Vocational training for adults—third-level professional qualification (ISCED-3)	5181
Post-secondary non-tertiary education (ISCED-4)	611
Vocational training for adults—fourth-level professional qualification (ISCED-4)	45
Tertiary education (ISCED-6, 7, 8)	30,376
Educational-qualification degree 'Professional bachelor' (ISCED-6)	1622
Educational-qualification degree 'Bachelor' (ISCED-6)	20,335
Educational-qualification degree 'Master' (ISCED-7)	8126
Educational and scientific degree 'Doctor' (ISCED-8)	293

[a]Break in the time series due to changes in the national education system (Pre-school and School Education Act, promulgated SG No.79 of 13 October 2015). The data are not comparable to the previous school years
[b]The data on secondary education are presented combined, because additional classification of educational programmes to levels of ISCED 2011 is needed". (Pupils and students by level of International Standard Classification of Education (ISCED 2011), National Statistical Institute, Republic of Bulgaria. http://www.nsi.bg/en/content/4790/pupils-and-students-level-international-standart-classification-education-isced-2011. Acceded April 5, 2019)

Detailed data from the National Statistical Institute of the Republic of Bulgaria shows the number of teachers by level in the Bulgarian educational system.

Teaching staff by level of international standard classification of education (ISCED 2011)	(Number)
	2017/18[a]
Total	104,374
Pre-primary education (ISCED-0)	19,617
Primary education (I–IV grade, ISCED-1)	19,412
Lower secondary and Upper secondary education (V–VII and VIII–XII grade, ISCED-2, 3)[b]	43,205
Post-secondary non-tertiary education (ISCED-4)	226
Tertiary education (ISCED-6, 7)	21,914
Education in colleges (ISCED-6)	707
Education in universities and equivalent higher schools (ISCED-6, 7)	21,207
Of Which In Private	
Total	4849
Pre-primary education (ISCED-0)	596
Primary education (I–IV grade, ISCED-1)	454
Lower secondary and Upper secondary education (V–VII and VIII–XII grade, ISCED-2, 3)[b]	1325
Post-secondary non-tertiary education (ISCED-4)	197

(continued)

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Teaching staff by level of international standard classification of education (ISCED 2011)	(Number)
Tertiary education (ISCED-6, 7)	2277
Education in colleges (ISCED-6)	2171
Education in universities and equivalent higher schools (ISCED-6, 7)	106

[a]Break in the time series due to changes in the national education system (Pre-school and School Education Act, promulgated SG No. 79 of 13 October 2015). The data are not comparable to the previous school years
[b]The data on secondary education are presented combined, because additional classification of educational programmes to levels of ISCED 2011 is needed

Data from the National Statistical Institute also shows the development of the teaching staff by level in Bulgarian educational system.

Teaching staff by level of international standard classification of education (ISCED 2011)					
					(Number)
	2012/13	2013/14	2014/15	2015/16	2016/17
Total	102,488	101,828	102,799	101,294	102,335
Pre-primary education (ISCED-0)	20,015	20,269	20,542	20,420	19,909
Primary education (I–IV grade, ISCED-1)	14,565	14,767	14,940	15,050	17,564
Lower secondary education (V–VIII grade, ISCED-2)	19,315	19,277	19,179	19,125	19,517
Upper secondary education (IX–XII grade, ISCED-3)	24,684	24,121	23,968	23,735	22,817
Post-secondary non-tertiary education (ISCED-4)	453	382	427	360	305
Tertiary education (ISCED-6, 7)	23,456	23,012	23,743	22,604	22,223
Education in colleges (ISCED-6)	1091	1070	1018	725	768
Education in universities and equivalent higher schools (ISCED-6, 7)	22,365	21,942	22,725	21,879	21,455
Of which in private					
Total	5519	5089	5276	4919	5006
Pre-primary education (ISCED-0)	373	424	500	516	572
Primary education (I–IV grade, ISCED-1)	256	277	277	354	430
Lower secondary education (V–VIII grade, ISCED-2)	458	450	456	488	523
Upper secondary education (IX–XII grade, ISCED-3)	1005	894	930	849	815
Post-secondary non-tertiary education (ISCED-4)	409	347	395	330	274

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Teaching staff by level of international standard classification of education (ISCED 2011)					
					(Number)
Tertiary education (ISCED-6, 7)	3018	2697	2718	2382	2392
Education in colleges (ISCED-6)	363	340	353	125[a]	128
Education in universities and equivalent higher schools (ISCED-6, 7)	2655	2357	2365	2257	2264

[a]The number of teaching staff decreased due to the conversion of three independent private colleges into universities (Teaching staff by level of International Standard Classification of Education (ISCED 2011), National Statistical Institute, Republic of Bulgaria. http://www.nsi.bg/en/content/4784/teaching-staff-level-international-standart-classification-education-isced-2011. Accessed April 5, 2019.)

4.2.3 *Government Expenditure on Education*

Data published on the website of the National Statistical institute on April 27, 2018 shows the development of the expenditure on education.

Public and private expenditure by educational levels[a]				
				(Thousand levels)
	2012	2013	2014	2015
Total public and private expenditure	3,200,843	3,472,828	3,759,602	3,704,137
Pre-primary education	651,933	729,089	764,802	743,844
Primary education (I–IV grade)	439,976	486,381	521,815	519,655
Lower secondary education (V–VIII grade)	473,807	514,468	547,258	545,652
Upper secondary education (IX–XII grade)	630,965	652,594	690,718	679,526
Post-secondary, non-tertiary education	10,396	23,694	16,748	15,440
Tertiary education—Professional Bachelor	47,009	55,283	68,484	66,374
Tertiary education—Bachelor, Master and Doctor	946,757	1,011,319	1,149,777	1,133,646

[a]Public and private expenditures by level of educational, National Statistical Institute, Republic of Bulgaria. http://www.nsi.bg/en/content/4946/public-and-private-expenditures-level-education. Acceded April 4, 2019

4.2.4 Enrolment Rate and Retention Rate

Data published on the website of the National Statistical Institute on April 27, 2018 shows net enrolment rate of the Bulgarian population by levels of ISCED and by age groups.

Net enrolment rate of the population in the educational system	
	(Percent)
	2017/18[c]
Group net enrolment rates[a] by levels of ISCED 2011	
Pre-primary education (ISCED-0)	78.4
Primary education (I–IV grade, ISCED-1)	90.8
Lower secondary and Upper secondary education (V–VII and VIII–XII grade, ISCED-2, 3)[d]	82.6
Post-secondary non-tertiary education (ISCED-4)	0.1
Education in colleges (ISCED-6)	1.7
Education in universities and equivalent higher schools (ISCED-6, 7)	40.4
Net enrolment rates[b] of the population in the educational system by age groups	
3–6 years	79.8
7–10 years	92.8
11–13 years	91.3
14–18 years	82.8
19–23 years	44.0

[a]"Group rates are calculated in per cents of the number of enrollments by levels in age groups 3–6, 7–10, 11–18, 19–20, 19–21 and 19–23 years to the number of population in the same age groups
[b]Rate is calculated in per cents of the number of enrollments in corresponding age groups, independently of the educational level, to the number of population in the same age groups
[c]Break in the time series due to changes in the national education system (Pre-school and School Education Act, promulgated SG No. 79 of 13 October 2015). The data are not comparable to the previous school years
[d]The data on secondary education are presented combined, because additional classification of educational programmes to levels of ISCED 2011 is needed"

The next table shows the development by years before the new Preschool and School Education Act:

	2012/13	2013/14	2014/15	2015/16	2016/17
Group net enrolment rates[a] by levels of ISCED 2011					
Pre-primary education (ISCED-0)	82.1	83.6	82.9	81.0	79.4
Primary education (I–IV grade, ISCED-1)	95.3	95.5	94.8	93.2	92.1
Lower secondary education (V–VIII grade, ISCED-2)	81.0	79.7	78.6	78.3	78.2

(continued)

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	2012/13	2013/14	2014/15	2015/16	2016/17
Upper secondary education (IX–XIII grade, ISCED-3)	82.1	83.0	82.2	81.5	80.4
Post-secondary non-tertiary education (ISCED-4)	0.4	0.3	0.2	0.2	0.1
Education in colleges (ISCED-6)	2.1	2.1	2.1	1.8	1.8
Education in universities and equivalent higher schools (ISCED-6, 7)	38.2	39.0	39.5	40.0	40.0
Net enrolment rates[b] *of the population in the educational system by age groups*					
3–6 years	83.8	85.5	84.8	82.8	81.0
7–10 years	97.1	97.2	96.7	95.5	94.1
11–14 years	95.9	95.1	94.1	92.4	91.2
15–18 years	86.2	87.3	86.7	85.9	84.6
19–23 years	43.3	43.7	44.2	44.1	43.9

[a]Group rates are calculated in per cents of number of enrollments by levels in age groups 3–6, 7–10, 11–14, 15–18, 19–20, 19–21 and 19–23 years to number of population in the same age groups
[b]Rate is calculated in per cents of number of enrollments in corresponding age groups, independently of the educational level, to number of population in the same age groups (Net enrolment rate of the population in the educational system in 2017/2018 school year, National Statistical Institute, Republic of Bulgaria. http://www.nsi.bg/en/content/4786/net-enrolment-rate-population-educational-system. Acceded April 4, 2019.)

4.2.5 Education Research

In Bulgaria, there are 51 universities—state and private that are accredited from the National Evaluation and Accreditation Agency. Some of the universities prepare students in different areas with diversity of professional fields—Sofia University "St. Kliment Ohridski", Plovdiv University "Paisii Hilendarski", South-West University "Neofit Pilski", Blagoevgrad, St. Cyril and St. Methodius University of Veliko Tarnovo, etc. There are a number of technical universities—Technical University, Sofia, Technical University-Varna, Technical University-Gabrovo; and economics universities—University of National and World Economy, Sofia, "D. A. Tsenov" Academy of Economics-Svishtov, University of Economics-Varna, etc. Some medical universities also—Medical University-Sofia, Medical University-Pleven, Medical University-Plovdiv. There are some higher educational institutions in the area of arts—National Academy of Arts-Sofia, National Academy of Theatre and Film Arts "Krustyo Sarafov", National Academy of Music "Prof. Pancho Vladigerov", Sofia, Academy of Music, Dance and Fine Arts, Plovdiv, etc.; and security—Vasil Levski National Military University-Veliko Tarnovo, Academy of the Ministry of Interior-Sofia. Each higher educational institution has respective number of program accreditations on professional fields, Bachelor, Master degrees, or doctoral programs. Research activity of the higher educational institutions is an object of their evaluation.

In a number of scientific organizations, doctoral programs are accredited from the National Agency for Evaluation an Accreditation, in Bulgarian Academy of Sciences—Institute of Mathematics and Informatics, Institute of Mechanics, Institute of Oceanology—Varna, Institute of Molecular Biology “Academic Rumen Tsanev”, Institute of Biodiversity and Ecosystem Research, Agricultural Academy, Military Medical Academy, etc.[12]

The national “Research fund” gives a financial support of universities and scientific organizations that are aimed at

1. “The creation of new scientific knowledge;
2. Bulgarian history, language, culture and national identity;
3. Stimulating the development of the natural, technical, humanitarian and social sciences;
4. Solving problems in the field of economics, education, agriculture, ecology, social processes, human resources, security, defense and health”.[13]

4.2.6 Teachers’ Professional Development

The professional training of Bulgarian teachers is done in accredited from the National Agency for Evaluation and Accreditation of higher education institutions in Professional field 1.2. Pedagogy and 1.3. Pedagogy of teaching in…, in the frame of the Higher education area 1. Pedagogic sciences. Such training is realized in Sofia University “St. Kliment Ohridski”, Plovdiv University “Paisii Hilendarski”, South-West University “Neofit Pilski”—Blagoevgrad, St. Cyril and St. Methodius University of Veliko Tarnovo, University of Shumen “Konstantin Preslavski”, Trakia University—Stara Zagora, etc. The teachers’ education is realized in Bachelor, Master and Doctoral degrees.[14]

Main document that defines compulsory subjects in the teacher training in Bulgarian university system is the Ordinance for State Requirements for the Acquisition of Professional Qualification “teacher” (2016). The minimal number and names of compulsory subjects in the Ordinance are:

- Pedagogy—60 academic hours;
- Psychology—60 academic hours;
- Methodics of the training of …—90 academic hours;
- Inclusive education—15 academic hours;

[12]National Evaluation and Accreditation agency. https://neaa.government.bg/en/homeen. Accessed April 3, 2019.

[13]Fond Nauchni Izsledcvania (Research Fund). https://www.fni.bg/?q=node/18. Accessed April 5, 2019.

[14]National Evaluation and Accreditation agency. https://neaa.government.bg/en/homeen. Accessed April 3, 2019.

- ICT in education and working in a digital environment—30 academic hours.

Minimal number of academic hours for practical training is 180 (incl. observation, current pedagogical practice and internship practice).[15]

4.3 New Progress of ICT in Education

4.3.1 Infrastructure

According to a statement of the Minister of Education and Science K. Valchev in March, by the middle of 2019 all schools in Bulgaria "are expected to have built Wi-Fi networks with a secure network environment with funds from the Ministry of Education and Science" as "a part of the overall e-learning environment" plus "electronic learning resources".[16]

The ICT development indicators are presented in the Strategy for Effective Implementation of Information and Communication Technologies in Education and Science in the Republic of Bulgaria (2014–2020). They are very well visible in the next table.

Basic measurable indicators for the effective realization of the Strategy[17]

Indicators	Measurement unit	Basic[a] value	Goal value Stage 1	Goal value Stage 2	Goal value Stage 3
Regional Education Inspectorates included in a backbone high-speed network	%	0	100	100	100
Public universities connected with optical network to the backbone educational network	%	0	100	100	100
Science units connected with optical network to the backbone educational network	%	0	70	100	100

(continued)

[15]Naredba za darjavnite iziskvania za pridobivane na profesionalna kvalifikazia "uchitel". (Ordinance for State Requirements for the Acquisition of professional qualification "teacher"). https://mon.bg/bg/59. Accessed April 7, 2019.

[16]Ministar Balchev: Uchitelite triabva da spodeliat electronni urozi (Minister Valchev: Teachers should share electronic lessons). http://www.mon.bg/bg/news/3503. Accessed March 20, 2019.

[17]Strategy for Effective Implementation of Information and Communication Technologies in Education and Science in the Republic of Bulgaria (2014–2020). http://www.strategy.bg/StrategicDocuments/view.aspx?Id=904. Accessed March 31, 2019.

(continued)

Indicators	Measurement unit	Basic[a] value	Goal value Stage 1	Goal value Stage 2	Goal value Stage 3
Schools connected with optical network to the backbone educational network	%	0	10	45	60
Average speed of Internet access of public schools	Mb	30	45	80	100
Speed of the Bulgarian connectivity to the Pan European research network GÉANT	Gb	1	10	100	1 000
Public schools completely equipped with Wi-Fi connectivity	%	15	60	95	100
Schools covered by electronic platform for e-learning	%	0	100	100	100
Schools that have implemented technology for setting a virtual classroom	%	2	5	50	100
Schools that have implemented paperless document flow	%	0	2	85	100
Universities that have implemented paperless document flow	%	0	4	100	100
Science units that have implemented paperless document flow	%	0	3	95	100
Schools that have implemented a comprehensive information-management system	%	0	0	100	100
Universities that have implemented holistic information-management system	%	0	2	90	100
Teachers and scientists who use authentication services	%	20	45	90	100
Teachers with certificates for basic and advanced computer literacy	%	20	40	85	95

(continued)

(continued)

Indicators	Measurement unit	Basic[a] value	Goal value Stage 1	Goal value Stage 2	Goal value Stage 3
Teachers who took courses for sharing good pedagogical practices using ICT	%	5	15	90	95
Trained teachers for creation and use of digital content	%	15	45	80	100
Education content in school secured with digital handbooks	%	30	70	90	100
Video collections and educational movies, uploaded to educational portals of MES	number	50	300	2 000	4 000
Developed virtual panoramas for education needs	number	800	1 500	3 500	5 000
Multimedia education materials	number	2 500	5 000	20 000	50 000

[a]*Source* Ministry of Education and Science

Other indicators for ICT development in education in Bulgaria are defined in the **national program "Training for IT Career"**. In the national program, indicators for implementation—Indicative parameters for 2018–2019 school years are:

- "Functioning in partnership school–university–IT business 5 centers for software training;
- Number of trained teachers—minimum 30;
- Number of pupils enrolled in the training in 2018–2019 school year—minimum 200 for the first school year of the second class of students and minimum 150 for the second school year of the first class of students;
- Number of students successfully passed the test for the first stage of the program—minimum 150;
- Number of students successfully passed the test for the second stage of the program—minimum 100."[18]

According to a "research on the European school network, funded by the European Commission, Bulgaria ranks among the last places as to the availability of computer equipment in class and opportunities for its use in class". The computer–student

[18]Nazionalna programa "Obuchenie za IT kariera" Ministerstvo na obrazovanieto i naukata (National program "Training for IT Career". Ministry of education and Science). http://www.mon.bg/upload/15056/NP6_ITKariera-200418.pdf. Accessed April 1, 2019.

ratio in Bulgaria is 1:11 in comparison with the mean in the EU—4:1/data from 2011–2012/.[19]

4.3.2 Educational Resources

Main engagement of the Bulgarian educational policy is the **"development/implementation of digital publically accessible and universal education resources"—**"digital handbooks and course tools, providing the following model opportunities:

- adaptation of content components and user interface according to the individual needs of the trainee and his/her current knowledge level (personalized learning);
- use of additional means for impact on the trainee (multimedia components of digital textbooks with animation, video fragments and interactivity);
- powerful and convenient mechanism for navigation and semantic search, including in external education resources and portals aiming at providing a broad range of resources on a given topic;
- interactive and adaptable tests to check covered issues, which can have intelligent add-on to spot knowledge gaps and a follow-up focus on checking identified gaps;
- elements of artificial intelligence, including mechanisms for vocalizing the studied texts and comments on the graphic and multimedia objects;
- future development toward 3D graphics, virtual reality, etc".

Such digital educational resources could be "created at budget expense (presumably textbooks for the main subjects), at the expense of education institutions funds, as well as on business and initiative basis" (see footnote 18).

According to a statement of the Minister of Education and Science K. Valchev in March 2019, "One of the new projects of the Ministry of Education and Science provides for the creation of an open cloud. This will be a platform with free educational resources". It "could contain electronic lessons developed by teachers themselves". The teachers will be trained "to use and create such resources".[20]

4.3.3 Learning and Teaching

Special accent on the development of the skills in ICT is put in the **national program "Training for IT Career".**

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[19] Strategy for Effective Implementation of Information and Communication Technologies in Education and Science in the Republic of Bulgaria (2014–2020). http://www.strategy.bg/StrategicDocuments/view.aspx?Id=904. Accessed March 31, 2019.

[20] Ministar Balchev: Uchitelite triabva da spodeliat electronni urozi (Minister Valchev: Teachers should share electronic lessons). http://www.mon.bg/bg/news/3503. Accessed March 20, 2019.

The main purpose of the program was to develop a partnership between "school–university–IT business" by creation of 5 "centers for software training". Information campaign for this program was organized and conducted. Curriculum had been developed for the first module "Introduction to Programming" for the professional training "Applied Programmer" for teachers and lecturers. 25 teachers were trained in the first phase of the training in November 2017. "A unified online learning platform was built to provide learning content and test tasks."

A system for registration of students who wanted to participate in the program was built, and after the candidates finished the test online, test materials for checking their level and motivation were developed. Curriculum for the first and second modules of the program for students, 1st year of training, had been developed. 941 students were trained in 32 groups in the whole country on the first module "Introduction to Programming". 531 students were trained in 30 groups on the second module "Programming".[21]

The main problem of the software companies in Bulgaria is to find "trained graduates with secondary education for positions related to programming". Because of that in December 2015, the Council of Ministers decided to adopt **Concept for promotion of software specialists training**. In December 15, 2016, **Cooperation Agreement for Student Software Training with Representatives of the IT Industry** was signed by the Minister of Education and Science, the Bulgarian Association of Software companies, the Bulgarian Association for Information Technologies, the Bulgarian Outsourcing Association and Foundation "Cluster Information and Communication Technologies".

The main aim of the program is "Expanding the base of students who have acquired professional qualification in the professional field of 'Computer Sciences' and/or continue their education in higher education institutions in the professional field 'Informatics and Computer Sciences'".

Concrete aims are:

- "Development of educational documentation and training materials for vocational education and training in the professions of professional fields "Computer Sciences" from the List of professions for vocational education and training in partnership with the business.
- Creating conditions for conducting software vocational education and training in cooperation with universities and employers from the IT sector."

Realization of the program—2018–2019. Students attend courses in their free time during the week, on Saturday or Sunday or during vacations. Learning activities are both in attendance and online. Training is organized in schools with necessary equipment in accordance with the State Educational Standard for acquiring qualification in the profession "Applied Programmer". There are 5 centers in the following towns: Pravets (for Professional High School of Computer Technologies and Systems

[21] Otchet po Nazionalnite programi za razvitieto na obrazovanieto—2017. Ministerstvo na obrazovanieto i naukata. (Report on National Programs for Development of Education—2017. Ministry of Education and Science.). http://www.mon.bg/bg/1375. Accessed 18 Mar 2019

and Technical University—Sofia), Ruse (for Professional High School of Electrical Engineering and Electronics and University of Ruse “Angel Kanchev”), Plovdiv (for Mathematic High School “Academic Kiril Popov” and Plovdiv University “Paisii Hilendarski”), Burgas (for Professional High School of Electrical Engineering “Konstantin Fotinov” and Electronics and University “Prof. Dr Asen Zlatarov”), Sofia (for Technological school “Electronic systems” and Technical University, Sofia).

The main engagements of the centers are:

- “to provide support for online platform for learning content and test tasks, for communication between teachers and students, and for the application of 10th grade students for participation in the national program;
- to develop a selection procedure for the participants in the training;
- to develop a training program;
- to select and train teachers or lecturers to conduct the training;
- to organize tests and at the end of the three-year period of the program, passing examinations for acquiring professional qualification for the profession ‘Applied Programmer’”.

Partners of the centers are representatives of the organizations of the IT business, companies and universities.[22]

4.3.4 ICT Integration into Practices

Data from researches on EU level shows that Bulgarian teachers “are curious and their participation in ICT pedagogical use courses is above the average for the EU, which is a clear indication that with up-to-date facilities and modern communication environment, our country could easily measure with the best European practices.”—43% in comparison to 42% for the EU.[23]

Specific activity in the national program “Training for IT career” is the training of teachers and lecturers to train and to develop training materials. These teachers are not only from schools to the main centers but also “from all other professional high schools and schools where a training in the frame of the national program is organized”.[24]

It could be mentioned as an example of good practice a project realized from the Sofia University “St. Kliment Ohridski” named “Increasing the capacity of the

[22]Nazionalna programa “Obuchenie za IT kariera” Ministerstvo na obrazovanieto i naukata (National program “Training for IT Career”. Ministry of education and Science). http://www.mon.bg/upload/15056/NP6_ITKariera-200418.pdf. Accessed 1 Apr 2019

[23]Strategy for Effective Implementation of Information and Communication Technologies in Education and Science in the Republic of Bulgaria (2014–2020). http://www.strategy.bg/StrategicDocuments/view.aspx?Id=904. Accessed March 31, 2019.

[24]Nazionalna programa “Obuchenie za IT kariera” Ministerstvo na obrazovanieto i naukata (National program “Training for IT Career”. Ministry of education and Science). http://www.mon.bg/upload/15056/NP6_ITKariera-200418.pdf. Accessed April 1, 2019.

academic staff from the pedagogical specialties of the Sofia University" in design, conduct and provision of quality electronic distance training". 97 lecturers from 7 faculties were included in the realization of the project. They were trained to transform their courses from traditional to electronic. The project was rewarded as project of year 2014 in the category "public sector" in the 11th national competition "IT project of the year".[25]

4.4 Policy and Strategy of ICT

4.4.1 Policy-Related Educational Informationalization

The main political document regarding Educational Informationalization in Bulgaria is the *Strategy for Effective Implementation of Information and Communication Technologies in Education and Science in the Republic of Bulgaria* (2014–2020).

The vision for ICT implementation in Bulgarian education and science is connected with the following:

- "Development of unitary modern ICT environment for education, science and innovations;
- Implementation of integrated digital management in all spheres of education and science and automation of the administrative work of university and school teachers and scientists;
- Priority development of generally accessible, universal and compatible (standardized) digital content (including access through mobile devices) as well as significant reduction of paper workflow in education and science;
- Development and adoption of recognized standards and metrics for ICT competency including ICT skills as a component in the career development in education and science;
- Implementation of national external assessment of digital competencies of primary students on graduation and certifying IT skills of students of specialized study course (profiled) and vocational schools;
- Measurable with ICT means actual metrics for education and science development, as well as synchronization with European and world dimensions and classificators, referent frameworks, programs, etc. including constant monitoring and active intervention targeting an improvement of Bulgarian positions in science and education exchange;

[25] Proekt na SU specheli parva nagrada v 11-a konkurs "IT proekt na godinata" (Project of SU won first prize in the 11th competition "IT project of the year"). https://www.uni-sofia.bg/index.php/bul/novini/arhiv/arhiv_na_goreschi_novini/proekt_na_su_specheli_p_rva_nagrada_v_11_iya_konkurs_it_proekt_na_godinata. Accessed April 7, 2019.

- Achievement of coordinated planning and realization of ICT projects of the educational and scientific institutions at European, national and regional level—from separate initiatives to realizing long-term and prioritized goals involving maximum stakeholders and achieving economy of scale;
- Development through ICT of new education and science services, registers and generally accessible public information aimed at involving all potential stakeholders to support the strategy—parents, institutions, companies, civil organizations and others.

Mission of the strategy: overall modernization and transformation of education and science through ICT means and achievement of measurable and convincible values of indicators for improving the quality of education and scientific activities in the country, as a result of the Strategy".[26]

Some "priority fields of ICT implementation in science and education" are defined as follows:

- "Cloud technology-based education and science development environment";
- "Unified information environment and modernization of education and science infrastructure";
- "Development/implementation of digital publically accessible and universal education resources";
- "Active network interaction among the participants in education and science process";
- "Broadening up digital distance education forms";
- "Production and use of information and knowledge. Human potential development";
- "Active network interaction among the participants in education and science process";
- "Informational environment as a basis to improve education management";
- "Developing a system for horizontal and vertical education and science portals";
- "(Self-) assessment automation of the quality of education and science activities".[27]

[26] Otchet po Nazionalnite programi za razvitieto na obrazovanieto—2017. Ministerstvo na obrazovanieto i naukata. (Report on National Programs for Development of Education—2017. Ministry of Education and Science.). http://www.mon.bg/bg/1375. Accessed March 18, 2019.

[27] Strategy for Effective Implementation of Information and Communication Technologies in Education and Science in the Republic of Bulgaria (2014–2020). http://www.strategy.bg/StrategicDocuments/view.aspx?Id=904. Accessed 31 March 2019.

Stages of Realization of the Strategy and Expected Results

"The Strategy could be relatively divided into three stages with the corresponding important results:

I stage. Key investments—short term (2014–15)

- unified backbone network, connecting REI, universities and science centers;
- national ICT cloud infrastructure for the needs of education and science;
- a backup center for storage, data processing and provision of services;
- wireless (Wi-Fi) infrastructure in educational and scientific institutions;
- national digital education and study content management platform;
- legislation on digital study content and ICT competences;
- pilot implementation of integrated management system at school and university levels;
- education portal and digital handbooks for all sciences and mathematics subjects.

II stage. Mobility and security—middle term (2016–17)

- permanent optical or high-speed connection with educational institutions;
- opening up of education and science environment to mobile devices (m-learning);
- integrated national education information and management system;
- digital platform for video-training, teleconferences and R&D;
- regional resource centers for data and content;
- digital handbooks with interactive content for all general subjects.

III stage. Universality and sustainability—long term (2018–2020)

- unified education environment for ubiquitous learning (u-learning);
- transition to digital textbooks for all subjects;
- virtual classrooms and laboratories;
- national system for online exams and external assessment;
- automation of quality assessment;
- open and universal access to education and science resources."[28]

Directorate "Information and Communication Technologies" is in the structure of the specialized administration of the Ministry of Education and Science. Among its 16th main functions are the following:

[28] Strategy for Effective Implementation of Information and Communication Technologies in Education and Science in the Republic of Bulgaria (2014–2020). http://www.strategy.bg/StrategicDocuments/view.aspx?Id=904. Accessed March 31, 2019.

- Responsibility for “the implementation of the information and communication technologies (ICT) in the field of education and science”;
- Coordination and responsibility “for implementing the policy of the ministry regarding the implementation of ICT at schools and its implementation by the administrative structures of the ministry with the functions in the same field”;
- Coordinating the implementation of “the activities in national and international programs for the introduction of ICT in the field of education and science”;
- Coordination and responsibility “for the activities on the creation and updating of electronic learning content”, etc.[29]

Here are some results from the implementation of the **national program “Information and Communication Technologies (ICT) in the System of Preschool and School Education for 2017”**:

- 100% of budget-supported schools have Internet connectivity.
- All 28 Regional Management of Education Administrations have been included in the network of the State e-Government Agency.
- 218 schools have received funding to purchase innovative hardware or they have received innovative hardware to use for the purposes of interactive learning. It was a result from the indicator “A minimum of 100 new schools assisted in the activities of updating computer equipment and/or implementation of educational innovations related to the learning process”.
- “Resources have been provided to build a main and a backup data center that will ensure reliable and quality providing of IT services for the needs of the education. The necessary IT equipment and hardware for the data centers was purchased.”
- According to the planning, at least 300 new kindergartens should include “modern technologies in the educational process”. The result shows that 367 kindergartens have been received “funding to buy an innovative hardware”.
- 1005 schools have been received funding “for creation of e-learning content and use of electronic platforms”.[30]

[29]Direkzia “Informazionni I komunikazionni tehnologii”, Ministerstvo na obrazovanieto i naukata (Directorate “Information and communication technologies”, Ministry of Education and Science.). http://www.mon.bg/bg/100165. Accessed March 31, 2019.

[30]Otchet po Nazionalnite programi za razvitieto na obrazovanieto—2017. Ministerstvo na obrazovanieto i naukata. (Report on National Programs for Development of Education—2017. Ministry of Education and Science.). http://www.mon.bg/bg/1375. Accessed March 18, 2019.

4.4.2 ICT Financing Resource

There is a special funding of ICT-related activities in education in Bulgaria.

For example, the financing of the **national program "Training for IT Career"** had total indicative budget of 770,000 BGN leva for each group of students enrolled in the program. Here are concrete data for the budget of the program: 400,000 BGN leva for the 2018–2019 school year, including 250,000 BGN leva for the first school year and 150,000 BGN leva for the second school year. Funding is provided by the budget of the Ministry of Education and Science.[31]

The budget of the National program "Information and Communication Technologies (ICT) in the system of the preschool and school education" 2018 is 10,000,000 leva.[32]

More concretely, the budget forecast for the period 2014–2020 could be seen in the next table.

Budget forecast by year and type of activities—by year, in thousands BGN[33]:

[31]Nazionalna programa "Obuchenie za IT kariera" Ministerstvo na obrazovanieto i naukata (National program "Training for IT Career". Ministry of education and Science). http://www.mon.bg/upload/15056/NP6_ITKariera-200418.pdf. Accessed April 1, 2019.

[32]Nationalna programa "Informazionni I komunikazionni tehnologii (IKT) v sistemata na preduchilishtnoto I uchilishtnoto obrazovanie. Ministerastvo na obrazovanieto I naukata (National program "Information and communication technologies (ICT) in the system of the preschool and school education" 2018. Ministry of education and science). http://www.mon.bg/upload/14521/pr_NacProg-7-IKT-070318.pdf. Accessed April 7, 2019.

[33]Strategy for Effective Implementation of Information and Communication Technologies in Education and Science in the Republic of Bulgaria (2014–2020). http://www.strategy.bg/StrategicDocuments/view.aspx?Id=904. Accessed March 31, 2019.

Activity/measure	2014	2015	2016	2017	2018	2019	2020	Total in Thousand BGN
ICT infrastructure	19,520	37,690	38,560	36,960	40,460	35,460	35,460	244,110
Development, expansion and integration of unified backbone network for the needs of education and science	3000	2000	800	500	1000	2000	2000	11,300
Development, renovation and maintenance of zones with wireless access and communication infrastructure in schools/universities/institutes/students' hostels	3000	6000	1000	1000	2000	1000	1000	15,000
Creating, renovating and maintaining national and regional cloud ICT infrastructure for the needs of education and science	2200	5000	3000	2000	2000	2000	2000	18,200
Ensuring access to national, European and world educational infrastructure—GEANT, etc.	500	1500	1500	15,000	1500	1500	1500	9500
Ensuring a team and a monitoring center for communications in the system of education and science	120	240	360	360	360	360	360	2160
Implementation of a specialized video-streaming infrastructure, video-conference system and IP telephony	80	250	500	1000	1000	1000	1000	4830
Subsidizing Internet access or development of permanent optical (fiber) connectivity to educational and scientific organizations	1500	5000	5000	3000	1000	1000	1000	17,500
Passing to virtualization solutions and platforms	60	2000	2000	3000	2000	2000	2000	12,060
Providing licensed software-operational systems, office packages, graphics and antivirus software, CAD, GIS, etc. as well as software for vocational and profiled high schools, people with special educational needs, etc.	4000	8000	8000	8000	8000	8000	8000	50,000
Co-funding of organizations in education and science for implementation of new ICT products	5000	15,000	15,000	15,000	20,000	15,000	15,000	95,000

(continued)

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Activity/measure	2014	2015	2016	2017	2018	2019	2020	Total in Thousand BGN
Purchase of portable computers and/or tables for teachers/scientists	60	1000	1000	1000	1000	1000	1000	5560
Provision of a subsidized Internet (including mobile) access to innovative science practitioners, pedagogical staff and trainees	0	300	300	500	500	500	500	2400
Identification, R&D and implementation of free educational programs and applications	0	100	100	100	100	100	100	600
Educational content	8280	19,580	25,150	29,500	25,500	24,000	24,000	156,010
Ensuring access to specialized information databases (science information and others)	5000	10,000	10,000	10,000	9350	9000	900	62,350
Initiatives for digitalization of existing educational and science content	0	1000	2000	3000	3000	3000	3000	15,000
Support of existing information catalog resources with educational content and centralized access to electronic periodic editions	1000	1000	1000	1000	1000	1000	1000	7000
License and localization of valuable international educational resources and programs, available online	2000	2000	2000	2000	2000	2000	2000	14,000
Support and expansion of national educational portal with digital repository for educational resources	60	250	500	1000	1000	1000	1000	4810
Creating educational websites, programs and self-training systems	0	0	1000	2000	1000	1000	1000	6000
National campaigns for stimulation of creation of digital content by students, teachers, PhDs and scientists	70	500	1000	1000	1000	1000	1000	5570

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Activity/measure	2014	2015	2016	2017	2018	2019	2020	Total in Thousand BGN
Development of video-lectures and educational movies, including those made by students, teachers, PhDs and scientists	0	750	1000	1200	900	750	750	5350
Development of national system for passportization, licensing, maintenance and monitoring of exiting digital educational content	0	1000	2000	1000	1000	1000	1000	7000
Development or purchase of e-handbooks for the needs of general and vocational education	0	2000	3000	4500	3000	2500	2500	17,500
Development of specialized educational programs for children with SEN	0	80	150	300	500	500	500	2030
Creating and support a national online bank for tests and tasks	0	500	500	500	250	250	250	2250
Funding educational online games and competitions, virtual panoramas, 3D modeling, etc.	150	500	1000	2000	1500	1000	1000	7150
IT training	0	8750	12,220	16,420	14,620	13,240	11,680	76,930
Training for creation and use of digital content, creation of information portals, web-based and mobile applications	0	2000	2000	2000	2000	1500	1000	10,500
Promotion of foreign language training and teamwork (including international) through ICT	0	150	300	500	500	500	500	2450
Training and additional qualification of ICT skills, including ICT courses for advanced (system administrators, etc.), as well as training of talented students in the sphere of ICT	0	300	500	1000	1500	2500	2500	8300
Creating and sharing good pedagogical practices with ICT means (implementation of ICT in the classroom as part of the process)	0	500	2000	4000	3000	2000	2000	13,500

(continued)

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Activity/measure	2014	2015	2016	2017	2018	2019	2020	Total in Thousand BGN
Setting virtual classrooms, laboratories and teleconference sessions for school and university students and PhDs	0	0	1000	2000	2000	2000	2000	9000
Setting a demonstration and training center for new ICT-based educational technologies	0	2000	3000	1000	1000	1000	1000	9000
Organization of electronic school and of electronic university	0	2000	1000	4000	3000	2000	1000	13,000
Creation and funding the activity of national center for qualification, certification and testing of ICT skills, including those online	0	1500	2000	1500	1000	1000	1000	8000
Training for ICT use with children with SEN and other specific needs	0	240	300	240	120	240	180	1320
Implementing measures against Internet addiction in adolescents	0	60	120	180	500	500	500	1860
Management systems	12,190	9000	10,650	10,650	9650	9900	10,400	72,440
Use of authenticating services—support of digital signatures of management and administrative staff in educational and scientific organizations	150	500	500	500	500	500	500	3150
Support to implement a complete management-information system in educational and scientific organizations including paperless document workflow	4000	3000	3000	3000	2000	2000	2000	19,000
Funding a unified information system and specialized registries in education and science (of diplomas, of scientific degrees, etc.)	900	1000	1000	1000	1000	1000	1000	6900
Providing dedicated funding from MES for ICT support in relevant organization-educational institutions, science units	0	500	1500	2000	2000	2000	2000	10,000

(continued)

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Activity/measure	2014	2015	2016	2017	2018	2019	2020	Total in Thousand BGN
Consultations and centralized helpdesk and call center on ICT-related subjects	60	150	150	150	150	150	150	960
Development of a flexible system of indicators for evaluation of the impact of ICT on the quality of education	0	1000	2000	1000	500	250	250	5000
Development of a nation system for online exams and external assessment	80	350	500	1000	1500	2000	2500	7930
Provision of platforms for digital training and control of classes, content management and communication with parents and students	7000	2500	2000	2000	2000	2000	2000	19,500
Regulations	160	1330	1760	2780	1560	1500	1420	10,510
Legislation for effective balance between protection of copyrights and free sharing of certified educational content	0	250	500	1000	500	500	250	3000
Support of legislation for prevention of cybercrimes and the distribution of harmful content	0	0	60	120	60	0	10	250
Provision of financial and administrative relieves for companies, investing in ICT for education	80	0	0	80	0	0	80	240
Development of national standards for creation of digital text- and handbooks and regulation, encouraging the uses of digital content in schools	0	1000	1200	1500	1000	1000	1000	6700
Creation of appropriate regulations about ICT training and training through ICT	80	0	0	80	0	0	80	240
Legislation connecting ICT competencies with the qualification requirements and career development of pedagogical and science staff	0	80	0	0	0	0	0	80
Total for the activities in thousands of BGN	40,150	76,350	88,340	96,310	91,790	84,100	82,960	560,000

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Chapter 5
Report on ICT in Education in the Republic of Croatia

Ivica Botički

5.1 Overview of the Country

5.1.1 Geography

The name Croatia is derived from the Croats, a Slavic tribe who migrated to the current country area in seventh century A.D. Croatia is geographically positioned in Southeastern Europe and has a land border with the following countries: Bosnia and Herzegovina, Slovenia, Hungary, Serbia, and Montenegro. Croatia is 56,594 km^2 in size and has direct access to 5835 km of coastline of the Adriatic Sea, out of which 4058 km is island coastline, comprised of more than 1200 islands, islets, ridges, and rocks. Due to the diverse territory configuration including flat plains, hills, mountains, coastline, and islands, the climate in Croatia is also diverse mainly being Mediterranean and continental.

5.1.2 The Political System

Croatia gained its independence in 1991 following the collapse of the communist state of Yugoslavia. Since then Croatia is a parliamentary democracy and has worked its way toward the NATO membership in 2009 and the EU membership in 2013 which required a significant adjustment of national laws and to the EU laws. Croatia relies politically, legally, and economically on the EU.

Croatia is a parliamentary representative democratic republic, in which executive political power is exercised by the government and the president of Croatia. Prime

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minister is the head of government in a multi-party political system. The judiciary is independent of the executive and the legislature.

5.1.3 Current Situation of Economic Development

After a period of a roughly 6-year-long recession, Croatia returned to economic growth in 2015 but is still overwhelmed with large state and corporate debts, fairly high employment rate, overly bureaucratic investment regulation, and a possible large black economy due to different modes of tax evasion. Nevertheless, GDP growth recovered in 2017 to around 3%, which is expected to continue in 2018. The GDP estimated GDP composition is 4%—agriculture, 26.5%—industry, and 69.5%—services (UNESCO Institute for Statistics, 2018).

5.1.4 Population

The population of Croatia is 4,292,095 people (2011 census, 2017 estimation is similar to the figure). The population growth rate is −4.0 per 1000 population with the life expectancy being 78 years (2012). The decline in population is mainly due to the aging population and out-migration (Croatian Bureau of Statistics, 2018).

5.1.5 The Status Quo of Social and Cultural Development

Croatia's social and cultural development is deeply rooted in long history and tradition since Croatian people have been inhabiting the current area for around 14 centuries. Since Croats are predominantly Christian Catholic (more than 86% according to the 2011 census), traditional values and family are of great importance. Geographical heterogeneity and rich history are reflected in diverse art, architecture styles, and cuisine styles. Croatian people take pride in their fairly small country's great sports successes.

5.1.6 The Status Quo of Information Communication Technologies

Although Croatia is a developing economy, quite a few ICT systems to support both administrative and educational processes have been developed in the last decade, such as e-Registries or online repositories for educational content. Nevertheless, the question of aligning these systems and novel pedagogies with the educational system is still a challenge, especially due to a lack of focus on teacher development and individual school on-site equipment. Croatia was recently successful in acquiring a large-scale EU-funded initiative e-Schools (e-Škole in Croatian). E-Schools is a concept overarching the implementation of digital infrastructure and e-services in schools for both administrative and educational purposes as well as in the daily use of digital technologies and resources for better quality in teaching and learning. The project establishes a comprehensive platform for ICT in educational development in the decade to follow and has recently been highlighted as a model for digitalizing schools on a national scale by the European Commission (Publications Office of the European Union, 2017), as well as shortlisted for the UNESCO ICT in Education Award as one of the 12 best projects in the world in 2017 (UNESCO, 2018).

5.1.7 The Relationship with China Under the "16 + 1" Cooperation Framework

In 2019, Croatia will host the next annual "16 + 1" Summit. Croatia takes it as an important opportunity to present itself as an active participant in the "16 + 1" framework and an interested partner to attract Chinese investment. The "16 + 1" initiative was designed to increase cooperation of China with the Central, Eastern, and Southeastern European countries. The increased cooperation between the two countries not only continues to be seen in tourism-related subjects but also beyond. There have been increasing investments by Chinese companies in Croatian infrastructure and more interest in the technology and food industries. China and Croatia also cooperate in other fields such as education and sport, where there is an ongoing exchange of students, coaches, professionals, and knowledge. In terms of sport, there a decade-long exchange and cooperation which continues today in various sports, such as basketball.

5.2 Overview of the Educational Development

5.2.1 Education System and Policy

5.2.1.1 Education System

The education system in Croatia is organized into four main levels: kindergarten/pre-primary (0.5–6 years old), primary (7–14 years old), secondary (15–18 years old), and tertiary levels (typically 19–23 years old, but varies). Compulsory education lasts 8 years from age 7 to age 14. There are three strands at the secondary educational system level: (1) grammar high schools, (2) 3-year vocational programs, and (3) 4–5-year vocational programs. The tertiary level has two strands: (1) bachelor (3 years of duration) and master (2 years of duration) university levels and (2) vocational levels (2–5 years of duration) (Publications Office of the European Union, 2018).

5.2.1.2 Education Policy

Despite successfully adjusting the educational sector to new national and existing EU legislation, policies, and programs, the Croatian educational system structure, organization, and innovation are slowly adjusting to allow for innovations. Since 2014, the most notable policy document is the strategy of education, science, and technology. This comprehensive document, drafted in the period from 2012 to 2014 by more than 130 experts outlined goals and objectives in the following areas: Early pre-school, Primary and secondary upbringing and education, Higher education, Adult education, Lifelong learning, Science and Technology (Croatian Parliament, 2014). One of the major measures was a comprehensive curricular reform, which was initiated energetically in February 2015, starting with the introduction of informatics as a mandatory subject in the fifth and the sixth grades in the school year 2018/2019, as well as with the experimental implementation of new curricula in the same year (Ministry of Science Education and Sports, 2016).

5.2.2 Government Expenditure on Education

The total education investment in Croatia in 2017 is 4.8% of the GDP (equal to 4.8% of GDP in 2014), which is similar to the EU average (4.9% in 2014 and 4.7% in 2017). However, it is to be noted that the expenditure per pupil in basic education and in upper secondary education is the lowest in the EU in terms of purchasing power parity (3495.00 €). Expenditure per student in secondary education is fourth lowest (3342.00 €) and in tertiary education third lowest (7999.00 €) in the EU in terms of GDP per capita (Publications Office of the European Union, 2018).

5.2.3 Enrollment Rate and Retention Rate

Croatia has high gross enrolment rates at the primary education level (95.40% in 2016) and the secondary education level (97.76% in 2016). Rates for the pre-primary education and tertiary levels are somewhat lower, 63.45% and 67.48% in 2016, respectively. Croatia has very low early school leaving rates, among the lowest in the EU (Publications Office of the European Union, 2018).

5.2.4 Education Research

Croatia has participated in TIMSS 2015 (Trends in International Mathematics and Science Education Study), PISA 2012 and 2015 (Programme for International Student Assessment), PIRLS 2011 (Progress in International Reading Literacy Study), ESLC 2011 (European Survey on Language Competences), and ICILS 2013 surveys. Although the presented survey data is at the time of writing of this report at least 4 years old, trends show that Croatian students have around average language competences (in ESLC 2011 just below average in the first target language and just above average in the second target language; in PISA 2015 slightly below-average reading skills; and in PIRLS 2011 well above average), below-average science and mathematics skills (PISA 2015) and below-average computer and information competence (ICILS 2013). According to ICILS, students' computer and information literacy (CIL) refers to the "students' ability to use computers to investigate, create and communicate in order to participate effectively at home, at school, in the workplace, and in the community." The 2013 ICILS cycle collects data from the student population at their eighth year of formal schooling (usually Grade 8, with the average student age being 13.5 years). The ICILS 2013 survey in Croatia was performed on a sample of 3533 students and 2736 students from 180 primary schools with the participant response rate of 82.4%. Among 21 countries included, Croatia is positioned as 14th on the list, just slightly above the average score (which was set to 500). One percent of Croatian students were in the highest literacy level, 21% in the second, 42% in the thirds, and 11% in the fourth literacy level (NCVVO, 2012, 2014; Programme for International Student Assessment (PISA), 2018; TIMSS, 2015).

ICILS 2013 research data gathered from the school principals shows that teachers attend ICT in education courses organized by the school they work in, with the majority of teachers participating in professional development courses on generic software and internet usage, which was seen by the teachers as a key limitation in the intended study. Less than 45% of teachers have participated in a course covering ICT use in education within a period of 2 years prior to the surveying date. Less than 20% of teachers participated in software or courses on the use of multimedia equipment used in their specific course, online discussions or forums on the topics of learning and teaching (IEA—The International Association for the Evaluation of Educational Achievement, 2014; Pović, Veleglavac, Čarapina, Jagušt, & Botički, 2015).

5.3 New Progress of ICT in Education

5.3.1 Infrastructure

The overarching reform of school curricula in Croatia was criticized by some on a number of accounts: for distancing Croatia from the Middle-European school system, for the curricular approach focusing on learning outcomes which was claimed to be abandoned by other forward-thinking educational systems, for disregarding the national identity and STEM content, for insufficient emphasis on the upbringing component, etc. On a related hand, Croatia ranks poorly on the DESI measurements (European Commision, 2017), with its Human Capital being below the EU average and has an acute problem with high low skill levels as well as the relevance of skills acquired through vocational and higher education. The EU also states that "basic skills have declined and are below the EU average. There are differences in performance linked to socioeconomic status, but the quality of curricula and teaching appears to be the main driver of Croatia's poor performance." Education focused on skill development, digital skills being the vital skills for the twenty-first-century society, is tackled not only through the Strategy of Education, Science, and Technology but also through other activities and strategic documents.

The Croatian educational arena has been rather conservative in accepting the digital transformation. Some of it is due to the lack of funds, which is being alleviated with the constant increase of the EU funding. Other important factors include a strong conservative strain in Croatian politics and consequently educational policy, opposing quick changes and leaps the young country could make based on the experience of more mature systems. Throughout the last decade there and prior to the implementation of the e-Schools project, there have been no major pushes for digitalization of the school system. Similarly, prior to the curricular reform, there have been no major pushes for the modernization of the curricula or teaching methods used in Croatian schools.

Croatian schools one computer is used by 26 students which is much lower than the ratio in most of the participating countries (NCVVO, 2014). Main national information systems as of 2018 are as follows: (1) e-Registry (national information system containing data about every student, program, and school at the primary and secondary level in Croatia), (2) e-Class Register, (3) e-Enrollment (national information system for application and enrollment at secondary schools, (4) National information system for application to higher education institutions, and (5) Information system for subsidized nourishment.

5.3.2 Educational Resources

The digital resource market in Croatia has so far remained rather conservative, both for schools and higher education, in terms of the digital transformation. Although there have been projects providing digital resources for teaching and learning, there has been no large-scale implementation of digital learning materials in the Croatian educational community. Publishers dealing in textbooks and educational materials have mostly focused their digitalization efforts on supplementing the printed textbooks with multimedia, although some offer advanced systems with a combination of content, classroom management system and educational applications and multimedia. An example of a state-run initiative with that goal is the distance learning portal Nikola Tesla[1] offering advanced interactive digital materials for STEM subjects and English for secondary schools. Other state-run projects resulted in websites with digital education materials such as eLektire[2] (a portal with mandatory readings for K-12, well accepted by the students and ICILS 2013 data shows that less than 10% of teachers use digital learning content on regular basis, and less than 5% use multimedia, digital games, collaborative or interactive resources.

5.3.3 ICT Integration into Practices

Croatian teachers' attitudes toward the use of ICT in education are less positive than the other teacher-participants, with only 54% of teachers believing that ICT increases student learning results. What is more, over 60% of teachers believe that ICT negatively impacts writing or social skills, with 51% believing that ICT only stimulates copy–pasting information from other sources. On the other hand, teachers have an affinity toward the use of technology solutions in education for administrative purposes. For example, 87% prefer using the electronic attendance and grading system registers compared to paper-based registers due to practicality, speed, 24/7 availability, and a better overview of data. Ninety-nine percent of teachers use desktop computers, tablets, or smartphones in their teaching, with 60% using desktop computers almost every day, while tablet computer and smartphones were not often used in teaching.

ICILS 2013 surveyed Croatian students to determine their experience in computer use as well as the level of self-esteem in using computers. Ninety-eight percent of Croatian students have computers at home and 97% an internet connection with 95% of students using the computer at home at least once per week and 61% of students using computers in the school at least once per week. Computers are mostly used by the students for editing documents, communication, and social networks and in leisure activities such as playing games. In Croatia, 24% of students use computers at least once per month for schoolwork like writing reports or essays, 41% for creating presentations, and 33% for group work with other students from the school. Computers are most used at the Informatics non-compulsory subject (70%), with only 10% of students using them in science or social subjects. Only 5% of students use computers in language subjects and 6% in mathematics subjects. According to the new Informatics curriculum for primary and secondary schools in Croatia that was put into force in 2018, the topics include use of information and communication technology in education, problem-solving using a programming language, development of computational thinking, abstraction, logic, data analysis, formulating problems for the digital tools use, problem-solving generalization, creativity and innovation by creating digital artifacts and algorithms, digital literacy and decision-making, ethical issues, digital communication, and digital citizenship.

[1]Nikola Tesla. https://tesla.carnet.hr/ Accessed March 29, 2019.

[2]E-Lektire. http://lektire.skole.hr/ Accessed March 29, 2019.

The EU-funded e-Schools project plays an important part in equipping the schools and promoting the use of digital educational resources and pushing both the users and the market toward the possibility of entirely digital educational resources (CARNet, 2017). It includes a series of activities covering the entire span of the e-Schools concept and will support primary and secondary schools in the process of growing their institutional digital maturity. As a significant component of e-Schools, a number of ICT systems are developed to supplement or add to the existing solutions in Croatia. One prominent example is the national digital educational content repository that will be used as a central place to store and manage current and future digital resources of all the previously mentioned initiatives and projects.[3] The repository will promote both OER and licensed use of the materials published. The same project is developing another, an alternative form of digital educational resources—teaching and learning scenarios—providing teachers with innovative methods, tools, applications, and advice on how to use them with modern teaching methods such as problem-solving and learning through experimentation.

The Ministry of Education and Science in Croatia in its latest mandate has been a strong advocate of the digital revolution. It is pushing for the introduction of mandatory computer science in primary and secondary schools, as well as the introduction of a new curriculum in alignment with the strategy of education, science, and technology in all other subjects, supported primarily by digital educational resources, rendering them equal to the print and pushing both the public institutions and the market to support more digital educational resources.

5.3.4 Pressing Issues

One of the pressing issues in the Croatian educational system is digital competences of teachers and professors and their readiness to accept new technologies, not only as tools but as a means of changing the way of teaching. After several decades of unsuccessful attempts of modernization of the education system, teacher motivation and confidence in changes are challenged. Introducing significant changes through new curricula and ICT in teaching at the same time is both an opportunity and a threat since there is a risk that sustained teacher professional development gets neglected. Even if in-service training and lifelong learning are focused on digital competences of teachers already in the schools, new teachers that are coming out of the higher educational teacher training institutions would lack these competences. Since changes in the education system are highly dependent on teachers carrying them out, teacher competences and motivation remain the issues Croatia will have to deal with.

[3] The Digital Contents Repository, Edutorij. https://edutorij.e-skole.hr/share/page/home-page Accessed March 29, 2019.

5.4 Policy and Strategy of ICT

5.4.1 ICT Financing Resource

School equipment in Croatia, including ICT infrastructure, is to be funded by school founders, which are mainly local government units. The central government, in principle, should not participate in this funding, but usually helps due to the notorious lack of budget in some communities. Investment in ICT infrastructure in schools at a national level has been at best sporadic since the 1990s. On the contrary, the country has been systematically and continuously building national networking infrastructure and information systems for educational institutions. In 1991 the Croatian Academic and Research Network—CARNet was established as a project of the Ministry of Science and Technology of the Republic of Croatia. Both local and central government bodies have funded periodic, but not frequent, procurement of computers as the main tools for teaching informatics in schools, which worsened with the economic crisis in 2008, so the infrastructure in many schools is less than satisfactory.

By joining the EU, Croatia has gained access to significant funding through the EU structural and investment (ESI) funds, most importantly for the education and research arena—ERDF and ESF funds (European Comission, 2018). To facilitate that, in May 2017, the e-Croatia 2020 Strategy (Ministry of Public Administration (Croatia), 2017) was adopted as one of the strategic documents necessary to take advantage of the ESI funds. Croatia is also involved in the European Digital Single Market strategy (European Commission, 2018), adopted in 2015 as of the priorities of the European. One of the key prerequisites for the development of digital single markets is the digital skills required to consume, among other things, public e-services, including education services.

5.4.2 Policies Related Educational Informationalization

Croatia was encouraged by the EU to follow up by developing a separate strategy ensuring the development of digital skills in four user groups (Education and Training being one of them). The development of this strategy is currently underway and is expected to be further supported by the establishment of the National Digital Skills and Jobs Coalition in 2018, coordinated by the Croatian Central State Office for the Development of the Digital Society. Perhaps the most significant development in terms of policy is the national development strategy Croatia 2030 (Ministry of Regional Development and EU Funds, 2018), an umbrella strategy initiated in 2018, which should overarch all the areas relevant for the development of the country (as well as all the other strategies), including digital society as one of the key thematic areas, and science, education, and human resource development as key horizontal topics.

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Chapter 6
Report on ICT in Education in the Czech Republic

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6.1 Overview of the Country

6.1.1 The Geography and History

The Czech Republic is a small highly developed country located in central Europe. Its total area is 78,867 km^2 and it is the 116th largest country in the world (CIA World Factbook 2016). The country is landlocked, having a common border with Austria, Germany, Poland and Slovakia. It is strategically located astride some of the oldest and most significant land routes in Europe.

The Czech Republic includes the historical territories of Bohemia, Moravia, and Czech Silesia. Since 1 January 1993, it is an independent state. It continues in the tradition of statehood of Czechoslovakia, Czech Kingdom and Great Moravia (ninth century). The country joined NATO in 1999 and the EU in 2004. The Czech Republic has a long industrial tradition and highly decentralized administration.

6.1.2 The Population Situation

In 2017, the Czech Republic had 10,590,000 people (5,382,000 of women, 1,617,000 children younger than 14 and 2,040,000 adults older than 65). The majority of the inhabitants of the Czech Republic are Czechs, followed by Moravians, Slovaks, Poles, Germans and Silesians. According to some estimates, there are about 250,000

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Romani people in the Czech Republic. There were 524,000 foreigners residing in the country (according to the Czech Statistical Office (CSO)) with the largest groups being Ukrainian, Slovak and Vietnamese, together with Russian, Polish and German, they formed three-quarters of foreigners residing in the country (ČSÚ 2017).

The population is linguistically homogenous, ethnic minorities are small and immigration is low. The number practising religion is the lowest in Europe. The country has an exceptionally long tradition in education attained by all social classes (EC/EACEA/EURYDICE 2009, p. 12).

The majority of the population speak Czech as their first language. As a written language, Czech dates back to the late thirteenth century. Czech is the language of instruction in all types of schools. By an Education Act, minorities are guaranteed the right to education in the learners' mother tongue. Secondary school learners can select from a larger range of modern languages. There are schools who provide instruction through a foreign language in selected subjects.

6.1.3 The Political System

The Czech Republic is a pluralist, multi-party, parliamentary democracy. The head of state is the President, elected by direct suffrage. The President and the Government exercise executive powers, while the Parliament consisting of the Chamber of Deputies and the Senate are the supreme legislative body. The territorial administration has two levels: municipalities that are basic self-government units and regions that are higher territorial self-government units. The State is denominationally neutral and the freedom of religion is granted (STUDYIN 2017).

6.1.4 The Current Situation of Economic Development

The Czech Republic has a developed, high-employment economy with a per capita Gross Domestic Product (GDP) rate that is 87% of the European Union average (World Bank, report from 2015). Most of the economy has been privatized, including the banks and telecommunications. The ambition is that also in the future, the economy will be linked mainly with industry (Iniciativa Průmysl 4.0). Good education, sufficient digital literacy, good knowledge of foreign languages, mathematics and physics and lifelong education are the necessary preconditions.

6.1.5 The Status Quo of Science and Technologies

The Czech lands have a long and rich scientific tradition. Several famous scientists were born within the current Czech Republic. Research based on cooperation between

Table 6.1 Changes in the use of technologies in households

Households	2015 (%)	2018 (%)	Tendency
Equipped with a computer	73.1	78.4	Increase
• Desktop computer	41.9	39.9	Decrease
• Laptop	54.7	66.9	Increase
Internet access	73.1	80.5	Increase

Resource ČSÚ (2018)

universities, the Czech Academy of Sciences and specialized research centres bring new inventions and initiatives in this area.

Since the political change in 1989, education has been undergoing development. The transition progressed from the demonopolization to a qualitative diversification of educational opportunities. Recommendations for new educational policies and structures were stated in the 'Reviews of National Policies for Education' prepared by the Organization for Economic Cooperation and Development (OECD) in 1996.

In the Czech Republic, the number of households equipped with a computer and Internet access is stable. Tables 6.1 and 6.2 show the changes in households between 2015 and 2018. According to the Czech Statistical Office (ČSÚ 2018), 97.9% of enterprises had Internet access in 2018. Table 6.3 shows the changes between 2015 and 2018 for different technological items (Fig. 6.1).

Table 6.2 The proportion of population using mobile devices and social networks

	2015 (%)	2018 (%)	Tendency
Mobile devices, whole population	75.7	80.7	Increase
• Mobile devices, population aged 16–24	77.1	93.7	Increase
• Mobile devices, population aged 65 and more	3.1	9.9	Increase
Profiles on social networks	37.4	51	Increase
E-shopping via Internet	41.9	53.9	Increase

Resource ČSÚ (2018)

Table 6.3 Changes in the use of technologies—enterprises

	2015 (%)	2018 (%)	Tendency
High-speed Internet access (30 Mb/s and more)	19.2	35.4	Increase
Optical connection	13.3	22.9	Increase
Websites	82.8	82.8	Constant
Profiles on social networks	23.5	42.3	Increase

Resource ČSÚ (2018)

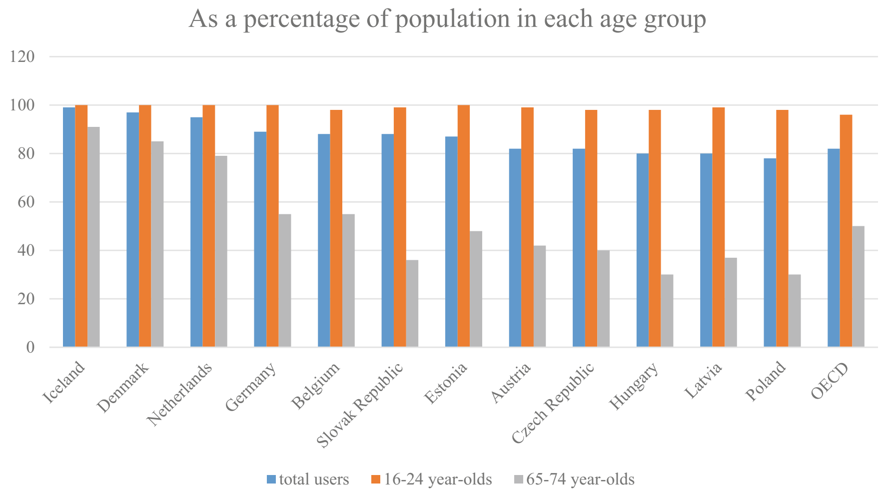


Fig. 6.1 Internet users by age in some selected European OECD countries, especially in countries neighbouring the Czech Republic or with a similar population—in 2014. Data taken from Fig. 2.2, OECD (2016, p. 41)

6.1.6 Relationship with China Under the '16 + 1' Cooperation Framework

The Czech Republic is involved into the initiative 16 + 1 for a multilateral platform facilitating cooperation between China and 16 Central and Eastern European countries (CEEC). There are some examples of bilateral projects realized in the Czech Republic: an important Chinese investor in the Czech Republic is the Changhong Company, a producer of TV, which opened its plant in an industrial zone in Nymburk with an investment of $ 10 million; another example is Shanghai Maling and its meat processing plant situated in Hrobice (Vozáryová 2017).

6.2 Overview of the Educational Development

6.2.1 Education System and Policy

'The Czech school system is based on European values, but it also has some singular aspects and it faces some challenges. Schools in the Czech Republic are administered in the framework of general administration. The responsibilities are distributed among individual layers of administration – the central government, regions (there are 14 regions) and municipalities. Regions are provided with a high degree of autonomy' (Mazouch and Vltavská 2016, p. 5).

'In the Czech Republic, formal education in public education institutions is provided free of charge. Parents only cover part of the costs of education in the case of pre-school education in nursery schools' (Mazouch and Vltavská 2016, p. 34) (Table 6.4).

'Nursery schools (MŠ) provide pre-primary education for children usually from (two) 3 to 6 years. From the age of 5, pre-primary education is compulsory and free of charge. Otherwise, fees in public and state schools are considerably regulated' (STUDYIN 2017).

Table 6.4 Structure of the education system in the Czech Republic

Institution	Age		Levels
Nursery school (MŠ)	(2) 3–6		ISCED 020
Basic school (ZŠ) (9 years)	6–15		
	Primary education (5 years)	6–10	ISCED 100
	Lower secondary school (4 years)	11–15	ISCED 244, EQF 1
Multi-year general secondary school (lower stage)		11/13–15	ISCED 244, EQF 1
Eight-year conservatoire	(First 4 years)	11–15	ISCED 244, EQF 1
Upper secondary school (SŠ)	Upper secondary education with Maturita examination (general) (4 years)	15–19	ISCED 344, EQF 4
	Upper secondary education with Maturita examination (vocational) (4 years)	15–19	ISCED 354, EQF 4
	Upper secondary education with vocational education and training (VET) certificate (2–3 years)	15–17/18	ISCED 353, EQF 2/3
	Upper secondary education (1–2 years)	15–16/17	ISCED 253/353, EQF 2
	Follow-up and shortened studies (1–2 years)	–	ISCED 353/354, EQF 3/4
Eight-year conservatoire	Lower and upper secondary and tertiary art education (8 years)	11–19	ISCED 554, EQF 6
Six-year conservatoire	Upper secondary and tertiary art education (6 years)	15–21	ISCED 554, EQF 6
Higher education institutions (HEI)	Bachelor study (3 years)		
	Master study (2 years)		
	Ph.D. study (3–4 years)		

Resource STUDYIN (2017)

Compulsory school attendance starts at the beginning of the school year following the child's sixth birthday, unless he/she is granted a postponement. Pupils start their compulsory school attendance in the 9-year basic school (ZŠ). The elementary school in the Czech Republic includes primary and lower secondary levels of education. Upon completion of the primary level, pupils who show interest and succeed in an admission procedure may transfer to a multi-year grammar school (gymnasium) to obtain more academic education rather than the traditional lower secondary level. After completing the fifth year of the elementary school, a small number of pupils start attending 8-year conservatoires (konzervatoř) (STUDYIN 2017).

Compulsory education can take the form of individual tuition (home education) without regular attendance at a school. After written application by the legal guardian of the pupil, permission for individual tuition may be granted by the principal of school where the pupil had been accepted for compulsory education (EC/EACEA/EURYDICE 2018).

Upper secondary education (SŠ) is a multi-structured, but internally coordinated system guaranteeing education and practical vocational training. Secondary schools are divided into four types: general, technical, vocational and integrated technical/vocational. A 'maturita' (upper secondary exit exam) qualification acquired at a secondary general, technical or vocational school is regarded in law as an equivalent 'maturita' qualification. Participation rate of the 15–19 year-old students is about 90%.

Tertiary education is provided by higher education institutions (VŠ), tertiary professional schools (VOŠ) and conservatoires (konzervatoř). The minimum entrance requirement to enter the tertiary level of education is the Maturita examination certificate (STUDYIN 2017). The general aim of higher education is to provide students with adequate professional qualification, to prepare them for engagement in research and participation in lifelong learning, to assist them to contribute to the development of civic society, and international, particularly European cooperation (STUDYIN 2017).

Higher vocational schools prepare students for skilled professions requiring a post-secondary education but not university education. They offer post-secondary vocational education ending with the 'absolutorium'. Higher education institutions (HEI) provide education and studies in undergraduate (lasting 3–4 years), postgraduate (lasting 1–3 years, or 4–6 years in case of programmes not following Bachelor's degree programmes) and doctoral study programmes (lasting 3–4 years). As the highest level of the educational system, they are regarded as the culminant centres of education, independent knowledge and creative activity. They are of either a university or a non-university type, and provide accredited degree programmes as well as lifelong learning programmes. The type of higher education activity is determined by the type of available accredited degree programme.

6.2.2 *Students and Teachers' Profiles*

Most EU countries are faced with ageing of teachers and a lack of novice teachers in schools. The Czech Republic is also in a similar situation (Table 6.5).

There are no qualified teachers for primary schools in the Czech Republic, for teaching mathematics, chemistry, physics, ICT (informatics) or English. 'One of the greatest efficiency challenges in recent years to the Czech school system has been the steep decline in the school-age population. The number of 15–19 year-olds is predicted to remain over 40% lower than the 1990 numbers until 2020' (Shewbridge et al. 2016, p. 7).

There is a great interest in higher education or universities in the Czech Republic, especially in bachelor studies. The growing interest in studying at universities is due to the fact that people can enroll at any age and that universities have a fairly large offer of part-time study programmes (Tables 6.6, 6.7, 6.8 and 6.9).

Table 6.5 Ageing and lower secondary school teachers in 2013/14

Teacher´s age (years)	Czech Republic (%)	European Union (%)
Less than 30	8.5	8.6
30–39	24.9	25.0
40–49	34.6	28.3
50–59	27.2	29.5
More than 60	4.7	8.7

Resources MŠMT (2014) and Eurostat (2017)

Table 6.6 Early childhood education (MŠ) in the Czech Republic

School year	Nursery schools	Classrooms	Pupils	Teachers
2016/17	5209	15,856	367,454	29,629
2017/18	5269	15,969	366,391	30,303

Resource ČSÚ (2018)

Table 6.7 Compulsory education in basic school (ZŠ) in the Czech Republic

School year	Basic schools (age 6–9)	Classrooms	Pupils	Teachers
2016/17	4140	45,116	906,188	61,634.9
2017/18	4155	46,023	926,108	63,004.8

Resource ČSÚ (2018)

Table 6.8 Secondary education (SŠ) in the Czech Republic

School year	Schools	Students	Part-time students	Secondary school education	Students			Teachers
					Secondary education ended with a vocational certificate	Secondary education ended with Maturita exam	General education	
2016/17	1308	421,535	404,087	2369	87,437	315,000	129,554	38,114.9

Resource ČSÚ (2018)

Table 6.9 Higher education institutions (HEI) in the Czech Republic

	Year	2016	2017
HEI	Total	66	65
	Public schools Private schools	26 38	26 37
Faculties	Total	149	149
Students of public and private HEI (Bc, Mg, Ph.D.)	Total	311,168	299,054
	With a foreign citizenship	43,497	43,831
	Full time	236,856	227,783
	Part time and distance education	76,790	73,496
	Public schools Private schools	280,170 31,455	269,689 29,820
Alumni of public and private HE schools/year	Total	77,382	72,057
	Public schools Private schools	67,417 9968	63,080 8987

Resource ČSÚ (2018)

6.2.3 Expenditure on Education

In the Czech Republic, education is free, but there are some exceptions. For example, nursery schools are paid by parents and only the final year before entering basic school is free. In private schools and school facilities, the state finances non-investment expenditures related to education and training. These schools usually collect tuition fees. Education is, decisively, financed from public budgets. However, financing of regional, higher and further education differs. The operation at these schools is regulated by Education Acts. The founder of primary and lower secondary school is usually a municipality. It is responsible for current expenditure (the running costs, e.g. energy) and capital expenditure. The founder of general upper secondary school and multi-year general secondary school is usually a region (EC/EACEA/Eurydice

2014). The major source (75%) of public higher education institutions finance is granted predominantly on the basis of the per capita amounts revenue.

According to the law, private higher education institutions are obliged to secure funding for educational and creative activities. The main part of their revenue comes from tuition fees.

Further education (adult education) is financed from the state budget if it is provided in schools and if it provides education at the respective level. Otherwise, it is financed by relevant ministries, companies or the students themselves. In the case where a company organizes courses for its employees, it is obliged to bear the costs.

6.2.4 Education Research

In the Czech Republic, research and development is seen as a part of a cycle resulting in innovations. The national policy of research and development is prepared in cooperation of the Ministry of Education, Youth and Sports (MEYS) and the Council for Research, Development and Innovation with other central institutions, representatives of academic community and other research organizations and institutions. Educational research covers education in and outside schools. The important scientific domains are subject didactics. Their agenda in the field of theory, practice and research covers specification and justification of subject teaching objectives, legitimization and didactical transformation of contents as well as methodological structuring of educational processes, taking into account psychological, social and other preconditions of pupils and teachers. Subject didactics are developing as autonomous interdisciplinary scientific disciplines (Stuchlíková et al. 2015).

6.2.5 Teachers' Professional Development

The standard path to obtain teacher qualification is provided by universities. Most teacher education programmes are divided into Bachelor's and Master's stages. Further, some one-stage parallel master degree programmes with elements of integration primarily between theoretical and practical parts of training are offered.

Primary teachers (education for children aged in 6–11) are generalists. Teacher preparation for lower and upper secondary schools consists of one or two disciplines. Graduates of bachelor's degree study are not qualified teachers. Graduates of the master's level study are fully qualified teachers for lower and/or upper secondary schools. In the study model for teacher preparation for lower and upper secondary schools, there is considerable variety in the organization of teacher preparation programmes.

Several faculties offer pedagogical staff programmes of continuing professional education. These programmes are divided into two categories: those oriented to obtaining, addition, extension and deepening teacher qualification (not offering an academic degree, guaranteeing the pedagogical qualification) and interest programmes (e.g. the University of the third age (U3) offering a large range of courses, not leading to pedagogical qualification).

In-service training of education staff includes study programmes for unqualified teachers resulting in formal teacher qualification, programmes resulting in other qualifications (e.g. ICT coordinator qualification) or professional development courses (in-service education). It is delivered within the lifelong learning system at higher education institutions, in establishments for in-service training of education staff or other institutions accredited by the MEYS, or this type of education can be gained through self-study. Teachers may get special allowances for acting as ICT coordinators or developing education programmes, and specific Teacher Professional Development (TPD) is required for performing these tasks.

In-service teacher education is not compulsory in the Czech Republic. In the mandatory pedagogical documentation of schools, there is a 1-year school plan of in-service teacher education. Schools have in their budgets finances for covering the costs of the training. The in-service teacher education plan is the head teacher's responsibility and it is up to the head teacher to inspire their teachers to participate. In the Czech Republic, the national labour code, also applicable to teachers, requires that employers evaluate employees. School leaders as employers have a duty to evaluate the quality of teachers but are fully autonomous in determining how this takes place (EC/EACEA/Eurydice 2018).

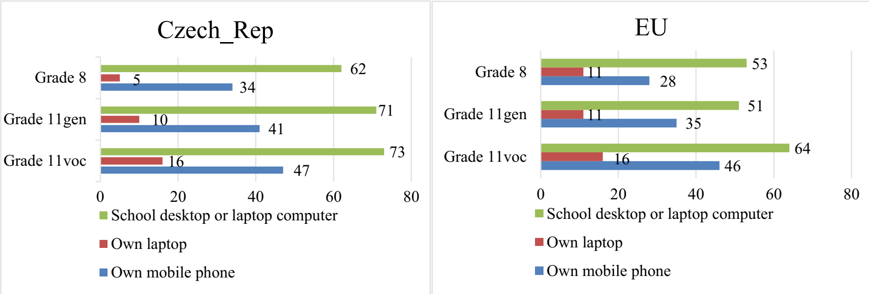
6.3 New Progress of ICT in Education

6.3.1 Infrastructure

In 2012, according to OECD (2015, p. 18), 98.1% of 15-year-old students in the Czech Republic reported that they have a computer at home, 36.9% have even three computers at home. On average, 15-year-old students spent 122 min using the Internet outside school on weekends, while in school during the working days only 18 min. Only 47.6% students reported that they were browsing the Internet for schoolwork at least once a week, while outside of school 61.6% students. In 2012, 25.6% Czech students had used computers in mathematics lessons during the previous month. In 2012, according to OECD (2015, p. 53), the index of ICT use at school was for the Czech Republic about 0.40. 84% of the Czech 15-year-old students reported using computers in schools. They used Internet at school on average for 19 min per day. 36% of students reported that they do not use the Internet at school during a typical school day.

In 2012, during an EC survey 'students at grade 8 and 11 were asked how frequently they used various items of ICT equipment in their lessons for learning purposes' (European Schoolnet 2012, p. 10) (Table 6.10).

Table 6.10 Percentages of Czech students using ICT equipment in their school for learning, at least once a week, in 2012



Resource European Schoolnet 2012)

Table 6.11 ICT equipment for each pupil/student in ZŠ and SŠ

	Small ZŠ (%)	Big ZŠ (%)	SŠ + tertiary vocational schools (%)
For all school subjects	39.5	27.8	36.1
For general subjects (SŠ)	0.0	0.1	1.2
For vocational subjects (SŠ)	0.0	0.0	3.1
For selected items	40.1	60.3	54.9
Classrooms are not equipped with digital technology	20.3	11.8	4.7

Resource ČŠI (2017a, p. 12)

Currently, a relatively large number of small ZŠ[1] (compared to big ZŠ) do not have computer labs available to facilitate active work of all pupils on a desktop computer (ČŠI 2017a, p. 12). On the other hand, there are a large number of small ZŠ in which all teachers can use such classrooms (ČŠI 2017a, p. 12). 'At 27.6% of ZŠ, SŠ and tertiary vocational schools, the so-called mobile classrooms (a set of laptops or tablets that are used in different classes/subjects) are available within classrooms and in teaching of various subjects' (ČŠI 2017a, p. 12) (Table 6.11).

In Czech schools, the use of desktop computers (PC) and laptops is clearly prevalent. A low proportion of BYOD implementation into schools is related to a lack of appropriate infrastructure in schools and to a lack of capacity to administer and manage ICT resources (ČŠI 2017a, p. 19) (Table 6.12).

'Almost all secondary and tertiary schools have classrooms where students can be actively involved in PC or other work with a digital device at the same time, and in more than half of schools it is possible to use such a classroom only for selected subjects' (ČŠI 2017a, p. 12).

[1]There are significant differences in the average size of schools in the Czech Republic. Small schools have less than 50 pupils (EURYDICE 2007).

Table 6.12 ICT resources available to pupils/students for their own active work

Type of device	MŠ (nursery schools) (%)	Small ZŠ (%)	Big ZŠ (%)
Mostly a school desktop computer/notebook	96.2	96.2	92.9
Mostly a tablet	13.9	17.6	15.0
Mostly a support for BYOD	1.6	5.9	15.2
Others	3.9	4.0	1.3

Resource ČŠI (2017a, p. 18)

Table 6.13 Teaching staff who have a computer or tablet—proportion of schools in *v* %

Teachers who have a computer or tablet	MŠ (nursery schools) (%)	Small ZŠ (%)	Big ZŠ (%)	SŠ + higher vocational schools (%)
Less than 25%	64.8	23.4	11.3	12.7
From 25 to 50%	20.5	17.1	15.1	14.9
More than 50%	14.7	59.5	73.5	72.3

Resource ČŠI (2017a, p. 13)

In 85% of nursery schools, 41% of small ZŠ, 26% of big ZŠ and 28% of SŠ and tertiary professional schools about 50% teachers have no computer (or digital devices) (ČŠI 2017b, p. 3). The study done by ČŠI showed in 2017 not all teachers can use tablets, or they have not any available tablet (Table 6.13).

The findings show a very low availability of ICT resources for a teacher's work part of Czech schools of all levels. At 85.3% of nursery schools, 40.5% of small ZŠ, 26.4% of big ZŠ and 27.6% of SŠ and higher vocational schools, no other computer (or similar equipment) is available for 50% of teacher staff in their school.

Each Czech school has formulated its own ICT strategy (called ICT plan) which is constantly updated. More than 50% of teachers have their own computer or other digital device. Computers (or other appropriate devices) for pupils are upgraded no later than 7 years. Each school is adequately covered (at least 60% of classrooms) with an internal network for connecting computers or other devices (BYOD support) (ČŠI 2017c, p. 1).

The majority of large ZŠ, SŠ and tertiary professional schools use specific information systems (IS) to manage their agenda. The aggregate annual cost for information systems in schools is at least CZK 80 million.

6.3.1.1 Student–Computer Ratio

According to EC (2013, p. 35), in 2011–12 at grade 4 there were seven students per computer on average in the EU and for the Czech Republic six students per computer, at grade 8 five students per computer on average in the EU and for the Czech Republic also five students per computer. At grade 11 general the student–computer ratio is 4:1 in the EU and for the Czech Republic 6:1, and at grade 11 vocational on average in the EU three students per computer and in the Czech Republic also three students.

In 2011–12, at the grade 4 there were on average in the EU 20 students per Internet connected laptop and in the Czech Republic 45 students. At the grade 8, there were on average in the EU 14 students per Internet connected laptop and in the Czech Republic 33 students. And at grade 11 on average in the EU 14 students per Internet connected laptop and in the Czech Republic 33 students.

According to OECD (2015, p. 65), a mean student–computer ratio for 15-year-old students in the Czech Republic in 2012 was 1.5 student per computer. 'On average across OECD countries in 2012, there were five students for every school computer. Brazil, Costa Rica, Indonesia, Mexico and Turkey had the largest numbers (at least 15) of students per computer, while Australia, the Czech Republic, Macau, China, New Zealand, Norway, the Slovak Republic, the United Kingdom and the United States had fewer than two students per school computer' (OECD 2016, p. 70).

6.3.1.2 ICT Coordinators in Schools

In schools, there are firstly, ICT coordinators (in 47% of small ZŠ and 87% of big ZŠ) who help teaching staff to use ICT in their work and who develop ICT strategy of school, and secondly, ICT administrators (in 18% of MŠ, 35% of ZŠ) who give a technological support to ICT users in schools. A role of ICT coordinator and his/her high performance are crucial for ICT strategy of each school and, in general, for the implementation of technology in teaching (ČŠI 2017b, p. 2). To become an ICT coordinator a teacher must be trained. 29.3% of ICT coordinators in small ZŠ and by 56.9% of ICT coordinators in big ZŠ have completed or still attend a study to become ICT coordinator (ČŠI 2017b, p. 10).

6.3.1.3 Connectivity of Schools

In 1996, Czech public universities and the Academy of Sciences of the Czech Republic founded the CESNET association which is working as a developer and operator of national e-infrastructure for science, research, development and education in the Czech Republic. An important part of CESNET's activities is research of advanced network technologies and applications from hybrid networking, programmable hardware, meta-computing to middleware and video transmissions (https://en.wikipedia.org/wiki/CESNET). The CESNET carried on the project, eduroam, in the Czech Republic supporting mobility and roaming within the National Research and Education Networks (NREN); eduroam is used not only in Czech universities but also on many Czech schools and educational institutions. 'A lack of large research infrastructures is addressed through the European Strategy Forum on Research Infrastructures (ESFRI) and by the MEYS Operational Programme Research and Development for Innovation (USD 1.2 billion). An e-infrastructure

Table 6.14 Connection speed of Internet connection in ZŠ, SŠ + tertiary vocational schools (in %)

Connection speed of Internet connection	MŠ (nursery schools) (%)	Small ZŠ		Big ZŠ		SŠ + tertiary vocational schools	
		(%)	Number of pupils	(%)	Number of students	(%)	Number of students
<1 Mbps	6.0	2.1	34	0.5	219	0.6	180
1–10 Mbps	41.9	35.3	53	13.4	347	11.9	159
11–30 Mbps	31.9	39.4	63	43.0	370	33.4	262
31–100 Mbps	16.6	19.7	64	35.3	420	42.6	385
100 Mbps <	3.6	3.5	58	7.7	466	11.6	451

Resource ČŠI (2017a)

within the GÉANT network (the CESNET – Czech NREN Operator) is under development. The ICT and Strategic Services Programme encourages innovation in ICT solutions, software, and high-technology repair and data centers' (OECD 2012, p. 274).

Currently, 'there are still schools in the Czech Republic that are not connected to the Internet at all or that are connected by a very slow connection' (ČŠI 2017a, p. 15) (Table 6.14).

More than 75% of SŠ and tertiary vocational schools said their students could add their own devices (such as laptops, tablets or smartphones) to school network or to the Internet at school (ČŠI 2017a, p. 17).

The governmental Digital Education Strategy (DES) strives to ensure a high-speed connection for all schools and school facilities.

6.3.2 Educational Resources

Educational resources play an important role in the learning process. Open educational resources can contribute to the fulfillment of the goal of open learning. The DES aims 'to ensure publication of digital content of a wide variety of characters, supported by public funds, under Creative Commons (or otherwise) licensed to simplify access and enable them to be shared by all actors in education' (MŠMT 2014, p. 20). The National Institute of Education (NIE) deals with a quality of digital educational resources supported from public budgets. In July 2016, the first version of criteria for defining a quality of digital educational resources was published. MEYS supports a creation of digital educational resources from public source. In 2016, there was made a proposal with criteria for assessing a quality of digital educational resources. These criteria were divided into three areas: (i) copyright requirements; (ii) technical and technological requirements and (iii) requirements for content science correctness, pedagogy and didactics (including user-friendliness).

Since 2008 digital teaching materials have been available to Czech teachers. The national learning objects repository DUM[2] is available through which users can search also in other linked repositories[3] (EDUin 2016). A number of Czech teachers gained experience with the use and creation of digital learning objects and open educational resources in EU projects involving the Czech Republic (CALIBRATE, etc.).

6.3.3 Learning and Teaching

In the Czech Republic, schools use ICT also with the aim to support face-to-face teaching. Teachers create and share materials for online support using different platforms. The Moodle platform is the most popular and expanded in the Czech Republic. Cloud computing and Open-Source Software (OSS) are two phenomena which penetrate to the Czech schools, too. 'Learning management systems (LMS such as for example Moodle, Google Classroom) and cloud services (e.g. Google Apps/G Suite, Microsoft Office 365) are used less than one-fifth of small ZŠ, more than one-third of big ZŠ, and more than 60% of SŠ and tertiary vocational schools, according to principals´ answers' (ČŠI 2017a, p. 19).

In some faculties of education, student teachers are trained to use different digital technology and platforms to be able to organize technology-assisted teaching. Using these experiences, they can contribute to implement innovative teaching approach in school practice.

In the Czech Republic, online learning platforms are used very often in in-service teacher education or in teacher professional development courses. However, 'across the 26 OECD countries for which data are available, 7.6% of people followed an online course, ranging from 16% in Finland down to and the lowest levels in Austria, Czech Republic and Poland' (OECD 2016, p. 106).

6.3.4 ICT Integration into Teaching Practice

6.3.4.1 ICT in Curriculum for Primary and Secondary Schools

In the Czech Republic, ICT education became a compulsory subject at all levels of school education (at primary school, at lower and upper secondary schools) by the decision of MEYS in 2005, when the Framework Educational Programmes (FEPs) were introduced into schools. Nonetheless, teaching ICT subjects has focused

[2]DUM. http://dum.rvp.cz/. Accessed 26 Apr 2019.

[3]Repositories for search: http://dumy.cz/. Accessed 26 Apr 2019, http://www.veskole.cz/. Accessed 26 Apr 2019, http://www.activucitel.cz/. Accessed 26 Apr 2019.

on developing user skills to work with computers, to use the Internet, search for information and to work with commonly available computer applications.

Currently, the NIE is preparing a revision of the FEPs which will bring radical changes in education curriculum precisely because digital literacy of pupils will be developed across all subjects and the compulsory ICT subject will be transformed into the subject of informatics (computer science or computing). These changes are in line with the DES for 2020 which the Czech government approved on 12 November 2014.

Since 2005, a compulsory subject 'Information and communication technology' has been a compulsory part of the curriculum for primary, lower and upper secondary schools. This subject is focused primarily on user skills to work with computers and the Internet (digital literacy). We know it is not enough; user skills to use a computer are no longer sufficient for study and work. Therefore, some ICT teachers have included step by step in ICT subject new topics from computing and computer science.

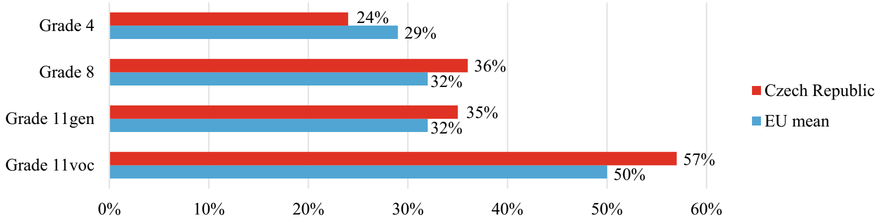
6.3.4.2 ICT or Informatics Teachers

Are there enough qualified or competent teachers in the Czech Republic to teach ICT subjects or informatics at all levels of schools? There are only 52% of teachers for teaching informatics and computing in small ZŠ, 43% in big ZŠ and about 80% in SŠ and tertiary professional schools (ČŠI 2017b, p. 3).

The ČŠI survey in 2017 shows there are not enough qualified ICT teachers for teaching of a compulsory ICT subject in ZŠ and SŠ. The ICT subject is taught on average by 1.3 teachers in each small ZŠ, 2.7 teachers in big ZŠ and 3.7 teachers in SŠ and tertiary vocational schools. 52.2% of ICT teachers in small ZŠ, 43.4% of ICT teachers in big ZŠ and 80.0% of ICT teachers in SŠ and tertiary vocational schools are qualified to teach ICT subjects (ČŠI 2017a, p. 11). According to the ČŠI survey, 60% of teachers assess their digital literacy at a higher user level, and only 21% at a basic user level, and 19% of teachers state they are able to use a wide range of digital tools (such as social networks, information systems, applications, text editors, spreadsheets, presentation programs, shared environments) and they demonstrate a high self-confidence in using the online environment' (ČŠI 2018, p. 26).

Only 7% of teachers say that they share their own products and experiences using digital technology not only with their pupils but also with others outside school; most of them are teachers who systematically organize their Personal Learning Environments (PLEs). By contrast, two-thirds of teachers only share some of their resources with their pupils (mostly offline); most of them are teachers who do not have their PLEs. Nevertheless, there are still 'more than 12% of teachers who do not mention using digital technologies. The highest proportion among these teachers are teachers of foreign language teachers, mathematics or geography' (ČŠI 2018, p. 27). In the Czech schools, digital technology is very often used in subjects like ICT (99% of the hours), natural sciences and geography (91%), and foreign language and social sciences (88%). The teachers use digital technology primarily to present study content

Table 6.15 Teachers' use of ICT in at least 25% of lessons, % of students in 2011–12



Resource European Schoolnet (2012, p. 9)

or to demonstrate working processes (69%). Less often, pupils use technology for simple activities (27%) or for complex (or creative) activities (14%), mostly in ICT lessons (59%) (ČŠI 2018, p. 23).

6.3.4.3 Teachers of Non-ICT Subjects

In 2012, in the Czech Republic use of ICT by teachers was similar 'to the EU average at all grades. There were more teachers using ICT in more than 25% of lessons, above the EU average, at all grades, except at grade 4. The most intense use was at grade 11 general where about one in four use ICT with their students in more than 75% of lessons' (European Schoolnet 2012, p. 9) (Table 6.15).

In 2012, 'at grade 8, Czech teachers were in the lowest group of countries as regards social media confidence and this was also the case at other grades' (European Schoolnet 2012, p. 13). In 2012, 'in the Czech Republic more than the EU average of students were in schools where teachers had recently undergone ICT training provided by school staff, at all grades except at grade 8 which was at the EU level. Fewer were in schools where teachers took part in training through online communities or had recently undertaken personal learning, below the EU average all grades' (European Schoolnet 2012, p. 17) (Fig. 6.2).

In 2012, at grade 8 the Czech Republic students were in the lowest group of countries as regards social media confidence close to European average (Fig. 6.3).

According to OECD (2016), in 2012, Czech primary and secondary school teachers have shown relatively a good level of ICT and problem-solving skills (Fig. 6.4).

6.3.4.4 Students' Ability to Use ICT to Create Digital Outcomes and to Solve Problems

In schools, students very often create different digital products (artefacts): a digital creative production is a typical component of digital literacy. ČŠI (2018) found that 'in 47% of lessons students do some digital products. Very often (in 97% of lessons)

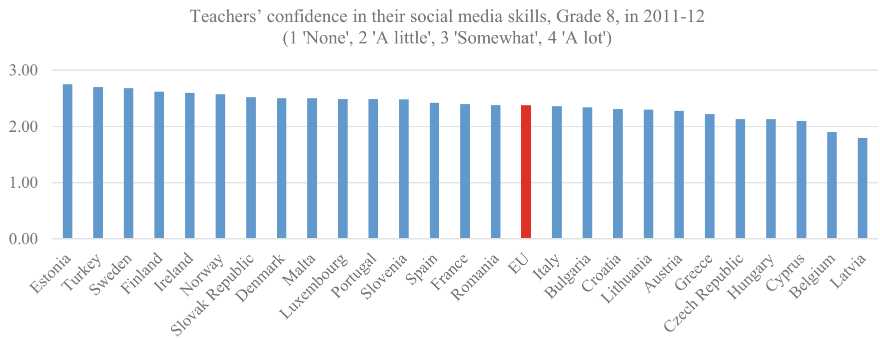


Fig. 6.2 Teachers' confidence in their social media skills, grade 8, in 2011–12. *Resource* European Schoolnet (2012)

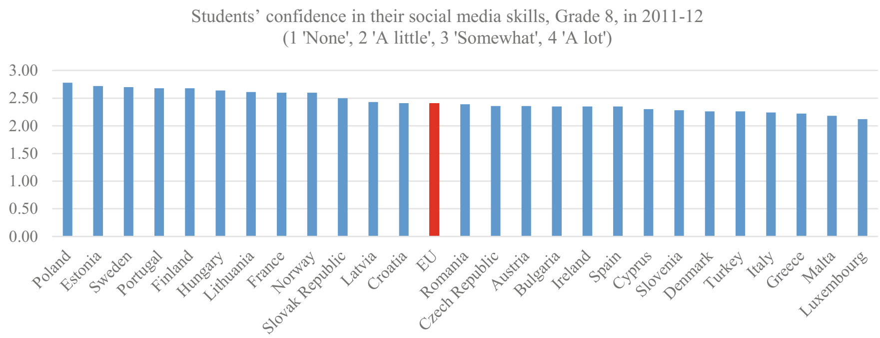


Fig. 6.3 Students' confidence in their social media skills, grade 8, in 2011–12. *Resource* European Schoolnet (2012)

a created product has a visual form (e.g., image, text, graph, diagram, table, movie, animation), much less often it is an acoustic product (sounds, narration, music, etc.), or others'.

In the Czech Republic, schools support pupils and students to participate in the Informatics Beaver competition (ibobr.cz) which has a great impact on pupils' and students' computational thinking development. It is an excellent and effective approach to engaging young people to develop their algorithmic and logical thinking and ability to design strategies to solve computational problems (OECD 2016, p. 59). The requirement to develop pupils' skills to solve ICT problems has not been particularly emphasized in the Czech school curriculum. As indicated above, the revised curriculum FEPs in the Czech Republic will implement the concept of digital literacy in accordance to the Digital Competence Framework 2.0 developed by the EC JRC (Vuorikari et al. 2016) in which problem-solving with ICT is one of five key components of digital competence.

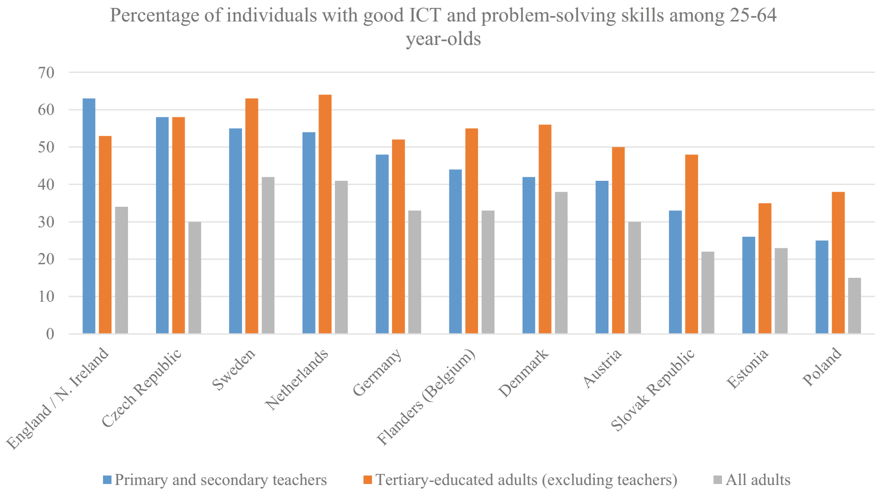


Fig. 6.4 ICT skills among primary and secondary teachers, other tertiary educated adults and the overall adult population in some European countries, in 2012. *Resource* OECD (2016)

6.3.4.5 Factors Influencing the State of Use of ICT in Schools

There are many reasons why we cannot be satisfied with the use of ICT and ICT teaching at schools. In Table 6.16, there are key factors that effect on using ICT in teaching practice in Czech schools.

The state of ICT use in schools is monitored and evaluated by the Czech School Inspectorate (ČŠI). During the school year 2016/2017, through an online questionnaire to head teachers of all schools (nursery schools, primary, secondary and tertiary professional schools), the ČŠI collected data about using digital technology in schools. It was found that 'the use of digital technologies in nursery schools (MŠ) has a specific character. Nursery schools (MŠ), as opposed to basic schools (ZŠ) and secondary schools (SŠ) do not carry out education in a specialized field of study (ICT); digital technology serves as one of a complementary form in pre-school education and is designed primarily for management and communication, and also as a tool for teaching staff' (ČŠI 2017a, p. 4).

To assess the integration of ICT into a school life, a diffusion model of 'integration of modern technologies into teaching' was proposed. This model describes 'the level of incorporation of ICT into school performance in five areas: (1) Management and planning; (2) ICT in school curriculum; (3) Professional development; (4) Integration of ICT into school life; and (5) ICT infrastructure. The individual areas are described in a total of 29 indicators' (ČŠI 2015, p. 6). Assessing of a level of ICT development of school by the ČŠI is based on school documents, including self-assessment, the school ICT strategy development and interviews with school staff (principal, ICT coordinator, teachers).

Table 6.16 Factors that prevent teachers from using ICT more intensively in their teaching

Factors	Small ZŠ (%)	Big ZŠ (%)	SŠ + tertiary vocational schools (%)
Lack of time	31.4	34.7	29.7
Insufficient ICT equipment	46.0	53.7	45.8
Insufficient knowledge of ICT	20.5	36.4	28.5
Problems in organizing teaching	26.5	32.1	26.3
Problems in linking ICT and curriculum	5.9	9.3	14.1
Negative attitude towards the inclusion of ICT in education	5.8	13.6	12.2
Poor prior experience with the use of ICT in teaching	3.2	7.7	7.7
Concerns about ICT and lack of self-confidence	10.5	28.4	20.5
Another reasons	8.6	8.3	8.4
Teacher do not see any obstacles	22.3	12.5	18.8

Resource ČŠI (2017a, p. 20)

The ČŠI has been monitoring and evaluating the status of ICT in schools for several years using the following indicators for identifying the ICT level of schools. These indicators ‘really influence the assessment of the conditions for the use of digital technologies in education’ (ČŠI 2017a, p. 21):

- updated school ICT strategy development;
- ICT administrator in the school;
- ensuring that more than 50% of teachers have their own computer or other devices in the school;
- upgrade of computers (or other appropriate devices) for pupils (at the latest after 7 years) and
- The school is adequately covered (at least 60% of classrooms) with a local network for connecting computers or other devices (BYOD support).

A school meeting these parameters has an up-to-date ICT service and development strategy, which is ensured by a qualified employee who is also responsible for comprehensive management, security and other requirements well in advance.

6.3.4.6 Indicators for Evaluating Students and Teachers in ICT Literacy Development

ČŠI has specified indicators of ICT literacy or digital literacy development. In accordance with Ferrari (2013), the following indicators have been defined for the assessment of the progress of pupil's digital literacy development: (1) information processing, (2) digital content creation, (3) working with digital technologies, (4) security and ethical behaviour in a digital environment, (5) solving problems, (6) communication and collaboration and (7) personal learning environment of pupils and teachers. The ČŠI monitors these indicators in schools, using observation methods of the activities in the classroom, evaluating the materials used, evaluating pupils' outputs, evaluating the digital technologies used, analysing school rules, regulations and orders, student work, interviewing teachers, pupils, ICT coordinators, analysis of the training organization, portfolio analysis, etc. (ČŠI 2015).

6.4 Policy and Strategy of ICT

The DES focuses on three cross-cutting priorities: (1) reducing inequalities in education, (2) promoting quality teaching and teaching as a key assumption and (3) managing the education system responsibly and effectively. Its main goal is to set the conditions and processes in education that will enable to realize digital education. It encompasses both education that effectively uses digital technology to support teaching and learning and education that develops pupils' digital literacy and prepares them for application in society and in a labour market, where knowledge and skills requirements in the information technology segment are still growing.

The DES emphasizes the concept of open learning. The Czech government is striving to 'build an open environment that will enable every individual, without any difference and without obstacles, to learn for life. Such learning by using available digital technologies and encouraging individuals to use them will increasingly be perceived as an activity without any link to a specific place and time' (MŠMT 2014, p. 11). Digital literacy development in schools will follow the DigComp concept defined in EU documents (see Ferrari 2012, 2013). In schools of all levels, including pre-school education, attention will be paid to computational thinking development of pupils and their teachers. The DES aims to meet these three priority objectives: (i) to open education to new methods and ways of learning through and with digital technologies, (ii) to improve pupils' competencies to use information and to work with digital technology and (iii) to develop pupils' computational thinking. A great deal of attention will be paid to digital literacy being developed in all subjects across the curriculum. The development of digital literacy and computational thinking will also focus on education of children in nursery schools.

6.4.1 Policies-Related Educational Informationalization in Recent Years

Since October 2017, in a frame of the 3-years project, «PRIM» (www.imysleni.cz), nine Czech faculties of education have been working closely together to develop and validate teaching materials, guidelines for teaching a new subject of Informatics and for validating these at several selected schools (starting with pre-school centres ending with secondary schools). At the same time, courses and subjects for teachers of MŠ, ZŠ and SŠ are being prepared to be ready for the planned curricular changes. All nine faculties of education must innovate study programmes for student teachers of all subjects including ICT and Computer Science. Moreover, since January 2018, all nine faculties have been collaborating on another 3-year project «DG: Support for the development of digital literacy» (http://pages.pedf.cuni.cz/digitalni-gramotnost/). Both projects, «PRIM» and «DG: Support for the development of digital literacy», should define conditions, design materials and verify new methodological approaches to make DES a reality in schools.

6.4.2 ICT Financing Resource

'Financing of schools starts from a normative basis (i.e., the number of pupils is significant) and is combined with programme financing (developmental programmes). Universities are also financed on a normative basis, but at the present time the influence of qualitative criteria in the process of financing is increasing. Universities get financial means for the instruction of students from the MEYS' (Mazouch and Vltavská 2016, p. 38). According to EUROSTAT (2017, p. 59), the Czech Republic's public expenditure on tertiary education relative to GDP in 2014 achieved 0.8%.

In 2012, 'the Ministry of Education allocates an overall amount for teaching, and other educational costs as well as for school services (in-service training of educational staff, special interest and leisure time activities of pupils, guidance, meals and accommodation and activities connected with school development) to regional authorities. Regional authorities then distribute resources to schools according to the number of pupils and their regional per capita amount' (EACEA P9 Eurydice 2012, p. 58).

'In the Czech Republic, the Ministry of Education (after negotiations with public HEIs) sets the limit on the number of students who are to be funded from the state budget. Public HEIs may admit more students but they have to fund them from their own resources, as they cannot charge students tuition fees for studying in a degree programme in the Czech language unless the length of studies exceeds the standard length by more than one year. Tertiary professional schools in the Czech Republic, providing programmes at level ISCED 5B, have fixed capacity of students which is based on the limits set by the relevant regional authority which is in charge of governance of tertiary professional education within the given region' (EACEA P9 Eurydice 2012, p. 61).

In the Czech Republic, 'the transfer of resources for teaching staff involves both the national administrations (top level) and their regional (intermediate level) authorities' (EC/EACEA/EURYDICE 2014, p. 15).

'In a majority of EU countries, central/top level ministries use a funding formula to establish the level of resources for operational goods and services. As is the case for teaching staff, a funding formula is the method most commonly used by the responsible ministries to determine the level of resources for operational goods and services, regardless of the type of funding (grants or lumps sums) and whether it is intended to cover all or only some of the costs involved' (EC/EACEA/EURYDICE 2014, p. 28). The Czech Republic belongs to three countries which use a method different to the one used for determining the level of teaching staff resources.

'The school system is principally financed from public budgets. Nevertheless, financial flows in the regional school system (including schools from nursery schools to higher vocational schools and school facilities; this is regulated by the Education Act), university system and further education are different' (Mazouch and Vltavská 2016, p. 30).

'According to Education at a Glance 2014, the overall level of educational funding is comparatively low in the Czech Republic: Total expenditure (public and private) on all levels of education in the Czech Republic is 5.0% of GDP (6.1% on average in the OECD); public expenditures on primary, secondary and post-secondary non-tertiary education is 2.6% of GDP (3.6% on average in the OECD; 3.5% on average in the EU21 countries)' (Mazouch and Vltavská 2016, p. 30).

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Chapter 7
Report on ICT in Education in the Republic of Estonia

Hans Põldoja

7.1 Overview of the Country

7.1.1 The Geography and History

Estonia is a small country located in Northern Europe, on the eastern coast of the Baltic Sea. It borders with Latvia in the south and Russia in the east. With the area of 45,000 km^2, it is slightly larger than the Netherlands. However, the population of Estonia is only 1.3 million people. The capital and the largest city of Estonia is Tallinn (population 439,000), which is situated on the northern coast. The second largest city Tartu (population 99,000) is a university town situated 186 km southeast of Tallinn. 69% of the population lives in urban areas and much of the economic activity is concentrated around Tallinn and Tartu. The sparsely populated areas in the countryside are a challenge both for the regional economic development and for the educational system.

Estonia has had a turbulent history with a number of rulers. Since the medieval times it has been under Danish and Swedish rule, until it was conquered by the Russian Empire in 1710. Despite the various rulers, Estonia has managed to maintain and develop its language and culture. The first university was established under the Swedish rule in Tartu on 1632. In the nineteenth century, Estonia had an enlightenment and a national awakening period which leads to declaring the national independence in 1918. The first period of independence lasted until 1940. After the World War II, the Estonia remained occupied by the Soviet Union until 1991. After restoring the independence, the country has had a quick economical development and has joined both the European Union and NATO in 2004.

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7.1.2 Cultural Development

The official language is Estonian and 68.7% of the population are Estonians. Other ethnic groups include Russians (24.9%), Ukrainians (1.8%), Belarusians (0.9%) and Finns (0.6%). Over the last two decades, Estonia has had initiatives that support foreigners to learn Estonian. In areas with significant Russian-speaking minority, there are also Russian schools. Basic education can be obtained in Russian, but in upper secondary level at least 60% of courses are taught in Estonian. Higher education in public universities is provided in Estonian, but there is an increasing number of study programmes in English which also attract international students.

7.1.3 The Political System

The Estonian political system is based on parliamentary democracy in which the single-chamber parliament with 101 members influences the governing of the state by determining state budget, approving the legislation and appointing high officials, including the prime minister and the president. The government carries out Estonian domestic and foreign policy which is shaped by the parliament. The president is the highest representative of the state with a limited role in the legislation. The main goals of Estonian foreign policy is to maintain national security and stable international relationships through involvement in the European Union and NATO.

7.1.4 Economic Development

Since restoring the independence in 1991, Estonia has reformed its economic system into a modern service economy. In 2011, Estonia became the member of the eurozone and its economy is strongly influenced by the economic developments of main export partners Finland and Sweden. In 2017, Estonia was among the fastest growing economies in the EU with a GDP growth of 4.9% (Müürsepp 2018). By GDP per capita, Estonia is on the fourth place after Slovenia, Slovakia and Czech Republic among the Eastern European countries. The main challenges that hinder the success of the Estonian economy are lack of highly skilled employees, lack of innovation, and low international competitiveness.

7.1.5 The Status Quo of Science and Technologies

The economic growth is depending on the state of science and technologies. As a small country, Estonia has to focus its science and research in some key areas. The

Estonian Research and Development and Innovation Strategy 2014–2020 (2014) establishes three selected fields of growth: (1) information and communication technology (ICT), horizontally through other sectors; (2) health technologies and services and (3) more effective use of resources. In the last decade, Estonia has become a base for an ecosystem of IT start-ups. The first success story of the Estonian IT sector was Skype, in which the technical backend was developed by a small team Estonian engineers, before it was acquired by eBay and later by Microsoft. The global economical crisis in 2008–2009 forced financial sector, telecoms and other major IT employers to reduce their workforce which created conditions for the emergence of the start-up sector. Dumas (2014) associates the success of the Estonian start-up ecosystem with three factors that are related to the small size of the country: (1) fewer regulations and barriers, (2) thinking internationally and (3) focusing on developing simplified and agile solutions for complex areas. The most successful current start-ups are a transportation network company Bolt (formerly known as Taxify) and money transfer service TransferWise.

Estonia is also known for its e-governance solutions (Kalja et al. 2013) which rely on the ID-card infrastructure that enables secure authentication of citizens and digital signing of documents on a wide array of e-services both from the public and private sectors. All the state e-services are connected through the X-Road system that enables data exchange between various systems. People can access public e-services and view information stored about them through the state portal. Around 98% of tax declarations are filed through an e-Tax service of the Estonian Tax and Customs Board. The majority of admission applications for universities are submitted through and online system SAIS. In the most recent parliament elections in 2019, 43.75% of citizens voted through an i-voting system (Galano 2019). Private e-services that can be accessed by authenticating with ID-card include online banks, telecom companies and various other companies that have a large number of customers. In 2014, Estonia launched the e-Residency initiative (Kimmo et al. 2018) that enables citizens of other countries to become e-residents of Estonia in order to use the Estonian e-governance services. E-residents are able to use all e-services based on the ID-card infrastructure: authentication, signing documents digitally, establishing and administering a company, using banking services, etc. According to the e-Residency statistics dashboard, more than 50,000 people have been approved as e-residents and they have established over 6000 companies.

7.1.6 The Relationship with China Under the '16 + 1' Cooperation Framework

Estonia is part of China-CEEC 16 + 1 collaboration platform established between China and 16 Central and Eastern European countries in 2012. Estonia has a stable and growing economical relationships with China. In 2017, China was the 9th foreign trade partner for Estonia. Estonian export to China includes electrical equipment, wood and wood products, and agricultural products. Estonia's geographical location provides possibilities for the logistics sector. Chinese ride-sharing, artificial intelligence and autonomous technology company DiDi is one of the key investors in the Estonian transportation network company Bolt. There is also growing cooperation in education, research and culture. Approximately, 100 exchange students from China are studying in Estonian universities every year. The Confucius Institute was opened in 2010 in Tallinn University to offer courses on Chinese language and Chinese traditional culture.

7.2 Overview of the Educational Development

7.2.1 Education System and Policy

The development of the educational system in Estonia is guided by the Estonian Lifelong Learning Strategy 2020 (2014), which establishes five strategic goals: (1) a change in the approach to learning; (2) competent and motivated teachers and school leadership; (3) the concordance of lifelong learning opportunities with the needs of the labour market; (4) a digital focus in lifelong learning and (5) equal opportunities and increased participation in lifelong learning. The Ministry of Education and Research (MER) has launched a number of specific development programmes under these five goals and the government follows the strategy when making the funding decisions.

General education in Estonia is divided into pre-school, basic and upper secondary education. Pre-school education is provided for children between 18 months and 7 years. Basic education is mandatory for all children and is divided into three stages: stage I (grades 1–3), stage II (grades 4–6) and stage III (grades 7–9). The content and objectives of the basic education are specified in the national curriculum of basic school. In order to graduate the basic school, the students have to complete all the courses of the curriculum and pass three exams: Estonian language (or Estonian as a second language), mathematics and one additional exam chosen by the student. After completing the basic education, it is possible to continue in the upper secondary school (grades 10–12) or in vocational education. In vocational secondary education study programmes, it is possible to obtain upper secondary education in addition to vocational training.

Basic schools and the majority of upper secondary schools are administered by rural municipality or city authorities. In recent years, the MER has started to develop a network of state upper secondary schools with the aim to ensure the high-quality secondary education and a more efficient school network. Currently, there are 15 state upper secondary schools and the ministry aims to have at least one state upper secondary school in each county by 2020. While typical upper secondary schools run by the local municipalities have grades 1–12, new state upper secondary schools have only grades 10–12.

7.2.2 Profile of School, Students and Teachers

The Ministry of Education and Research has developed an online portal Haridussilm (EducationEye) that provides annual statistical data about the Estonian education. In 2018/19 school year, there are 518 schools providing general education in Estonia and 160 of these are providing upper secondary education. The number of schools has been declining every year, in 2005/06 school year, there were 602 schools. All together there are 151,000 students in general education and 22,000 of them in upper secondary level. In recent years, the number of students has been slowly increasing. The lowest point was in 2012/13 school year when then were 134,000 students in general education. 84.6% of the students are studying in Estonian and 14.7% in Russian. In 2018, over 11,000 students graduated from the basic school and over 6000 from the upper secondary school.

For a long period of time, the vocational education was perceived as less prestigious than secondary education and students preferred upper secondary schools to vocational schools. After joining the European Union, big investments have been made to increase the quality of vocational education. Currently, there are 38 vocational education institutions with 23,000 students. While in 2007/08 school year, there were 22% more students in upper secondary schools than in vocational education, from 2010/2011 school year, there have been more students in vocational education. Although overall student numbers in vocational education have decreased 14% in the last decade, the decrease has been more significant in upper secondary education (28%).

The higher education is provided in 20 institutions: 6 universities under public law, 8 state professional higher education institutions, 1 private university and 5 private professional higher education institutions. Three largest public universities are University of Tartu (12,000 students), Tallinn University of Technology (10,000 students) and Tallinn University (7000 students). All together there are 45,000 students studying in higher education in 2018/2019 academic year. This number has decreased significantly over the last decade, in 2008/2009 academic year, there were 68,000 students in higher education level. The decrease of student number has mainly affected bachelor's studies and vocational higher education. The number of master's students has increased slightly during the last decade, as many adults return to university to obtain a master's degree in a different field. In 2013, Estonia had a higher education reform with the aim to make higher education free of charge for new full time students admitted to study programmes taught in Estonian. On one hand, this step has improved access to higher education, but on the other hand, it has complicated the financial situation of the universities. The universities have opened international study programmes in English, which also attract foreign students. In last 10 years, the number of foreign students has grown five times, and currently there are about 10% of international degree students in the Estonian universities. The annual enrolment rate in higher education was 14,000 in 2018/2019 academic year. However, the dropout rate is quite high. In 2017/2018 academic year, 9000 students graduated in higher education and 7000 students interrupted their studies.

There are 15,000 teachers working in general education, 2000 teachers in vocational education and 7000 in pre-school education. A critical issue is the age of teachers: 49% of school teachers are 50 years or older. Only 9% of the teachers are under 30 years old. With these numbers Estonian teachers are among the oldest in OECD countries. The ministry has taken measures to rise teachers' reputation and increase teachers' salaries. Despite these attempts, there is still a lack of young teachers in schools and teacher education programmes do not attract enough new students. In 2017/2018 academic year, only 355 students graduated master level studies in teacher education programmes.

7.2.3 Teachers' Professional Development

Teacher education programmes are run by two public universities, Tallinn University and University of Tartu. General requirements for teacher training are established in the Framework for Teacher Training. Teacher training programmes are offered in the master level and consists of core courses in the area of subject, teacher training courses, subject-specific didactics, placement and master's thesis. It is expected that students enrolling the teacher training programme have completed bachelor's studies in the subject area. Teachers graduating the teacher education programmes are certified on the basis of Teacher's Professional Standard. Novice teachers are also expected to complete the induction year during which they are supervised by the mentor. A detailed overview of the Estonian teacher education system is provided by Sarv (2014). In-service teacher training is provided by universities, various foundations and non-governmental organizations according to the conception of teachers' and school heads' continuous education, which sees changing the approach to learning as a main challenge. Although the studies such as TALIS 2013 (OECD 2014) show that teachers believe in constructivist approaching the learning, the actual school practice is slow to change. In-service teacher training must support using ICT in the learning process and developing self-analysis and research skills.

7.2.4 Government Expenditure on Education

The government expenditure on education was 5.8% of GDP in 2017. 59% of the costs went for personnel expenditure, 21% for operational costs, 12% for investments and 8% for other costs. In order to compare the government expenditure on education with other countries, we have to look at the OECD Education at Glance report (OECD 2018, p. 266), which has a different methodology for achieving comparative results. According to OECD report, Estonia's direct expenditure within educational institutions was 4.1% of GDP in 2015, which is below the OECD average. In recent years, the expenditure on general education has increased (from 2.07% in 2012 to

2.20% in 2017) had the expenditure on higher education has decreased (from 1.44% in 2012 to 1.01% in 2017).

7.2.5 Education Research

The structure and operational principles of research and development in Estonia are established in the Research and Development Organisation Act. National R&D development plans are prepared and approved by the government, which is advised by the Research and Development Council. The research policy is implemented by the MER. Positively evaluated research and development institutions include 6 public universities; 1 private university and more than 10 research institutes, museums and private companies. The research activities are funded by the base financing of research institutions, personal and institutional research grants and national science programmes. The national research funding also covers centres of excellence, doctoral schools and expenses of research and development infrastructure. Different competitive funding instruments are managed by the Estonian Research Council. The four main objectives of research and development are established in the Estonian Research and Development and Innovation Strategy 2014–2020 (2014): (1) research in Estonia is of a high level and diverse; (2) research and development functions in the interests of the Estonian society and economy; (3) research and development makes the structure of the economy more knowledge-intensive and (4) Estonia is active and visible in international research, development and innovation cooperation. In order to achieve these goals, the strategy aimed to increase the public research funding to 1% of GDP by 2020. However, it is not realistic as current government expenditure on research and development is 0.81% of GDP, which is considered insufficient by the research institutions.

7.3 New Progress of ICT in Education

ICT in education has been a priority area for Estonia from mid-90 s, when it was understood that the smart use of information technology in various sectors is a success recipe for a small country. In 1996, the Tiger Leap Program was launched to support the development of ICT infrastructure in schools, provide basic ICT training for teachers and develop educational software and learning resources in Estonia. In order to coordinate these developments in general education, the Tiger Leap Foundation was established in 1997. The general level of using ICT in teaching and learning was lower in higher and vocational education, although some innovative lecturers provided online courses already in late 1990s. The Estonian e-University consortium was established in 2003 with the aim to provide more flexible learning opportunities in higher education. The consortium coordinated the licensing and hosting of WebCT learning management system for the partner universities and supported the sharing of good practice among the educators. The consortium worked in tight cooperation with the Estonian Information Technology Foundation, which coordinated ICT projects in higher and vocational education. In 2013, the Tiger Leap Foundation, Estonian Information Technology Foundation and educational Internet service provider EENet were reorganized and a new coordinating organization Information Technology Foundation for Education (HITSA) was formed. In order to implement the goals of the Estonian Lifelong Learning Strategy 2020, MER has established the Digital Focus programme.

7.3.1 Infrastructure

The general situation of ICT infrastructure in schools can be considered satisfactory, although there is no recent data published about the current situation of the ICT infrastructure. The most recent study about the ICT infrastructure in schools was carried out in 2014 by the HITSA foundation (HITSA 2014). According to the study, the average student–computer ratio in schools was 13.9. About 30% of the computers were located in computer labs, the rest were in other classrooms or in personal use of teachers and school administration. At average, 90% of the computers were connected to Internet, which means that in schools there are still rooms without proper Internet connection. About half of the computers used by the students are relatively new: 45% of computers were up to 3 years old and 37% of computers were between 4 and 6 years old. The computers used by the teachers and the school administration were slightly older: 39% of computers were up to 3 years old and 41% of computers between 4 and 6 years old. Still, almost 20% of computers in schools are older than 6 years. Large schools with more than 600 students are able to upgrade the computer labs more frequently. In 2018, the MER had a project for updating the ICT infrastructure in schools, which included purchasing 4900 laptops, 2100 desktop computers and 480 multimedia computers for schools. In recent years, some schools have invested also in tablet computers, although the majority of schools have taken BYOD approach in which the students will bring their own device to the school. In 2014, the student–tablet ratio was 81, which means that most of the schools do not have sufficient number of tablet computers to be used in lessons. However, in this case, the average number might not indicate the real situation, as some schools have invested in a set of 30 tablets that can be used with the whole class while other schools have just a few or no tablets at all. Another technology that has gained use in Estonian schools is interactive whiteboard. In 2014, 10% of classrooms had an interactive whiteboard installed. In state upper secondary schools, every fifth classroom had an interactive whiteboard. While interactive whiteboards were still in a minority of classrooms, video projectors were installed in 65% of the classrooms according to the study.

One of the areas that need improvement is the network connection speed. An analysis carried out in 2014 indicated that 80% of schools have a network connection speed slower than 30 Mbit/s, which is not sufficient for using modern media rich online services in the classrooms. In order to improve this situation, the Ministry of

Economic Affairs and Communications has launched a programme for modernizing the ICT infrastructure of general schools in 2016–2020. During the first 3 years of the programme, the work has been completed in 159 schools, where the local area network cabling was renovated and network equipment was replaced.

7.3.2 Educational Resources

Digital educational resources

The development of digital learning resources in Estonian has been a focus since the Tiger Leap Program in late 1990s. Looking at the use of digital learning resources in schools, we can identify three phases. In late 1990s and beginning of 2000s, the focus was on the use of educational software that was mainly produced by the Estonian universities or by foreign educational content publishers. In 2001, the national educational portal Koolielu (Schoollife) was launched, which provided a repository platform that enabled teachers to publish their own learning resources. In the second phase from mid-2000s to mid-2010s, the main focus was on the content developed by the teachers. In general education, this process was supported by various teacher trainings and competitions which motivated teachers to create and share their resources. In vocational and higher education, there were a number of projects in which the lecturers were paid for developing digital learning objects and course modules. While this approach provided a large number or resources developed by the educators, the quality of this content varied and lecturers of higher and vocational education institutions stopped sharing their resources when the funding for content development ended. In recent years with the Digital Focus programme, the MER has taken an approach to combine professionally developed content by the textbook publishers with user-generated content from the teachers. Since 2015, the textbook publishers are required to make the digital versions of their textbooks available for schools. To provide a common platform for textbook publishers and teachers, the MER launched e-Koolikott (e-Schoolbag) repository in 2016. The largest textbook publisher Avita has developed a platform Opiq, which contains 140 digital textbooks, mainly for the basic school level. In order to cover upper secondary school curriculum with digital learning resources, MER contracted with Tallinn University, which coordinated a large content development project in which more than 120 experienced subject teachers were hired to develop digital learning resources for schools. As a result, the teachers developed more than 10,000 resources using H5P authoring platform.

Open educational resources

The concept of open educational resources (OER) is understood by the key people who are involved in shaping the policies for ICT in education. As a result, Creative Commons licenses were introduced to learning resource repositories in late 2000s and localized to Estonian in 2010. e-Koolikott repository contains more than 18,700 resources, 11,700 of these are under Creative Commons licenses. Usage statistics from the repositories show that the teachers in general education are more open to share their learning resources as OERs. In vocational and higher education, Creative Commons licenses are often chosen because of the funding requirements and in that case more restrictive license types are preferred. For example, in HITSA foundation's repository, which focuses on higher and vocational education, 46% of resources are under the most restrictive CC BY-NC-ND license, followed by 41% of resources under CC BY-NC-SA license. In e-Koolikott, which focuses on general education, the most commonly used license is CC BY (61% of OERs), followed by CC BY-NC-SA (28% of OERs). In recent years, the MER has required that content which is developed with public funding must be distributed under Creative Commons licenses. This has resulted the growth of OERs and shift towards more liberal licenses, as the most recent content development projects have required the use of CC BY license.

7.3.3 ICT Integration into Learning and Teaching Practices

In the national curriculum for basic schools, digital competence is listed as one of the eight general competences that is developed through all subjects and in extracurricular activities. For more than a decade, the main focus has been on teaching digital competences through other subjects. Informatics is listed as an optional subject, which the schools are not required to offer. The national curriculum describes the learning outcomes of school informatics for the second (grades 4–6) and third (grades 7–9) stage of general education and outlines two courses: (1) computer as a means of work and (2) information society technologies. The schools are free to develop and provide additional informatics courses as well. However, a recent study carried out by Tallinn University in 2018 found out that more than half of the schools involved in the study do not provide any informatics courses. One reason for this is lack of informatics teachers in schools. Subject teachers are able to teach basic digital competences through using ICT in their subjects, but this is not sufficient for more technical courses such as programming, robotics, 3D modelling or web design.

In recent years, a special attention has been given on teaching programming and robotics in the schools. In 2012, ProgeTiger programme (HITSA 2015) was launched to enhance learners' technological literacy and digital competence. The programme aims to combine engineering sciences, design and technology, and information and communication technology. The programme targets both teachers and learners by developing learning materials, providing trainings for teachers, supporting various networking activities, providing financial support for purchasing various equipment (robotics kits, sensors, 3D printers, etc.) and sharing information.

A study of teaching digital competences in general education and pre-school education (Leppik et al. 2017) summarized three main conclusions: (1) the approach to teaching digital competences varies a lot between the different schools; (2) availability and quality of digital tools and learning resources is key obstacle for teaching digital competences and (3) although teachers and students have a positive attitude towards using digital technologies in teaching and learning, the digital tools are not sufficiently used in practice. The study indicates, that teachers of mathematics (67%) and natural sciences (58%) found the most that teaching ICT competences is integrated with their subject. 78% of teachers use computers and 70% of teachers use presentation tools regularly in their teaching. From the students' perspective, it is important to point out the use of smartphones in lessons: 57% of students use smartphones at least weekly for learning in lessons. Regarding digital learning resources, 78% of teachers have used their own learning resources and 72% of teachers have used resources found from the Estonian educational repositories. The main types of digital learning resources developed by the teachers include worksheets, presentations, quizzes, interactive exercises and videos.

Monitoring the ICT integration into teaching and learning in a state level is a challenge. Tallinn University has developed a framework and online tool for assessing the school's digital maturity. The assessment framework covers three domains: digital infrastructure development, pedagogical innovation and change management in the school. Currently, more than 80% of the schools in Estonia have completed the self-assessment and composed the digital development plan for their school using the Digipeegel (Digital Mirror) online tool. In order to improve the reliability of the data, the self-assessment can be validated through peer evaluation by another school or expert visit. Digital development plans created in Digipeegel are public, so that schools can learn from each other.

In vocational and higher education, a common way of using ICT is to develop an online course either for supporting traditional face-to-face course or providing the course completely in a distance education form. In order to support the development of online courses, the e-University consortium has coordinated the development of various guidelines and established the e-learning quality label process (Plank et al. 2013) which combines self-evaluation, evaluation from the organization and from the experts. 39 courses were awarded with quality label in 2018. The most widely used online learning platform in higher and vocational education is Moodle, which is hosted centrally by the HITSA foundation. Tallinn University has developed an online learning platform eDidaktikum, which is used mostly for teacher education. MOOCs have not been adopted very widely, although there are several successful cases from University of Tartu (Leito et al. 2015; Lepp et al. 2017). Lecturers in Tallinn University have experimented with more learner-centred approaches such as using personal learning contracts (Väljataga and Laanpere 2010), using blog-based learning environments (Põldoja et al. 2016a; Tomberg et al. 2013), and awarding learners with open badges (Põldoja et al. 2016b).

7.4 ICT Related Policies and Financing Resource

The main development strategy and funding instrument for ICT in education is the Digital Focus programme. According to the Estonian Lifelong Learning Strategy 2020, the five strategic measures of the Digital Focus include (1) incorporating a digital culture into the learning process; (2) supporting digital learning resources in schools; (3) accessing a modern digital infrastructure for learning; (4) creating and implementing assessment models for digital competence and (5) creating learning opportunities for adults to acquire digital competences. The action plan of Digital Focus programme for 2018–2021 focuses on two measures: incorporating a digital culture into the learning process and creating preconditions for that. In order to integrate digital culture into the learning process, it is planned to develop curriculum and study programmes, support innovative learning activities, develop teachers' digital competences and provide educational technology support, and to develop the e-assessment methodology. Creating preconditions for these activities involve developing new and innovative digital learning resources, integrating the e-services used in education and improving the network connectivity in schools. The annual budget for these activities varies between 7.3 and 8.8 million euros. This funding is targeted mainly on general education, although the universities are involved in the research and development activities of the Digital Focus, such as coordinating the development of digital learning resources.

IT Academy programme focuses specifically on improving the quality of ICT education in higher education. The programme provides funding for ICT research in the universities, supports the students of ICT study programmes with scholarships and finances development projects for improving the quality of ICT study programmes and teaching subject-specific ICT skills in non-ICT study programmes. IT Academy programme is managed by the HITSA foundation in collaboration with MER, universities and ICT companies. The annual budget of IT Academy programme is 3.4 million euros.

Since joining the European Union in 2004, the resources of European structural funds have also played an important role in improving the education in Estonia. All together, more than 820 million euros have been invested in educational sector. Measures under education include development of educational support services, professional development support for teachers, development of innovative learning resources and other measures that can be associated with ICT in education. The area of information society has received more than 170 million euros, mainly for the development of ICT infrastructure and smart services.

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Chapter 8
Report on ICT in Education in Greece

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8.1 Overview of the Country

8.1.1 The History and Geography of Greece

Greece is situated in the south of the Balkan Peninsula covering an area of 131,049 km^2. The country combines rugged mountains, forests, lakes in the mainland, and an archipelago of about 3000 islands. Greece is bordered to the east by the Aegean Sea, to the south by the Mediterranean Sea, and the west by the Ionian Sea. There are land borders to the north and northeast with, from west to east, Albania, the Republic of North Macedonia, Bulgaria, and Turkey. The country has the longest coastline in Europe and is the southernmost country in Europe.

The first great civilization in Greece was the Minoan culture on the island of Crete around 2000 B.C. The Mycenaeans from the mainland conquered the Minoans in 1450 B.C. During ancient times the country was divided into city-states, which were ruled by noblemen. The largest were Athens, Sparta, Thebes, and Corinth. Each state controlled the territory around a single city. They were often at war with each other. Athens became the most powerful, and in 508 B.C., the people instituted a new system of rule by the people called democracy. Foreigners ruled Greece for over 2000 years beginning with the Romans conquering the Greeks in the second century. Then, after almost 400 years under Turkish rule, Greece won independence in 1832.

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During the Second World War of 1940–41, Greece was one of the few countries that had resisted for so long against the Axis forces. The war was celebrated on October 28, 1940, and eventually, Greece was captured altogether in June 1941 with the occupation of Crete.

Due to its strategic position, and as a natural limit of Europe with the east and the west, Greece has always been considered a vital area. In 1952, Greece became a member of NATO. On April 21, 1967, a coup from a group of kings led Greece to a military dictatorship until 1974. In July 1974, a referendum resulted in the rejection of the constitutional monarchy and the establishment of the current Presidential Parliamentary Republic. Since 1981 Greece has been a member of the European Union.

8.1.2 The Population Situation

The population of Greece is of 10.8 million permanent residents, and of these 5,303,223 are men and 5,513,063 are women (census 2011). According to forecasts, the country's demographic makeup will be quite different in the coming decades due to adverse demographic pressures. These include a decreasing number of births, an influx of migrants, and an expanding aging population. The average age is 42.7 years. The table shows some of the population characteristics (Hellenic Statistical Authority Census 2011).

Of the total of 10.8 million Greek citizens, more than 76% of the population is living in urban or suburban areas. Based on population forecasts of ELSTAT, the population structure per age groups will be rather different in the upcoming decades due to adverse demographic changes and the trends of low birth rate and population aging (Table 8.1).

Table 8.1 Population situation

	Total	%
Population	10.816.286	
Urban	8.285.275	76
Suburban	2.628.357	24
Gender		
Male	5.303.223	49
Female	5.513.063	51
Age		
0–14	1.514.280	14
15–64	7.214.278	67
65+	2.044.278	19
Average Age	42.7	

8.1.3 The Political System

Greece is a parliamentary constitutional republic, with both a President and a Prime Minister as head of the government. The legislative body is the Greek Parliament, which has mainly regulatory competences. The judiciary branch is independent of the legislative branch.

8.1.4 The Current Situation of Economic Development

The current political status has been influenced by the economic crisis. From late 2009–early 2010, due to both international and domestic factors, Greece confronted serious economic hardships. In 2010, a Memorandum of Understanding signed between Greece and the International Monetary Fund (IMF), the European Union (EU), and the European Central Bank (ECB) to receive financial assistance for reducing its debt.

The economic and political situation in Greece has made its mark on every aspect of Greek society including education. The public education expenditure as a share of GDP was 3.8% in 2017, below the EU average (4.6%) (OECD 2018a).

8.1.5 The Status Quo of Science and Technologies

Innovation as a sector of science and technologies in Europe as a whole had an upward trend in 2018. 25 out of the 28 EU Member States have shown improvement since 2011 (which is the reference year for the study), while performance has worsened for three member states (Germany, Romania, Slovenia). Greece is ranked 20th in Europe (9th from the end) and is ranked among the countries of the third category—it is a country of "moderate innovation."

Greece's relatively strong points are the innovative sector (38.8% increase from 2011) and the interconnection sector (an increase of 35.7% from 2011). In both areas, Greece is above the EU average. This means that small- and medium-sized businesses in Greece seem to be innovative in their internal way, but they also seem to offer innovative solutions to the market. There is also an improvement in public–private partnerships in projects aimed at innovation and research. Finally, the employment sector has high prices, which means that jobs in the field of innovation and research have increased. However, this area is likely to need monitoring as there is a general decline (−6.8%) from 2011 (European Innovation Scoreboard Edition 2019).

An important fact that we should not overlook is that in recent years, Greece has experienced a leak of scientific potential that has intensified since the onset of the economic crisis due to the resulting increase in unemployment and the austerity measures that have affected education and the labor market. The result was the mass escape of highly qualified individuals while the current economic crisis, backed by limited state funding for research and reduced wages, discouraged Greek scientists working abroad from returning to their country (Ifanti et al. 2013).

8.1.6 The Status Quo of Social and Cultural Development

In Greece, the Ministry of Culture has started the implementation of a program which focuses on mapping the whole cultural and creative industries of the country, aiming to a comprehensive understanding of the cultural creation and the development of specific supporting policies. Additionally, it operates a database where private cultural institutions can be registered and a platform, which includes information on intercultural dialog issues as well as all the information about festivals and other cultural events nationwide. The Ministry of Culture focuses also on the accessibility of the people with disabilities, with the improvement of infrastructures in cultural spaces and the development of diversified and innovative cultural products for different social groups (UNESCO 2016).

Funding for cultural activities in Greece is mainly from public sources, either from the Ministry of Culture in the central government or from the local budgets of authorities at local and regional levels (Mergos and Patsavos 2017).

The official language of Greece is Greek, spoken by 99% of the population. In addition, a number of non-official, minority languages and some Greek dialects are spoken as well. The most common foreign languages learned by Greeks are English, German, French, and Italian. English is the most widely spoken foreign language in Greece by 51% of the population. 9% speak French and 5% speak German as a second foreign language (EC 2012a).

8.1.7 The Relationship with China Under the "17 + 1" Cooperation Framework

Greece officially joined the "Cooperation between China and Central and Eastern European Countries" Group, which had been known as "16 + 1," in April 2019 and became the seventeenth member of the 16 + 1, which has been renamed to "17 + 1." By joining in, Greece becomes the first new member of the group, which now comprises 12 EU Member States and five Balkan nations that are also slated to join the EU in the future.

8.2 Overview of the Educational Development

8.2.1 *Education System and Policy*

The Greek education system aims to provide free education to all stages of the school system, and according to the Greek Constitution in Article 16, Sect. 8.4, aims "at the moral, intellectual, professional and physical training of Greeks, the development of national and religious consciousness and at their formation as free and responsible citizens" (Hellenic Republic 2008).

At central level, the Greek education system is under the administrative responsibility of the Ministry of Education, Research and Religious Affairs (MofERRA) across all fields, agencies, and levels (OECD 2017). The Greek education system is highly centralized as the central administrative agency exercises control and takes the key decisions related to long-term objectives and also regulates various issues, such as the content of curricula, the education staff, and the funding (OECD 2015). At regional level, the Regional Education Directorates have the mission to coordinate, supplement, support, and implement the national educational policy along with supervising the implementation of various education projects, like European projects, in schools. At local level, the Directorates of Primary and Secondary Education are responsible for all schools in their area and schools are also taking care of their operation (Eurydice 2018a). The Greek Education System is mainly divided into three levels, primary education, secondary education, and tertiary education as shown in Fig. 8.1. Compulsory education in Greece is mandatory for all children between the ages of 4 and 15 and lasts 11 years.

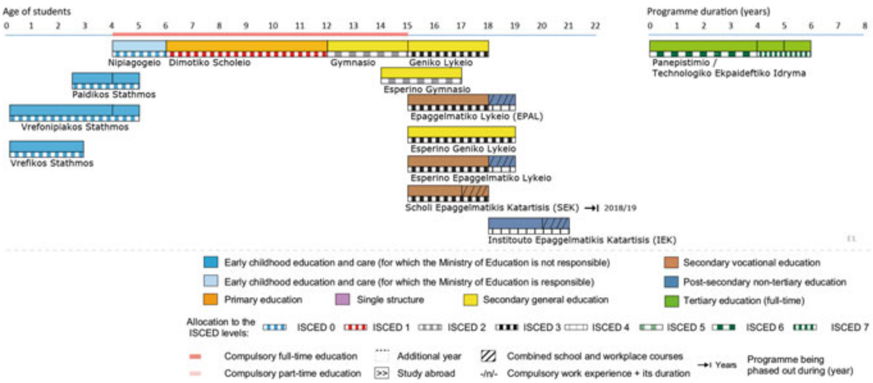

Fig. 8.1 Structure of the Greek education system. *Source* Eurydice (2018a, b)

8.2.2 Students and Teachers' Profiles

Primary education includes pre-primary schools and primary schools. Pre-primary education in Greece lasts 3 years. From the school year 2018–2019, the 2-year pre-primary school for 4-year-old children is compulsory (Law 4521/2018, https://bit.ly/2YlMzAB). Attendance in primary schools has 6-year duration and concerning children in the age range of 6–12 years and includes six grades (1–6), each of which represents specific learning goals defined at central level.

Secondary education consists of two stages, compulsory and non-compulsory secondary education. Compulsory secondary education is provided by lower secondary schools (Gymnasia) day and evening, lasts 3 years and covers the ages of 12–15. This school level aims to promote the all-round development of students depending on their age-related competences and life's demand (Law 1566/1985, https://bit.ly/1hUYlUh). Non-compulsory secondary education is provided either by general or vocational upper secondary schools (Geniko or Epaggelmatiko Lykeio) day and evening. General Lykeio (Geniko) lasts 3 years and includes general education subjects and subjects of specialization in specific cognitive fields (Law 4186/2013, https://bit.ly/2LF9rFr), while vocational Lykeio (Epaggelmatiko) consists of two cycles of studies, the secondary cycle which lasts 3 years and the optional post-secondary cycle, called "Apprenticeship Class," which is optional, lasts 1 year and is addressed to degree holders of the secondary cycle (Eurydice 2018a, b).

Tertiary education in Greece is public and is the last stage of the formal education system. Students can enter in tertiary education only after they pass entrance exams conducted at a national level. Higher education in Greece includes the university and technological sector and provided only by legal entities under Public Law. The Greek state is responsible for the supervision and financial support of higher educational institutions. Studies are divided into three cycles: the undergraduate studies, which usually last 4 years for the most majors; the postgraduate studies, which last 1–2 years and leads to a Master's degree; and the doctorate study program, which requires a thesis preparation, which lasts at least 3 years and leads to the award of a doctoral diploma. Lifelong learning in Greece is not a part of formal education but can be seen as a wider development plan and includes informal education, which can lead to certifications accepted at national level. Vocational training institutes, lifelong learning centers, vocational training schools, and colleges are the main organizations that provide lifelong learning in Greece (Eurydice 2018a, b).

Figure 8.2 presents the teachers' gender distribution in Greece in 2016 in public and private institutions, by level of education. Women constitute almost all of the teaching workforce at the pre-primary level (99%), something that is observed in other OECD countries (OECD average is 97%). Comparing the data over the past decade (2005–2016), there has been an increase in the share of female teachers and the gender gap has widened by 5% points in Greece (OECD 2018b). On the contrary, at the tertiary level, women represents less than half of the teaching workforce (34%), which also occurs in other OECD countries (OECD average is 43%).

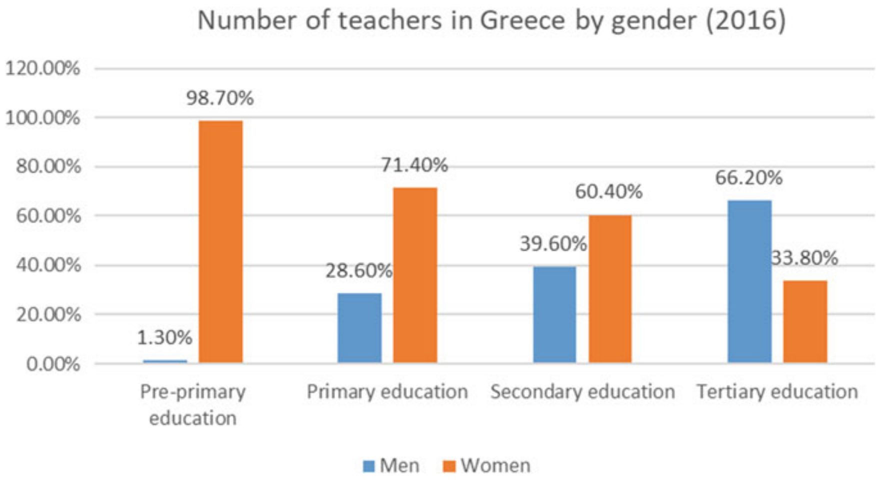

Fig. 8.2 Number of teachers. *Source* OECD.stat data extracted on July 23, 2019

With regards to the initial teaching staff education, teachers of all educational levels in Greece are higher education graduates. Teachers in pre-primary, primary, and secondary education must complete a first cycle degree (UNESCO 2015). Prospective teachers in pre-primary and primary schools must take a 4-year degree in a pedagogical department, while in secondary schools most teachers take a 4- or 5-year subject-based degree at a teacher education faculty (Eurydice 2018a, b). The academic staff in tertiary education must have at least a PhD title and their doctoral thesis and the overall research and scientific work must be consistent with the cognitive field of the announced position.

In 2017, the number of academic staff in tertiary education for Greece was 18.968. As shown in Fig. 8.3, the overall number of teachers in tertiary education shows downward trends over the period 2005–2014, while over the period 2014–2017 shows upward trends.

8.2.3 Enrollment Rate and Retention Rate

Table 8.2 presents the overall number of the enrolled students in Greek pre-primary, primary, and secondary education and its evolution during the years 2013–2017. The number of students enrolled in pre-primary education showed a 9% reduction between 2013 and 2017, while in primary education showed an increase of 2.45% between 2013 and 2017. Finally, the number of students enrolled both in compulsory and non-compulsory secondary education between 2013 and 2017 reduced to 2% and 0.6%, respectively.

Table 8.3 presents the overall number of the graduated students in Greek primary and secondary education (compulsory and non-compulsory) in 2017 compared to

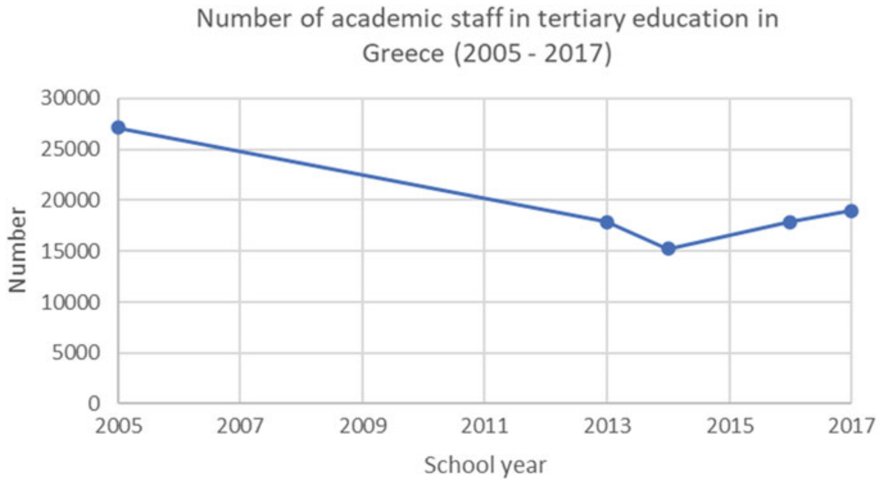

Fig. 8.3 Academic staff. *Source* OECD.stat data extracted on May 1, 2020

Table 8.2 Enrolled students per education level

School year	Pre-primary education	Primary education	Secondary education (compulsory)	Secondary education (non-compulsory)
2013	166.576	630.043	319.950	245.892
2014	160.994	625.165	310.389	241.905
2015	162.781	640.001	315.702	239.055
2016	155.243	642.707	311.236	240.852
2017	151.804	645.250	313.130	244.386

Source Hellenic Statistical Authority

Table 8.3 Graduated students per education level

School year	Primary education	Secondary education (compulsory)	Secondary education (non-compulsory)
2016	101,771	99,820	75,995
2017	103,016	100,980	76,900

Source Hellenic Statistical Authority

2016. The collected data showed an increase of 1.2% in 2017 compared to 2016 regarding the overall number of graduated students both in primary and secondary education levels.

The ratio of students to teachers by education level refers to the number of students enrolled in primary, secondary, and tertiary education, divided by the number of teachers at the corresponding educational level. In Greece, student–teacher ratio in primary education was declining from 10.3 students per teacher in 2007 to 9.4 students per teacher in 2014. Contrary, student–teacher ratio in secondary education increased from 7.9 students per teacher in 2007 to 8.3 students per teacher in 2014. In tertiary education level, student–teacher ratio increased from 20.79 students per teacher in 2007 to 39.68 students per teacher in 2014 (https://knoema.com/atlas/Greece/topics/Education#Expenditures-on-Education).

8.2.4 Government Expenditure on Education

Government expenditure on education in Greece as a percentage of GDP is one of the smallest among OECD and partner countries, as the data show. In 2015, total public spending on education as a percentage of total government expenditure was one of the lowest among OECD countries (around 6%) with an average of 11% among OECD countries (OECD 2018b).

Funding for primary education in Greece covers 34.5% of the ordinary budget of Ministry of Education, Research and Religious Affairs. Over 2013–2015, there was a reduction of 4.3% in the share of public expenditure on primary education. Expenditure per student in primary education decreased around 13% during 2005–2015, as Fig. 8.4 shows (KANEP/GSEE 2017).

Funding for secondary education in Greece covers 35.3% of the ordinary budget of Ministry of Education, Research and Religious Affairs. Over 2013–2015, there was a reduction of 14.7% in the share of public expenditure on secondary education. Expenditure per student in secondary education decreased around 25% during 2005–2015, as shown in Fig. 8.5 (KANEP/GSEE 2017).

Fig. 8.4 Expenditure per student in primary education and the rate of change during 2005–2015. *Source* KANEP/GSEE (2017)

Fig. 8.5 Expenditure per student in secondary education and the rate of change during 2005–2015 *Source* KANEP/GSEE (2017)

Funding for tertiary education in Greece covers 20.1% of the ordinary budget of Ministry of Education, Research and Religious Affairs. Over 2013–2015, there was a reduction of 21.4% in the share of public expenditure on tertiary education. Expenditure per student in tertiary education decreased around 16.6% during 2005–2015, as shown in Fig. 8.6 (KANEP/GSEE 2017).

Fig. 8.6 Expenditure per student in tertiary education and the rate of change during 2005–2015. *Source* KANEP/GSEE (2017)

8.2.5 Education Research

Education research in Greece is not sufficiently developed mainly due to insufficient funding. This can be justified mainly because of the fragmentary nature of the educational research in conjunction with the lack of a systematic way of implementation in the Greek context (Mparalos 2006).

According to Law 4310/2014, the research centers in Greece, which are under the supervision of the General Secretariat for Research and Technology (GSRT) of the Ministry of Education, Research and Religious Affairs, are the following:

- "Athena" Research and Innovation Center in ICT and Knowledge Technologies, (https://www.athena-innovation.gr/);
- Centre for Research and Technology Hellas (CERTH) (https://www.certh.gr/root.en.aspx);
- National Observatory of Athens (http://www.noa.gr/index.php?lang=en);
- National Hellenic Research Foundation (http://www.eie.gr/index-en.html);
- National Research Centre for Scientific Research "Demokritos" (NSCR) (http://www.demokritos.gr/);
- National Center for Social Research (https://www.ekke.gr/);
- Hellenic Centre for Marine Research (https://www.hcmr.gr/en/);
- Biomedical Sciences Research Center "Alexander Fleming" (https://www.fleming.gr/); and
- Foundation for Research and Technology—Hellas (FORTH) (https://www.forth.gr/index.php?l=e).

Moreover, the Hellenic Scientific Association of Information and Communication Technologies in Education (ETPE) aims at developing basic and applied scientific research in Information and Communication Technologies in Education (ICT). For more information on educational organizations and research areas, see the link below: https://www.etpe.gr/drasis-melon/erevnitikes-omades/.

8.2.6 Teachers' Professional Development

Teachers' professional development in Greece can be mandatory or optional. Prospective candidates to be appointed either in primary or secondary education must follow a mandatory introductory training with a duration of at least 100 teaching hours. Continuing teachers' professional development is optional and is being implemented by various training providers such as school units, universities, the Educational Policy Institute, etc. (Eurydice 2018a, b).

Some of the most representative teachers' training programs in Greece are the teachers' training in the use of ICT and the Erasmus + funding program for education.

Teachers' training in the use of ICT consists of two levels. The first level (A-level training course) was implemented from 2002 to 2008 with the title: "Training of primary and secondary teachers in the basic skills of Information and Communication Technologies (ICT) in education." The aim of the program was to provide educators with basic knowledge and skills in the use of ICT in education (Tsoulis et al. 2012). It was a 48 h training program, where almost half of the primary and secondary teachers in Greek education had been certified (EK, Peiraia 2017).

The second level (B-level training course) consists of two sub-levels: the introductory training for the educational use of ICT (B1-level) and the advanced training for the educational use of ICT (B2-level). "B1-level teachers" training on ICT aims at acquiring knowledge and skills concerning the use of new digital infrastructures and modern educational tools in the educational process, while "B2-level teachers" training on ICT aims not only at expanding and deepening the knowledge, skills, and competences of teachers in the educational use of Web 2.0 tools but also at acquiring skills about the design and use of educational software, according to their specialization (Tsoutsa et al. 2013).

The Erasmus + EU funding program for education, training, youth, and sport 2014-2020 includes the key action "mobility project for school education staff," a program that enables teachers to visit and live in other counties for a certain period of time in order to acquire different learning experiences, including activities like teaching assignments, job shadowing, etc. (Eurydice 2018a, b).

8.3 New Progress of ICT in Education

8.3.1 Infrastructure

This section focuses on more detail on the topics of access to the Internet and access to equipment for all levels for education. Those two factors are very important not only for the implementation of ICT in the learning process, but also to enable the innovation in learning in general (Brecko et al. 2014).

According to the European Commission report (EC 2019a, b, c) about ICT in Education, Greece has levels of Internet speed that are well below the European average. In all public schools of both primary and secondary education, free broadband access is provided. The connectivity technologies (allowing broadband services) are mainly ADSL (basic), VDSL, optical fiber, and dedicated lines. Only 12% of the Greek schools have access to a high-speed Internet speed above 100mbps via fiber optic. Besides, for all levels, schools that are located in larger towns and cities are, on average, more likely to connect to the Internet (GSN 2018).

Highly digitally equipped and connected schools have a high provision of digital equipment per number of students and high broadband speed. In Greece, there are considerable fewer computers available for students in primary and secondary education. Only 2% of the primary schools, 9% of the lower secondary schools, and 21% of the upper secondary schools are highly digitally equipped and connected to the Internet (EC 2019a).

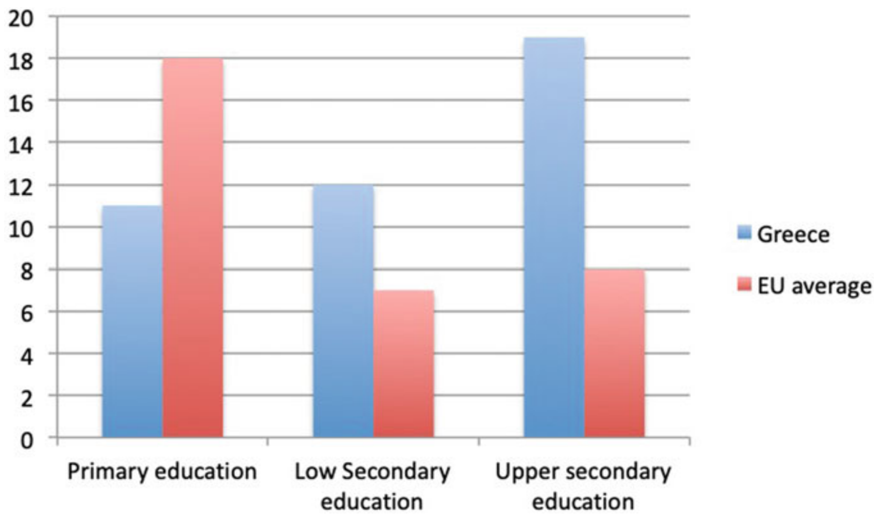

Fig. 8.7 Students per computer ratio in comparison to the EU average

Computer–Student Ratio

With regard to the number of computers per pupil and according to the 2nd Survey of Schools ICT in Education (EC 2019b) by the European Commission, the corresponding average is 11 pupils per PC in Greece in primary education, 12 pupils per PC in low secondary education, and 19 pupils per PC in upper secondary education, while in most EU countries there are 3–7 students on a PC and the EU average is 7–8 in secondary education. Indeed, the higher the education level, this number tends to increase (Fig. 8.7).

As for the location of the desktop computers, on average in Europe, about one-third of the students are in schools where desktop computers are located in classrooms, while in Greece the desktop computers are mostly located in a computer lab. Especially in Greek upper secondary schools, only 10% of the computers are located in the classroom, which is the lowest percentage in the EU (Fig. 8.8).

Campus Network Access

The Greek Research and Technology Network or GRNET (the national research and education network of Greece) provides not only the Internet connectivity, but also high-quality infrastructures and services to the Greek educational, academic, and research communities. GRNET supports all universities, technological education institutes, research centers, and over 9500 schools via the Greek School Network (GSN), serving a population of more than one million people (Wikipedia).

In all public schools and administrative units of both primary and secondary education, free broadband access is provided by the Greek School Network (GSN). Greek School Network (GSN) (http://www.sch.gr/en) is the national network of the Ministry of Education, Research and Religious Affairs (MoE) (http://www.min

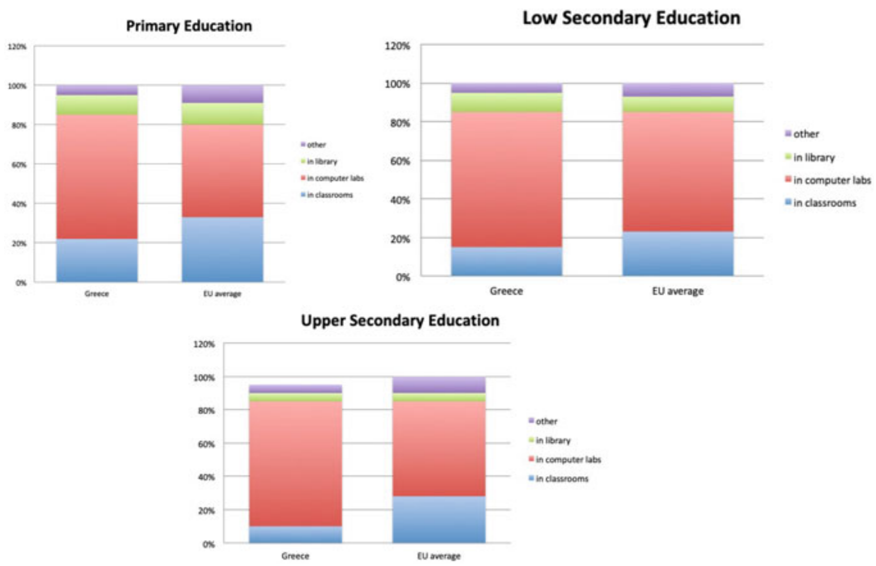

Fig. 8.8 Desktop computers' location in comparison to the EU average

edu.gov.gr). The Central Government Budget covers the connections fees of public educational units with GSN and the Internet. The connectivity technologies (allowing broadband services) are mainly ADSL (basic), VDSL, optical fiber, and dedicated lines (rarely). The GSN is the largest public network in Greece in terms of users that it serves. In particular, it interconnects a community of 1.350.000 pupils and 160.000 teachers (Greek School Network 2018).

ICT Development Indicators

The indicators selected by the European Commission services, which illustrate key dimensions of the European Information Society (telecom sector, broadband, mobile, Internet usage, Internet services, eGovernment, eCommerce, eBusiness, ICT skills, research and development), allow a comparison of progress over time. For the ICT in education, the two sectors are (EC 2012a, b) as follows:

- Computers for educational purposes include desktop, laptop, netbook, or tablet computer whether or not connected to the Internet.

The ESSIE Survey (SMART 2010/0039) shows that the number of computers for educational purposes rose from 9.5 per 100 students in 2006 to 15.8 in 2012, an increase of 66.3% in a 6-year period in the European Union (Fig. 8.9). Specifically for Greece, the report shows that the number of computers per 100 students has declined over a 6-year period, with the largest decline in vocational education, while the opposite has happened in other European Union countries (Fig. 8.10).

- Schools having a website

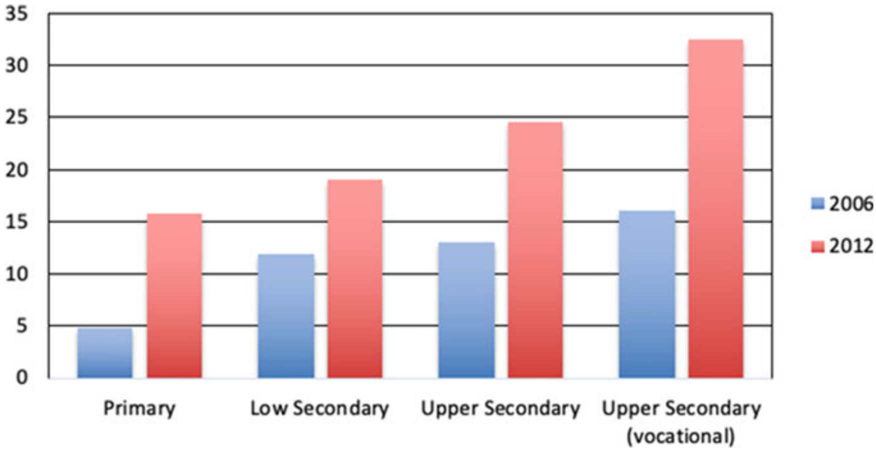

Fig. 8.9 Computers for educational purposes, by educational grade, EU

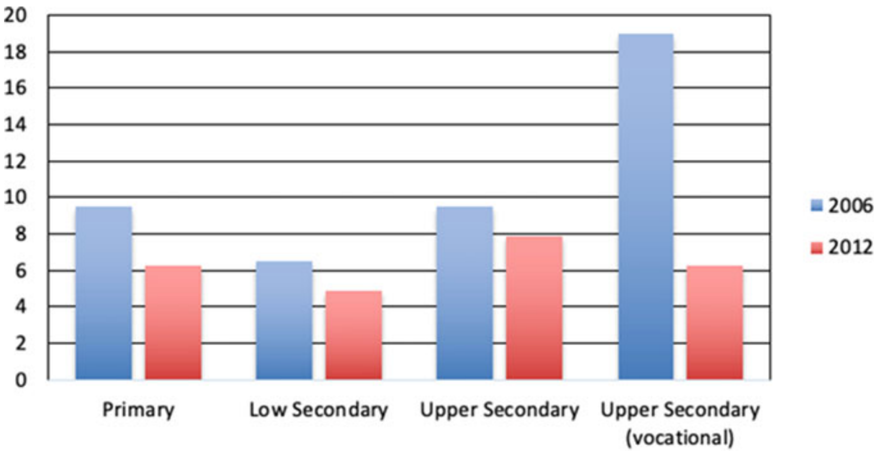

Fig. 8.10 Computers for educational purposes, by educational grade, Greece

The number of primary schools having a website rose from 28.1 to 48.2% which represents an increase of 20.1% in a 6-year period and for upper secondary vocational education from 63.8 to 98.7% which represents an increase of 34.9% in the same period. The increase was not significant in upper secondary general education (from 53.6 to 69.6%) and in lower secondary education (from 51 to 61.3%) (Fig. 8.11).

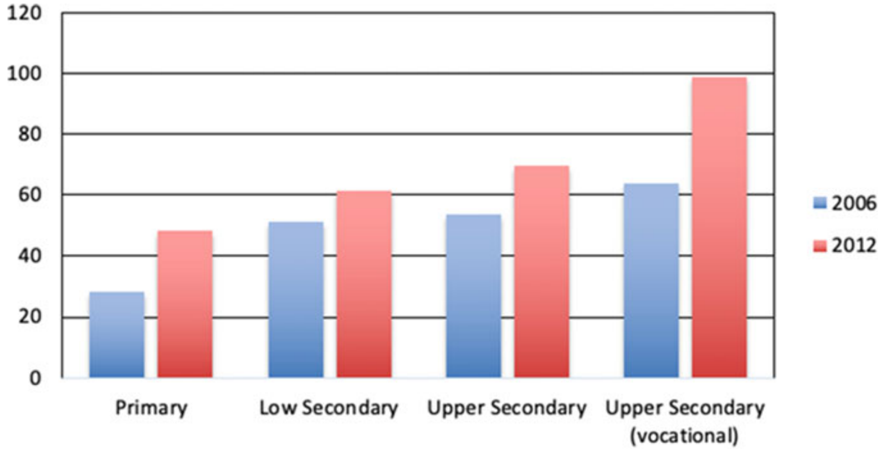

Fig. 8.11 Schools having a website, by educational grade, Greece

8.3.2 Educational Resources

Digital School Project was the most well-known reform, which has been launched in 2010 to integrate ICT into school curricula, as well as the teaching practices. It concerns the design, development, and operation of three Ministry of Education's central web services for the digital educational content of primary and secondary general education:

1. The "Interactive School Books" website (ebooks.edu.gr).
2. A series of digital educational repositories under the name "Photodentro" (repositories of learning objects, educational videos, educational software, user educational material, open educational practices, external sources/cultural collections) and the National Educational Content Collector for school education (photodentro.edu.gr), the Digital Learning Platform e-me (e-me.edu.gr).

The main platforms offering open educational resources both for primary and secondary education are as follows:

- The platform "MITIDA." MITIDA is an online environment specifically designed to assist educational cooperation communities and the promotion of student-centered, active, and non- formal learning. Using a set of online operating tools and freely accessible digital resources, participating teachers both of primary and secondary education have the opportunity to collaborate, experiment, and create digital content, thus contributing to the enhancement of the didactic act and its professional self-improvement (Vagellatos and Panagiotopoulos 2017).
- The platform Photodentro. One of the actions that has been implemented is "Photodentro." Photodentro is the National Accumulator of Educational Content for Primary and Secondary Education. It is the central e-service of the Ministry of Education for the integrated search and provision of digital educational content

in schools. It is open to all: students, teachers, parents, and anyone interested. Photodentro promotes the use of Open Educational Resources (OER) for schools, implementing the national digital content education strategy (Megalou et al. 2016).

The most valuable initiatives for open educational resources for higher education are as follows:

- The portal Openarchives.gr. Openarchives.gr is the largest online portal for search and navigation in reputable Greek digital content science and culture. The National Documentation Center (EKT) develops and maintains openarchives.gr in the framework of its institutional role, namely, the collection, organization, promotion, and diffusion of the scientific and cultural production of the country in a manner consistent with international standards and trends in the field as well as with the modern needs of users.
- The initiative "Open-courses." This project (co-funded by the European Union) has developed open content based on courses taught at universities, freely accessible and free of charge for all. These courses are not part of a distance education program or a university curriculum. Open digital lessons do not offer support from teachers and do not lead to a certificate. They offer new knowledge, training, and specialization, an opportunity for learning.
- The initiative "Kallypos." "Kallypos" is a very important open access initiative for higher education. More specifically, as it appears on its website, the Kalyppos Depository is a collection of books, aids, and learning objects that have been created by members of the academic and research community within the framework of the action "Greek Academic Electronic Texts and Assistants/Kallypos "or have been placed in the action through an open call for scientific content. The purpose of the repository is to systematically record, organize, and sustain long-term textbooks and learning objects of the academic and research community.
- "Anemi." The platform "Anemi" offers a rich collection of bibliographic information, digitized books, and articles with an emphasis on Greek culture. Two million digitized pages of books and more recent editions, the authors of which have allowed digitization and free online availability, are freely available to the visitor. Anemi was created in the spring of 2006 by the Library of the University of Crete, within the framework of the Operational Program "Information Society" and was enriched by 2009 (Vagellatos and Panagiotopoulos 2017).

8.3.3 Learning and Teaching

Information Technology-assisted Teaching

Research by Pesmatzoglou and Papadopoulou (2013) reveals that Greek teachers use ICT more as a source of information and teaching material rather than as a means of supervision during their teaching. The use of ICT as an autonomous teaching unit, however, seems to be still limited at the level of primary education. In another study

(Tassi 2014), teachers were found to maintain a cautious use of systematic use of ICT in their daily teaching practice. In particular, teachers appeared to continue to use ICT more as a source of information not only in order to better organize their lesson but also to create competitions or other assessment tests for their students, rather than as a self-taught lesson taught, for example, the cultivation of digital literacy skills it includes.

At the same time, it is found that Greek teachers have been associated with the use of ICTs, and with the development of competences and skills by the students themselves. That is why they are trying to integrate new technologies into the teaching process. They spend twice as much time at home on their education, through digital technology than at school, where they spend only 1 h a day. At the same time, however, teachers appear to be not yet fully trained and familiar with interactive boards, so they have not yet integrated them into the educational process (Gerouki 2014). Another similar research (Georgouli et al. 2011) also shows that teachers are making the most of ICT in mathematics and language courses. Education software programs of the Ministry of Education are rarely used, while their first preferences include HotPotatoes and GoogleEarth.

In special education, teachers have begun to get their students in touch with special software programs trying to solve various problem situations (Kotti and Politis 2017). In the area of kindergarten, the day-to-day kindergarten teachers use new technologies in an attempt to creatively utilize them in the educational process. The most commonly used applications are the use of the Internet and various painting software programs (Manesi 2016).

At all levels of education, the majority of teachers state that ICT-assisted teaching can be more interesting and help students learn better. In addition, they believe that the use of ICT can contribute to the development of students' educational and cognitive levels (Tsilis 2018).

The Greek Ministry of Education and Religious Affairs in order to enhance the integration and utilization of ICT at all levels of education created the website Open-edu (https://opengov.minedu.gov.gr/) intending to present all digital repositories and educational material available to all users with open access. The Greek School Network (GSN) is the official and exclusive network of public primary and secondary education. The e-Classroom service (e-Classroom), which is part of the services of GSN, aimed at teachers and students, to enrich the classical teaching that takes place daily in the school, with modern tools that enhance the learning process. During the school year 2018–2019, the e-Classroom platform hosts approximately 27,500 courses for both primary and secondary education with approximately 37,000 students and teachers registered. On the other hand, the Greek Open Courses Project is aimed at tertiary education and is about freely available courses taught at Greek universities, adapted to the digital environment freely accessible and available over the Internet for everyone. The Greek Open Courses Project contains more than 3750 courses by approximately 4000 instructors with more than 25 academic institutions participated.

Courses about Information Technology

From 1983, Information Technology (IT) was established as a separate educational sector in Vocational High Schools. Nine years later an introductory course of Informatics was introduced in the schools of Lower Secondary Education (gymnasiums). During the same period, the Information Science became a new formal faculty for teachers in secondary education. The first Information Technology course was entered in the upper secondary education (Lyceum) as well in 1998.

The basic principles and terms of information science and the basic simple concepts concerning the general structure and function of computers and acquisition of basic knowledge and skills of computing are the general aims of informatics teaching as a school subject in the lower secondary education. In the upper secondary schools, the IT courses are designed as the continuation and deepening of the knowledge acquired in previous levels of education. According to the Unified Framework Studies Informatics Program, the IT application electives and computer applications courses included in the schools' curriculum emphasize the development of competences and skills in the use of ICT not only as a programming tool but also as a learning and thinking tool.

On the other hand, in vocational education, the offered courses are focused on specialized subjects of informatics and the acquirement of professional-level skills in programming, use and development of computers, computational systems, networks, and the Internet.

Informatics teachers both in primary and secondary schools in Greece are graduates from Computer Science or Information Technology University departments (Kaltsa and Rorris 2013).

More recently in 2010, the introduction of IT was extended to primary education as well, by establishing an indicative curriculum and equipment by schools with computers. The UFC (Unified Framework Curriculum) proposes to incorporate the use of Information Technology first for teaching science and technology in primary education and gradually throughout the entire curriculum. The use of computers by students can also be seen in several activities falling outside the narrow framework of the curriculum (Tsami 2016).

In higher education, there are more than 50 Computer Science and IT Bachelors in Greece offered by the public universities and technological institutions. The majority of the university departments offer ICT courses to acquire basic skills in the applications of Information and Communication Technologies. Additionally, departments of education have integrated ICT modules into students' curriculum, aiming at developing pre-service teachers' competence of ICT use in education (Liu et al. 2014).

8.3.4 ICT Integration into Practices

Many studies indicate how important is the proper preparation not only for the teachers but also for the students to use educational technology in teaching practice in an effective way. Other factors that play a major role to integrate ICT in schools are the lack of Internet access and infrastructure, the large number of pupils in the class, and the lack of funding (Nikolopoulou and Gialamas, 2015).

The Ability for Faculty to Use ICT to Teach

According to Diamantis (2019), most of the researches about the use of ICT to teaching conclude that teachers, even when they have a positive attitude toward digital media, continue to use them in the traditional teacher-centered way, they use them as a tool for presenting information and almost as an exclusive source of knowledge.

According to the research carried out by Tsilis (2018) and Tsakiridou (2016), the teachers who participated in the second-level training programs accept the utility and efficiency of digital media when used in the educational and teaching process. Teachers have also developed the ability to integrate digital media into the teaching process and thus can make pedagogically more technologically enhanced learning. Tsilis research showed (Table 8.4) that both A-level and B-level certified teachers use ICT much more in the process of preparing to teach (58.64 and 67.08% accordingly), less often in teaching using ICT themselves (44.35 and 52.50% accordingly) and even less in teaching by promoting the use of ICT by students (28.50 and 41.73% accordingly).

Especially in terms of gender, male teachers appear to use ICT more often than their female counterparts in both preparation and teaching (Table 8.5).

The Ability for Students to Use ICT to Solve Problems

Regarding the use of ICT outside the school for schoolwork, Greek pupils declare that they are using ICT out of school to complete their obligations to a greater extent than their counterparts in OECD countries. The use of ICT for school purposes involves Internet surfing for schoolwork and studying; exchanging emails or messages via social networks with peers; communicating via email or social networks with teachers, downloading, uploading, or searching for data from the school's website for

Table 8.4 Use of ICT by the teachers

	Frequency of use of ICT by the teacher in preparation (%)	Frequency of use of ICT by the teacher in teaching process (%)	Frequency of use of ICT by the pupils while teaching (%)	Total use (%)
A-level training	58.65	44.35	28.50	35.39
B-level training	67.08	52.50	41.73	46.41
Average	62.83	48.40	35.08	40.85

Table 8.5 Use of ICT by the teachers in the terms of gender

	Frequency of use of ICT by the teacher in preparation (%)	Frequency of use of ICT by the teacher in teaching (%) process	Frequency of use of ICT by the pupils while teaching (%)	Total use (%)
Male teachers	64.94	51.80	40.33	45.30
Female teachers	60.81	45.15	30.06	36.63
Average	62.83	48.40	35.08	40.85

school lessons and announcements; downloading educational applications to mobile devices, etc. In addition, male students seem to use ICT more often outside school for school-related purposes (Sofianopoulou et al. 2017).

8.4 Policy and Strategy of ICT

8.4.1 Policies-Related Educational Informationalization in Recent Years

In 2018, the European Commission has adopted the Communication on the Digital Education Action Plan, which outlines how the EU can help individuals, educational institutions, and education systems to better adapt for life and work in an age of rapid digital change by

- Making better use of digital technology for teaching and learning;
- Developing relevant digital competences and skills for the digital transformation; and
- Improving education through better data analysis and foresight (EC 2019c).

Greek educational policies in ICT have adopted the entire ICT literacy objective set by the EU. Existing ICT policies in the Greek school system cover the following areas:

- Learning theories and teaching methodologies to promote digital literacy by introducing both access to digital learning material in classroom and at home (e.g., "Photodentro") via web portals but also their use under pedagogical indicators in the classroom.
- Two levels of ICT training for primary and secondary educators.
- Integration of e-portals, e-books, and online resources in primary and secondary education.
- Infrastructure and educational software for several special needs schools.
- Incentives to purchase notebooks for secondary school 1st grade students ("Laptop for Students programme").

- Broadband in many schools through a school network (sch.gr), recognizing Internet access as a basic right.
- ICT equipment in several schools that have the necessary infrastructure.
- Official policies to promote new learning environments under the vision of each political governmental scheme (Abbassi et al. 2015).

8.4.2 ICT Financing Resource

The "Digital Services of the Ministry of Education, Lifelong Learning and Religious Affairs" project from 2007 to 2013 targeted the digital upgrade of the primary and secondary educational process in Greece. The total investment for the project was EUR 174.441.430, of which the EU's European Regional Development Fond contributed EUR 146.635.815. The project was divided into sub-projects such as the supply and installation of interactive systems, the supply and installation of mobile computer laboratories, with 10 laptops for a primary school and 15 for a secondary school. Overall, 825.423 pupils from primary schools to lyceums and institutes were benefit from the project.

The next period, the PA 2014–2020 (Partnership Agreement for the Development Framework) constitutes the main strategic plan for growth in Greece with the contribution of significant resources originating from the European Structural and Investment Funds (ESIF) of the European Union. The objectives of the European Structural and Investment Funds of the European Union, which co-finance the Partnership Agreement (PA) 2014–2020, are implemented through Operational Programmes (OP). One of the actions is about the procurement of ICT equipment for school units of primary and secondary schools, via the upgrade of the technological equipment.

In Greece, the higher education institutions are funded on a national level from the national budget earmarked for higher education of the Ministry of Education, Research and Religious Affairs. Besides teaching and research, public funding covers administration, infrastructure, lifelong learning departments, and centers for career guidance and psychological support. Other resources are income from the institution's entrepreneurial activity or private assets, income from investment grants or donations, endowments and bequests. As far as funding for conducting research is concerned, the institutions are beneficiaries of the operational programs that are co-financed by the Greek State and EU Structural Funds, according to the related regulations and directives.

Funding from other private resources outside the National Budget is limited. However, donators, sponsors, and private stakeholders are encouraged to finance higher education with tax relief and exemptions being the primary motive.

It should be noted that public financing of research and technology from the national budget of the Ministry of Education in 2018 amounts to 122.548.000 million allotted to research organizations such as the Hellenic Pasteur Institute, the Biomedical Sciences Research Center "Alexander Fleming," and others (Eurydice 2018a, b).

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Chapter 9
Report on ICT in Education in Hungary

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9.1 Overview of the Country

9.1.1 Geography and Population

Hungary is located in Central Europe with an area of 93,000 km^2. Budapest is the largest city in the country; it is also the capital. According to the latest census, the current population was 9,804,000 in 2016. Since 2011, the population had decreased by 134,000. The younger, active population dropped the most in the last decade: in 2016, there were 26,000 fewer children and 144,000 more 65-year-olds and older in the country than in 2011. Hungary is an ethnically homogeneous country; the largest minority groups are the Romani people (3.1%) and Germans (1.3%). More than half of Hungarians are Roman Catholic (52.9%; Census Report 2011, 2016).

9.1.2 History

After World War II, Hungary became part of the socialist bloc. The year 1956 saw a revolution and war of independence in the country, but this was crushed through

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Soviet intervention. A tranquil period started in the 1960s and 70s, the economy was centrally planned, but the standard of living and relative political freedom were better than in other socialist countries. In return, society withdrew into passivity and did not question the political system. Finally, the weakening of the socialist bloc led to a regime change and the proclamation of the republic in 1989 (Cartledge 2011). The democratization process resulted in more opportunities and political pluralism. Hungary became a parliamentary democracy, where the national assembly wields legislative power and the president is the head of state. Hungary joined NATO in 1999 and the European Union in 2004, similarly to other post-socialist countries.

9.1.3 The Status Quo of Social and Cultural Development

An aging population and the decreasing birth rate are the most urgent problems in Hungarian society. Hungarian citizens are among the most passive in Europe; they are less likely to vote in an election or to volunteer (Domokos 2013; Oross 2013, Róbert et al. 2016; Somlai 2010). Average life expectancy is 75.7 years, and the rate of unemployment is 5.1% (OECD 2017a). An average Hungarian spends 15.6 years in school, and 73% of the population enjoys internet access. In 2017, based on life expectancy, schooling, and the standard of living, Hungary had the 43rd highest Human Development Index among 188 countries (Human Development Report 2016; Human Development Indices and Indicators 2018).

The general characteristics of Hungarian society are the following. 96.8% of the population aged 25 or older have completed secondary education (Human Development Indices and Indicators 2018). In 2017, 24.1% of 25- to 64-year-olds have finished tertiary education.[1] In 2012, 65% of the population did not speak any foreign language, while 35% spoke at least one, and 13% knew at least two. The data based on specific age cohorts shows a different result: 74% of 15- to 24-year-olds speak at least one foreign language, while this ratio is only 38% among those who are 55 years old and older (Special Eurobarometer 386 2012).

The value of overall life satisfaction is 6.1 (on a ten-point scale). Only 58% of Hungarian society are satisfied with the quality of education, while 68% are satisfied with their standard of living (Human Development Indices and Indicators 2018). At the same time, according to EU surveys, 29% state that rising prices/inflation/the cost of living represent the most important issue they face. Hungarians have a contradictory feeling towards the EU: 80% view themselves as citizens of the EU, while only 48% trust the EU (Standard Eurobarometer 90 2018).

[1] Adult education level. Available at: https://data.oecd.org/eduatt/adult-education-level.htm#indicator-chart. Accessed 25 Mar 2019.

9.1.4 Current Situation of Economic Development

After decades of socialist central planning, Hungary became a market-driven economy. The recession set in motion by the 2008 financial crisis affected Hungary as well. Since then the economy has recovered. Now it is a growing, export-oriented economy, with GDP per capita at $26,701 and real GDP growth at 2.0% in 2017 (OECD 2017a). The strongest sector of the economy is services, followed by industry. Agriculture only accounts for 3.5% of GDP. The low unemployment rate reflects the results of the population decline and the large numbers of Hungarians working abroad. These circumstances make it difficult for companies in Hungary to find skilled labor.

9.1.5 The Status Quo of Research and Development

In 2016, 1.21% of Hungary's GDP was spent on research and development (R&D), industry financed nearly half of these investments, and 34.6% were made by the government. Hungarian R&D investment has been growing since 2005, but its value is significantly lower than the EU average of 2.34%. In this year, Hungary employed 25,804 researchers full time (this means that researchers made up 5.8% of Hungary's labor force) (OECD 2018).

9.1.6 The Relationship with China Under the "16 + 1" Cooperation Framework

Chinese outward foreign direct investment (OFDI) has grown significantly in Central and Eastern Europe (CEE) since 2008. The CEE countries—including Hungary—have a lower performing economy than other members of the European Union. After the economic crisis of 2008, OFDI offered a good opportunity for CEE countries to accelerate their economic growth. The largest Chinese investments in Hungary were made in 2012, amounting to more than $500 million. Partnership between China and the CEE countries grew closer after the launch of the "16 + 1" cooperation effort in 2012 (Szunomár and Biedermann 2014; Szunomár et al. 2014). This effort aims to expand trade between China and the CEE countries. Part of this cooperation is the New Silk Road Project (or the so-called One Belt, One Road Project), which fosters investment in infrastructure to develop a Eurasian trade route.[2]

[2]For further information, see The New Silk Road Project. https://www.thenewsilkroadproject.com/. Accessed 25 Mar 2019.

9.2 Overview of the Educational Development

The educational participation data provided in this section are based on the official communication of the Hungarian Central Statistical Office (HCSO) for the 2018–19 academic year. Please note that the HCSO English terminology is used.

9.2.1 Education System and Policy

Hungarian public education covers kindergarten (ages three to six), primary school (Grade 1 begins at the age of six) and secondary school (the last possible grades are 12/13). All children attend kindergarten. Previously, only the final year of kindergarten was compulsory, but recent legislative changes oblige parents to send their children to kindergarten for the full three-year program. Kindergarten education uses only playful methods to facilitate the development of basic skills and knowledge.

Schooling is compulsory between the ages of 6 and 16. Primary schools include primary grades (1–4) and lower secondary grades (5–8). Secondary schools usually involve the higher secondary grades, 9–12/13. (Five-year programs in schools insert an extra year between the lower and upper secondary grades devoted to foreign language and digital literacy development, as part of a bilingual program or a program to foster the development of disadvantaged but gifted students). Some elite secondary schools run programs that include either Grades 7–12 or Grades 5–12. Secondary schools are divided into three different streams: (a) Secondary general school (gimnázium) prepares students for higher education (45.19% of the school-age population can be found in this stream); (b) Vocational grammar school (szakgimnázium) prepares students for the labor market but also provides academic training, enabling students to participate in higher education (36.78%); (c) Secondary vocational school (szakközépiskola) provides vocational training, with a recently drastically de-emphasized general education component (16.58%). Students enter these streams based on a decreasing order of previous academic achievement. For students whose performance is not appropriate even for the vocational stream, remedial programs are offered until they reach school-leaving age. It is possible to complete primary and secondary grades as part of adult education.

Tertiary-level programs are available for vocational training. Higher education is provided by colleges (four-year bachelor's level programs) and universities (mostly three-year bachelor's-, two-year master's- and four-year Ph.D.-level programs). A few professional training programs are "undivided," that is, the bachelor's level is incorporated into a unified (five- or six-year) master's-level program, which can be found in teacher, medical, and legal education.

The objectives and contents of Hungarian public education are outlined in the National Core Curriculum. Regularly updated, the former and the present versions (2007, 2012, 2020) require the development of key competences (treated as transversal content) in accordance with European Commission recommendations. The Core Curriculum is further detailed in ministry-approved (and generally ministry-commissioned) Curriculum Frameworks for each school level and stream. These Curriculum Frameworks include detailed objectives, content and learning objectives for each grade, and schools are required to incorporate them into their local curricula. No national standards have been defined yet.

9.2.2 Students and Teachers' Profiles

Figure 9.1 shows the percentage of 3- to 5-, 16- and 20-year-old students in school from 2003 to 2018, and Fig. 9.2 shows the percentage of 18- to 24-year-olds leaving school and training programs from 2008 until 2019 (EU target: <10% drop-out rate; National target: 10% drop-out rate).

Based on a decision taken at their school, first graders at risk of slow progress or low performance can participate in a diagnostic assessment of basic skills (DIFER; Nagy et al. 2004), which, in turn, can inform targeted intervention by their teachers. Instituted in 2001, the national Assessment of Basic Competences (ABC) is a system with annual, compulsory assessments in reading and mathematical literacy at the end of Grades 6, 8, and 10. The ABC reports show the effects of selection within the school system, which is supported by the PISA results as well. Family socioeconomic background has a robust effect on student performance, further amplified by homogeneous student bodies.

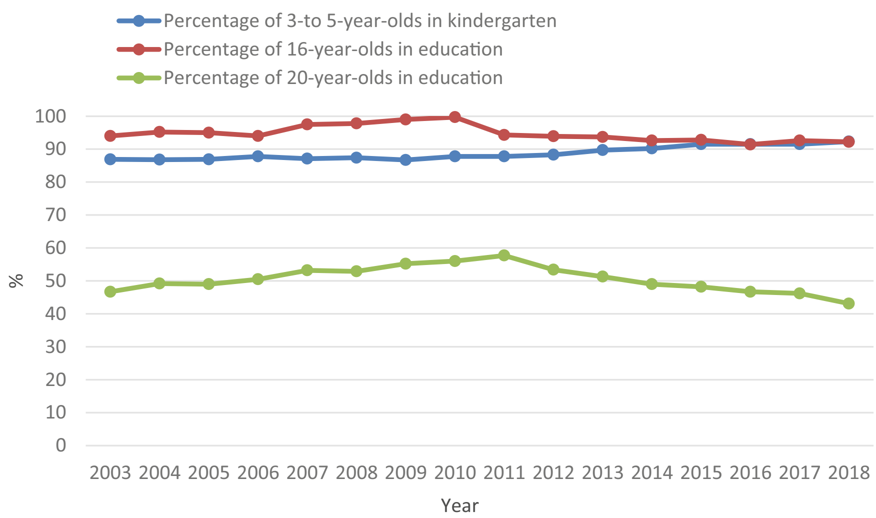

Fig. 9.1 Percentage of the 3- to 5-, 16- and 20-year-olds population in education from 2003 to 2018 (Hungarian Central Statistical Office (HCSO))

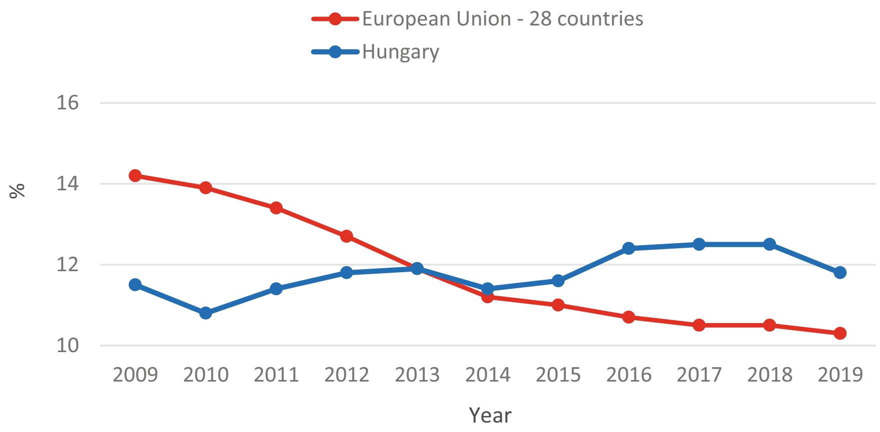

Fig. 9.2 Percentage of school and training drop-outs (% of population aged 18–24) from 2008 to 2019 (European Commission: Europe 2020 targets: statistics and indicators for Hungary)

The PISA surveys showed significant declining tendencies in student performance over the years until 2015, even though the Hungarian averages were around the OECD averages (see Fig. 9.3). In 2018 the declining tendency generally stopped, resulting in no significant achievement differences between 15-year-old students in 2015 and 2018. The declining pattern is also present in TIMMS. The PIRLS surveys

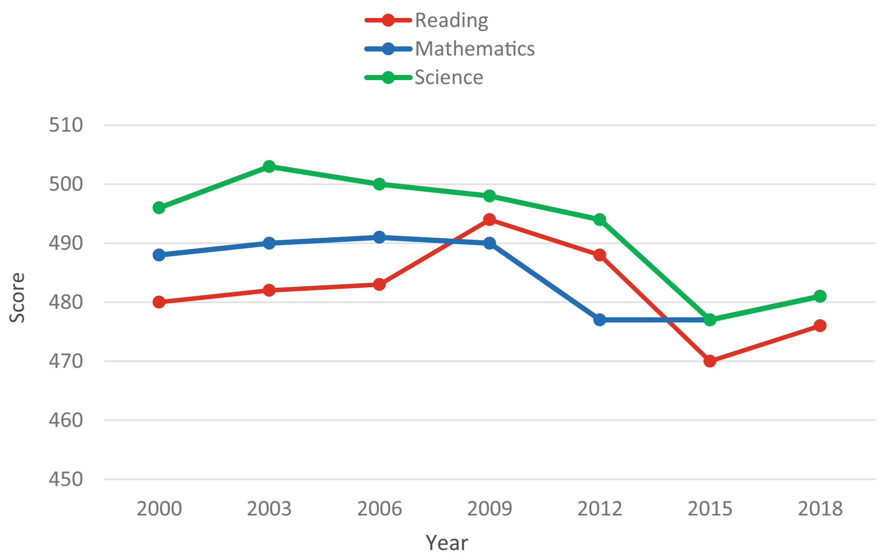

Fig. 9.3 Changes in academic achievement of 15-year-old Hungarian students based on available PISA results from 2000 to 2018

show fluctuation at a very high level of reading literacy at the end of Grade 4—an advantage that students lose by the age of 15, when PISA targets them.

9.2.3 Teachers' Professional Development

Teachers in kindergarten and primary grades are trained in pre-service, four-year BA programs, with considerable emphasis on practical training. For teachers of lower and upper secondary grades, the centrally defined training system has changed several times over the past ten years, and now it is at the MEd level. MEd programs take 10–12 terms and qualify participants to teach two school subjects. The entry requirement for this pre-service degree is the successful completion of upper secondary education; applicants are selected on the basis of their school-leaving examination results and an interview assessing their suitability for the profession. At present, the MEd study programs consist of 100 or 130 credits in each of two school subject areas (depending on the desired qualification for teaching at the lower or upper secondary level). This is complemented by 100 credits of education and psychology, as well as supervised, practice-based learning, 40 credits of which constitute an internship at a school, with the support of a mentor, and with increasing responsibilities and independence. Routes to earning a teaching degree after the completion of purely academic (or other professional) bachelor's and master's degrees also exist.

The initial teacher training curricula are controlled through a central regulation of learning outcomes. Though the goals of teacher training have been constant—to recruit the best, to attract more trainees, and to provide them with knowledge and skills easily put to practical use—the present implementation seems to suffer the consequences of a less than optimal qualification and promotion system (and thus career prospects), work environment, and professional guidance. Personal initiative is required in teachers' professional development, various in-service training opportunities are offered; the centrally defined qualification system wishes to steer teachers towards reflectivity and research-based practice.

9.2.4 Quality Assurance in Education

At present, educational quality assurance occurs through central control (including set textbooks) as well as through state maintenance of the majority of schools and state financing for different school maintainers (i.e., entities such as local governments that are charged with maintaining schools but rely on the state for financing). The inclusion of special needs children has been a policy concern, but has brought mixed results because of a lack of appropriate human resources and financing. 69% of special needs children are mainstreamed (Hagymásy and Könyvesi 2017). Gifted children are often directed by their teachers towards tracks and programs favorable for them. Equity issues have been interpreted variously in the past ten years, and have thus been treated variously depending on government policies. A consistently sustained state measure has been the establishment and development of a support program (boarding and equipment) for gifted low SES (socioeconomic status) students in secondary education. There are considerable civic initiatives to contribute to educational equity as well.

9.3 New Progress of ICT in Education

9.3.1 Infrastructure

Despite the number of initiatives in educational informatization in Hungary since the proclamation of the republic in 1989 (Molnár 2011), the ICT infrastructure in schools is still below international norms. The statistics on school infrastructure below are based on a large-scale empirical study (Molnár and Pásztor-Kovács 2015). Almost 20% of primary and secondary schools took part in an online assessment of school infrastructure. According to the results, there are major infrastructural differences between primary and secondary schools. At the primary level, there are 49 (SD = 54) computers available in school on average, and at the secondary level there are 117 (SD = 72). That is, the student–computer ratio in primary schools is 9:1 (SD = 8:1), while at the secondary level it is 6:1 (SD = 9:1) with very large differences (see Fig. 9.4).

There is at least one computer lab in 98% of the schools. There are two or more computer labs in 50% of the primary schools and 90% of the secondary schools (Fig. 9.5). The number of computers available in an average computer lab is 19 (primary school: $M = 18.85$, SD = 5.0; secondary school: $M = 19.01$, SD = 3.5;

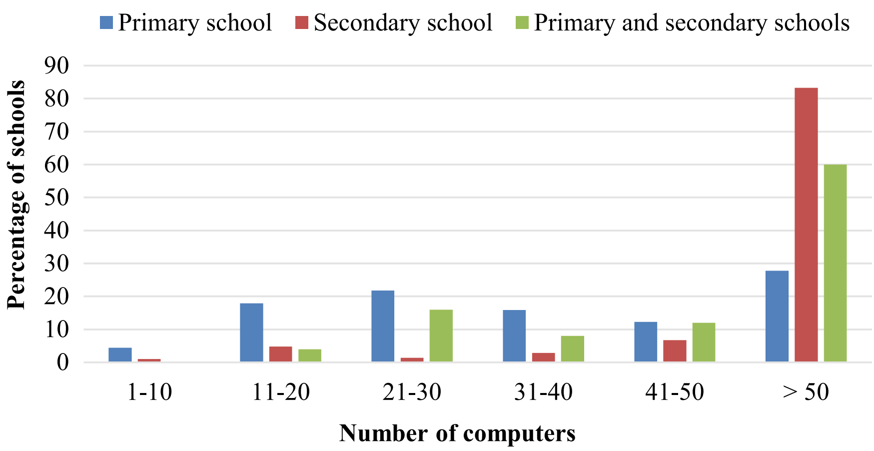

Fig. 9.4 Number of computers available at different levels of schooling

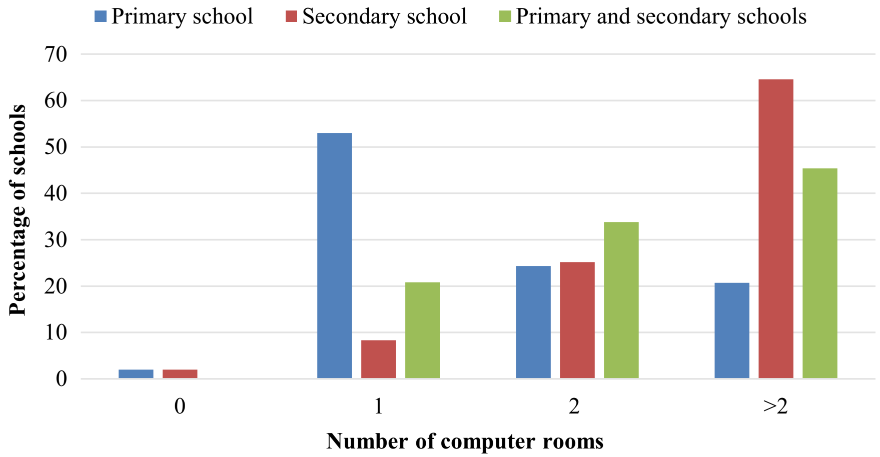

Fig. 9.5 Distribution of the number of ICT labs at different levels of schooling

the average class size at the primary and secondary levels is 21 and 26, respectively). All of the computer labs are connected to the internet.

Much greater differences can be detected at the university level. In some areas, the "basic ICT infrastructure in higher education is excellent and meets world-class standards; however, in some other fields it is below the EU average" (DSP 2016, p. 9). Higher education institutions have access to broadband internet, but in many cases there is a shortage of institutional WiFi services. Thus, many institutions have severe problems with wireless broadband internet access, so they cannot exploit the full potential of broadband internet. Nearly all of the students (based on DES 2016, more than 86% of the students owned a laptop in 2014) who enter higher education have appropriate digital work equipment (laptops, smartphones, and tablets), but, generally, "institutions have not developed facilities with which these tools could be integrated into the teaching process. The replacement of IT infrastructure, especially hardware, and the purchase of legal software are critical areas, particularly due to the prohibition of centralised procurement" (DSP 2016, p. 9).

9.3.2 *ICT Integration into Practices*

These infrastructural differences can also be observed in teacher education; thus, there are also major differences in teachers' ICT skills, depending on where they received their teacher qualification. The development of ICT skills, including the usage of interactive white boards, voting systems, and other IT tools in parallel with progressive educational methods connected to ICT, are not automatically part of the teacher training courses. They are only available in a few higher education institutions. E.g., at the University of Szeged, the Institute of Education, which is responsible for teacher training there, has put a great effort into developing the necessary IT labs (see Molnár 2007) and teaching staff. Based on the fact that according to the statistics almost all students own a mobile computer on entering the university, developments have started to focus on the issue: bring your own device and we will see how these devices can be used in and integrated into the teaching and learning process (DSP 2016; e.g., procuring WiFi routers to provide access to broadband internet at institutions; installing the NIIF Institute service, which is called EDUROAM and refers to a European virtual university campus; using programs and environments available online; and developing e-learning materials).

International assessment projects as well as national studies (for a comprehensive review, see Molnár and Kárpáti 2012) have indicated that Hungarian students' ICT literacy and skills of working in technology-rich environments are below the international norms. The digital reading assessment in PISA 2009 already pointed to these problems (OECD 2011), and in 2012 Hungarian students also performed lower on the computerized versions than on the paper-and-pencil tests (OECD 2013a). In the 2012 technology-based assessment of problem solving (OECD 2013b) as well as in the 2015 collaborative problem-solving assessment (on computer, too; OECD 2017b), they achieved far below expectations.

9.3.3 Educational Resource

Both government initiatives (e.g., SDT[3] and NKP[4]) and private companies (e.g., Mozaik[5] and Okosdoboz[6]) as well as higher education institutions and research groups (e.g., eDia[7]) foster the development of digital educational resources. In recent years, the government has introduced a digital platform called the Public Education Registration and Scholastic System (*Köznevelési Regisztrációs és Tanulmányi Alaprendszer* (KRÉTA)[8]), which is compulsory in all primary and secondary schools.

There are several government initiatives to catch up with mainstream international developments, and private companies sponsor individual schools as well as comprehensive projects. University researchers are also deeply engaged in educational informatization, especially in proposing innovative use of ICT in schools and evidence-based development of instructional instruments and learning materials. Informatization in schools started in the late 1990s when the government established the national SchoolNet (*Sulinet*) network to connect schools to the Internet

[3]Sulinet. http://tudasbazis.sulinet.hu/hu. Accessed 25 Mar 2019.

[4]Nemzeti Köznevelési Portál. https://portal.nkp.hu/. Accessed 25 Mar 2019.

[5]Mozaik. http://www.mozaik.info.hu/Homepage/Mozaportal/MPdigitalis.php. Accessed 25 Mar 2019.

[6]Okosdoboz. http://www.okosdoboz.hu/. Accessed 25 Mar 2019.

[7]eDia. http://pedagogus.edia.hu. Accessed 25 Mar 2019.

[8]https://www.ekreta.hu/.

and then launched the SchoolNet Digital Knowledge Base (*Sulinet Digitális Tudásbázis*) program in 2002 to collect, create, and disseminate digitized content. Later, the National Public Education Portal (*Nemzeti Köznevelési Portál*) was created for the same purpose, providing digital learning materials for all main school subjects. Most recently, the Centre for Educational Digital Methodology (*Digitális Pedagógiai Módszertani Központ*) was established to coordinate the development of the ICT infrastructure in schools within the framework of the Digital Well-being (*Digitális Jólét*) program.

Private companies play an active role in improving ICT conditions in schools. The Hungarian Alliance of Informatics, Telecommunication and Electronic Companies (*Informatikai, Távközlési és Elektronikai Vállalkozások Szövetsége*) has been managing a number of programs from promoting learning of programming to popularization of ICT-related jobs. For example, Vodafone, one of the largest telecommunication service providers sponsors a group of schools, where a high proportion of students come from low socio-economic status families. Mozaik Kiadó, a publishing house, having originally focused on printed textbooks, has successfully migrated its content to a digital platform and now develops a broad range of educational multimedia content utilizing the full range of ICT options.

9.3.4 Information Technology-Assisted Teaching and Learning

At present, the most comprehensive initiative in primary education is the development of an online diagnostic assessment system that serves as a foundation to differentiate pupils' personal development. This complex project aids in individualizing learning and adjusting teaching to the personal needs of every pupil and supports educators in teaching heterogeneous classes. The assessment covers the first six years of primary school in the three domains that are also constant areas in the PISA program: reading, mathematics, and science. The diagnostic assessment is based on a sophisticated conception of students' knowledge differentiating three main dimensions (Molnár and Csapó 2019). Beyond assessing the mastery of curricular materials, it measures the skills of applying knowledge in new contexts and monitors students' psychological (domain-specific and general thinking skills) development (Csapó and Csépe 2012; Csapó and Szendrei 2011; Csapó and Szabó 2012). The core of the assessment system is the eDia platform, which stores the item banks; at present, it contains over 20,000 innovative multimedia-supported items. This system delivers the online tests and provides students and teachers with feedback (Csapó and Molnár 2019).

eDia is used in more than 1000 schools (over a quarter of Hungarian schools). In the present phase of the work, the aims are to integrate diagnostic assessments into educational processes, to develop instruments (online training programs, serious games, etc.) to solve the problems indicated by the diagnostic assessment, and to expand the online assessment for the kindergarten–school transition (developing online school-readiness instruments, see Csapó et al. 2014). Practicing teachers receive intensive in-service training and are actively engaged in the project as item writers and developers of online intervention materials.

This project models several progressive initiatives, including university–school partnerships, empowerment of teachers, and research-based teacher training. It aids in preventing students from dropping out and in fighting social exclusion.

9.4 Policy and Strategy of ICT

As the digital transformation is indispensable in the twenty-first century, the Government has prepared the Digital Success Programme (DSP) aimed at the digital development of Hungary's society and economy. The program includes the Hungarian Digital Education Strategy (DES) as one of its key strategic elements. It set goals and tools for preparing "the system of education and training for performing education, instruction and training tasks in line with the needs of the digital society and economy in terms of infrastructure, technology, content, work organisation and human resources" (DES 2016, p. 27). Thus the DES covers all levels and factors of education: teachers' methodology, digital preparedness and attitude, physical infrastructure, available equipment, content and management. It declares that digital tools and approaches should be introduced in the classrooms as they are becoming deeply integrated into our everyday lives from day to day. "According to the intention of the strategy, in the future no one can leave the education and training system without basic digital competences required by the labour market" (DES 2016, p. 27).

The aims of the DES are in harmony with the National Infocommunications Strategy (NIS), with the EU and Council Recommendation on the validation of non-formal and informal learning, and with the Education and Training 2020 document; the most important related strategic documents in Hungary are Hungary's Public Education Development Strategy; the National Core Curriculum; the vocational education and training concept; and the Degrees of Change in Higher Education strategic document (see EMMI 2016).

In line with the OECD publications on the educational sector, this Hungarian higher education strategy document lays special emphasis on transforming higher education and rethinking its responsibilities. The strategic document envisages a standardized online digital environment in Hungarian higher education that offers personalized learning opportunities. The overall strategic goal is to promote digital preparedness and the use of tools to reach international standards. According to the document, the full use of the ICT potential in education and learning forms part of the breakthrough developmental changes that are required of higher educational institutions.

The learning environment in higher education is most often based on traditions and established practices. New, progressive teaching, and learning methods as well as innovative technology are used at the initiative of individual teachers or institutes (see e.g., the case of the Institute of Education at the University of Szeged). There is no central support to develop the infrastructure of the institutes responsible e.g., for teacher training. Further barriers are based on an international comparison of higher education programs that shows the Hungarian course descriptions contain few forms of learning that are different from the traditional ones (lecture, seminar and practice; EMMI 2016). "The main obstacle to modernisation within study programmes is the centralised regulation of the academic work, which recognises only the most traditional "face-to-face" activities as paid working time" (DES 2016, p. 89).

The European Union has always considered digital learning as a high priority. About a decade ago, a series of conferences on technology-based assessment was organized by its Joint Research Centre. These conferences were attended by over a hundred experts, and the meetings and the books based on the participants' presentations (Scheuermann and Guimarães Pereira 2008; Scheuermann and Björnsson 2009) have had a great impact on the development of digital testing in Europe and elsewhere.

The most recent EU policy on digital learning and ICT in education was set in the Action Plan on Digital Learning. The Communication on the Digital Education Action Plan[9] was adopted by the European Commission on 17 January 2018.

The Action Plan describes how the EU intends to support stakeholders, including individuals and institutions to meet the challenges of rapid digital change. Three main priorities were identified:

1. Making better use of digital technology for teaching and learning;
2. Developing relevant digital competences and skills for the digital transformation;
3. Improving education through better data analysis and foresight (Digital Action Plan, p. 4).

Eleven actions were outlined within these priorities: (1) Tackle the connectivity divide between EU Member States; (2) Support the digital readiness of both general and vocational schools; (3) Provide a framework for issuing digitally-certified qualifications; (4) Create a Europe-wide platform for digital higher education; (5) Strengthen open science and citizen science in Europe; (6) Bring coding classes to all schools in Europe; (7) Tackle the challenges of digital transformation by launching an EU-wide awareness-raising campaign targeting educators, parents, and learners to foster online safety, cyber-hygiene, and media literacy; and a cyber-security teaching initiative; (8) Support measures to further decrease the gender gap in the technology and entrepreneurial sector; (9) Build evidence on the uptake of ICT and digital skills in schools; (10) Launch artificial intelligence and learning analytics pilots in education; and (11) Initiate strategic foresight on key trends arising from digital transformation.

The EU supports a number of projects to advance ICT in education, for example, "ProSocialLearn: digital games to boost social inclusion and academic achievement,"

[9]Title of subordinate document. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52018DC0022&from=EN. Accessed 25 Mar 2019.

“DE-ENIGMA: using play to help autistic children recognise and express emotions,” and “Living Schools Lab: using technology in teaching and learning.”

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Chapter 10
Report on ICT in Education in Latvia

Ilze Ivanova and Ineta Kristovska

10.1 Overview of the Country

10.1.1 The History and Geography

Latvia is situated in the north-eastern part of Europe at the Baltic Sea. The Republic of Latvia boarders with Lithuania, Belorussia, Russia and Estonia. The name "Latvia" originates from the ancient Latgalians, one of four eastern Baltic tribes that formed the ethnic core of the Latvian people (ca. eighth–twelfth centuries A.D.). It was under the control of Germans, Poles and Swedes for many years. First the Republic of Latvia was founded on 18 November, 1918. In 1940 Latvia was incorporated in the Soviet Union. It regained its independence in 1991. In 2004 Latvia became the member of European Union. The Latvian lats were currency of Latvia from 1922 until 1940. It was replaced by roubles till 1992 and then by lats again till 2014, later the same year the euro was introduced.

10.1.2 The Population Situation

The current population of Latvia is 1,916,096 based on the latest United Nations and Central Statistical Bureau of Latvia estimates. Latvia's population is equivalent to 0.02% of the total world population. Latvia ranks number 151 in the list of countries (and dependencies) by population 70.0% of the population is urban (1,338,022 people

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in 2019). The average age in Latvia is 42.8 years. The following ethnic groups live in Latvia: Latvian 61.8%, Russian 25.6%, Belarusian 3.4%, Ukrainian 2.3%, Polish 2.1%, Lithuanian 1.2%, and others 3.6% (2016 est).[1]

10.1.3 The Political System

Latvia is a parliamentary republic, with the Saeima (parliament) elected by general elections. The Saeima in turn elects the president. The government cabinet is nominated by the leading coalition and approved by the parliament. Latvia is a member state of EU. The Latvian language is the official language in the Republic of Latvia. The national flag of Latvia is red with a band of white.[2]

10.1.4 The Current Situation of Economic Development

According to the report of the European Commission's Annual Growth Survey published on 21st November 2018, Latvia is a country which economy is catching up fastest with the EU average, but at the same time addressing population decline and ensuring that economic growth benefits all of the society continue to be important challenges. It is stressed in the report that Latvia's main challenge over the coming decades will be to continue catching up with the EU average while coping with a falling population. Due to the fact that there is a great need to invest in regional developmental human capital to improve its social, health and public governance policies, a strong rise in investment and solid consumer spending carried economic growth to 4.7% in 2018. It became possible with a support of EU funds. Strong economic growth helped increase employment for the first time in 3 years. The unemployment rate felt down to 7.4% in 2018. Wages have been growing rapidly by nearly 9% in 2017. Latvia's labour market performance is positive overall but employment conditions vary across different parts of Latvia. The unemployment rate is higher in regions furthest away from the capital and big cities. Older people with outdated skills also encounter difficulties in finding job.[3]

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[1] World Population Prospects (2017) https://www.un.org/development/desa/publications/world-population-prospects-the-2017-revision.html.
Available at: http://www.worldometers.info/world-population/latvia-population/.

[2] The Constitution of the Republic of Latvia (1922);
Leagal acts of Republic of Latvia, available at: https://likumi.lv/ta/en/en/id/57980.

[3] Central Statistical Bureau (CSP) (2018). Available at: https://www.csb.gov.lv.

10.1.5 The Status Quo of Science and Technologies

Guidelines for the Development of Science, Technology and Innovation for 2014–2020 proposes to implement a new horizontal approach to science and innovation policy, linking research and industry sectors in a single system. The main components for a successful development of innovation system are the following: (1) the development of the potential of scientific activity; (2) the development of the platform for long-term cooperation between researchers and enterprises; (3) the support of the development of innovative enterprises.

The aim of the Guidelines is to raise the global competitiveness of Latvian science, technology and innovation, satisfying the development needs of Latvian society and economy.

The research system in Latvia is developed in line with European Research Area with the aim to synchronize the Latvian research system with the research systems of other EU member states, to increase research results to EU standards and strengthen the capacity of scientists in Latvia in order to solve global societal challenges.[4]

Latvia develops scientific potential on the basis of the existing scientific traditions, particularly in organic chemistry, medical chemistry, genetic engineering, physics, materials science and information technologies. The highest number of inventions, which are patented both nationwide and abroad, are made in the branch of medical chemistry.[5] Higher education institutions and research institutes act as main performers.

10.1.6 The Latvian Research Funding System

The amount of investments in research and development of science is very little. In 2017, the share of expenditure on research and development was 0.51% of GDP (against 2.1% in the EU average). Moreover, research funding relies almost entirely on EU funds.

The government has made some of research-performing organizations' institutional funding dependent on past performance. This is done by 'three-pillar' funding model comprising:

- Institutional funding for higher education and research and competitive project funding for research;
- Funding dependent upon past performance in higher education and research;

[4]European Research Area (ERA), available at: https://ec.europa.eu/info/research-and-innovation/strategy/era_en.

Available at: https://www.izm.gov.lv/en/science-policy.

[5]Ibidem.

- Funding to promote institutional development and innovation—which has largely yet to be implemented.[6]

10.1.7 The Status Quo of Social and Cultural Development

Latvia is the only country in the world where the Latvian nation, language and culture can exist and fully develop. There is also a broad community of people outside of Latvia with a sense of belonging to Latvia. Language and culture are uniting the Latvian society. Therefore, society and the state foster the Latvian language and promote the values of national identity.

Latvia is rich in strengthening sense of belonging to the culture of Latvia by its traditions—song and dance festivals for school children and adults, dancing and singing in different ensembles and clubs, making of ceramics and pearls of amber, celebrating of different festivals. Latvia is proud of its rich heritage of folklore and folk customs.

The Latvian language is the language for instruction and communication, signs, as well as written language. The Latvian is the native language of at least 1.5 million speakers in the world. At least half a million of people use Latvian parallel to their native language. The Latvian language counts as the 150th biggest language among the 6700 languages of the world. The Latvian is used by approximately 60% of residents of Latvia as the native language. In accordance with the ethno-demographic structure of the residents of Latvia and traditions, society in different functions (mainly in families) uses: Latvian, Russian, Ukrainian, Belorussian, Polish, Lithuanian, Estonian, German, Liiv, Latgalian and several foreign languages. The expansion of the individual bilingualism and multilingualism among Latvians and minorities of Latvia is growing. The State Language Policy of the Republic of Latvia is formulated in two important documents: The Guidelines of the State Language Policy for 2005–2014 and the State Language Policy Programme for 2006–2010.[7]

The State Language Policy Planning Document for 2015–2020, is adopted for strengthening the Latvian language in all spheres of social life. Ministry of Education and Science is increasing the role of the education system and culture in implementing the state language policy and creating the Latvian cultural space and forming a united society. It is planned to develop a new programme for minorities to ensure the acquisition of the state language in early years.[8]

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[6]Specific Support to Latvia: the Latvian Research Funding System, available at: https://rio.jrc.ec.europa.eu/en/library/specific-support-latvia-final-report-%E2%80%93-latvian-research-funding-system.

[7]State Language Policy for 2005–2014, available at: https://www.google.com/search?client=firefox-bd&q=ht10.State+Language+Policy+for+2005-2014.

Available at: https://valoda.lv/en/about-us.

[8]Official Language Policy Guidelines for 2015–2020, Min.cab. No 630, 03.11.2014. Available at: https://likumi.lv/ta/en/id/270016-on-official-language-policy-guidelines-for-2015-2020.

10.1.8 Social Guarantees and Development

Latvia has one of the highest levels of income disparity among EU member states, with a Gini index of 34.5 in 2016. It is still one of the largest in the European Union. This situation has been created by policy decisions that promoted rapid economic recovery at the cost of social-security provision for at-risk population groups.[9]

The high emigration rate serves as a major indicator of marginalization and the lack of opportunity to remigrate. A total of 275,131 people left Latvia between 2006 and 2016. The annual emigration rate is decreasing now. The emigration, high mortality rate and low birth rate have led to a 12% decline in population over the past 10 years. The remigration programme has been worked out to return people back to Latvia (Central Statistical Bureau, Ministry of Economy).

10.1.9 The Relationship with China Under the "16 + 1" Cooperation Framework

The Suzhou Guidelines for Cooperation between China and Central and Eastern European Countries and The Medium-Term Agenda for Cooperation between China and Central and Eastern European Countries (2015) has put forward main directions for cooperation in different fields. China has defined three potential priority areas for economic cooperation: infrastructure, high technologies and green technologies.[10]

Latvia highly appreciates the "Belt and Road" initiative, and actively supports and participates in the "16 + 1 cooperation". Latvia is also involved in cooperation for maritime affairs. Latvia was the first among countries in the Baltic Sea region that signed a document on cooperation with China on the Belt and Road initiative. It was a start of cooperation of both countries in the field of logistics and infrastructure construction. It helps to promote interconnectivity between Asia and Europe.

Being well aware of the considerable potential of cooperation, Latvia actively facilitates broadening of the scope of areas for joint activities between the regions in Europe and China. The Academic China and Latvia Centre in the frame of initiative Belt and Road was founded in University of Latvia in 2015. Two institutions—Policy Science Department of University of Latvia and North China Institute of Science and Technology develop the activities of this centre. Its aim is to promote the exchange

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National Development Plan of Latvia for 2014–2020, approved by Saeima 02.12.2012. Available at: https://www.google.com/search?client=firefox-b-d&q=national+development+plan. Available at: http://www.sgi-network.org/2018/Latvia/Social_Policies.

[9] Available at: http://www.sgi-network.org/2018/Latvia/Social_Policies.

[10] The Suzhou Guidelines for Cooperation between China and Central and Eastern European Countries, available at: https://www.fmprc.gov.cn/mfa_eng/zxxx_662805/t1318039.shtml.

Available at: http://www.china-ceec.org/eng/zyxw_4/t1597367.htm.

Available at: https://www.mfa.gov.lv/en/policy/multilateral-relations/cooperation-between-central-and-eastern-european-countries-and-china/the-suzhou-guidelines-for-cooperation-between-china-and-central-and-eastern-european-counries.

of students and academic staff of these institutions, to develop common courses for studies. In 2018 the centre for the first time organized the first symposium to evaluate the potential possibilities of cooperation Latvia and China. University of Latvia has signed the Memorandum with Beijing Foreign Language University for future cooperation in the Latvian language teaching and learning as well as for exchange of staff and students.

Latvia has signed the Agreement to strengthen cooperation in the fields of trade, investment, transportation, logistics and tourism and people-to-people exchanges.[11]

The amount of students coming from China to study in the institutions of higher education is increasing. It allows to make the conclusion that exchange of people is very fruitful for further development of the project.

10.2 Overview of the Educational Development

10.2.1 Education System and Policy

In 1211, Christian missionaries from Germany founded the first school in the territory of Latvia. From the thirteenth to the sixteenth century, German was almost exclusively the language of instruction. Schools first started providing Latvian-language education in the mid-to late-sixteenth century. The aim was to spread literacy among the Latvian serfs, to promote the development of religious literature, including the Bible that was translated into the Latvian language by Ernst Glük in 1689. In Soviet times education was in both languages—Latvian and Russian. These 2 languages were the languages of instruction.

Great reforms started in education in so-called Awakening period (eightieth) and to a certain extent already in the Soviet Union and especially when independent state of Latvia was renewed in 1991. Three stages can be identified in these reforms:

- democratization and decentralization of the system of education
- evolution of the legal basis for reform and implementation of it
- further development of the system of education after accession in order that a democratic, socially integrated society based on knowledge develops in Latvia as a member state of the EU.

The first Law on Education was adopted by the Republic of Latvia in 1991. It gave the way to the following changes: depoliticization of education, freedom of choice during the education process, creation of private education establishments.

It allowed to delegate the right to take decisions to municipalities and schools. It strengthened the autonomy of establishments of higher education, and partially decentralized the system for financing of education.

[11]The Riga Guidelines for Cooperation between China and Eastern European countries, available at: https://www.google.com/search?client=firefox-b-d&q=.+The+Riga+Guidelines+for+Cooperation+between+China+and+Eastern+European+countries%2C.

The reforms were wide-ranging and affected all aspects and levels of the education system. They were rapid and quick based on great debate and discussions.

The change of paradigms took place in education—from centralization to decentralization: from teacher centred—to students centred approach; from teaching to learning (Bluma 1999, 2007).

An inclusive education was established in Latvia, promoting the development of socially inclusive society in the country. Since 2004, Latvia is a member of the European Agency for Special Needs and Inclusive Education.

During the changes, great attention was paid to teacher education, to create new understanding of teaching and learning.

Obviously, the curriculum for basic and secondary schools was changed greatly during the reform process, in particular, in the social and humanities. New text books and teaching materials were prepared. Standards for each subject were laid down with aims, content and assessment of the performance of pupils. New State Standard for basic education (1st–9th grades) practically completed the reform. Each teacher had a task to develop a teaching programme for his/her subject respecting the requirements set out in the standard. The teacher could use different forms and methods, but the aim of the standard had to be reached. The curriculum was continuously updated, and the standard for secondary education was adopted in 2013, and for basic education, in 2014. In 2016, revisions of curriculums started, the discussions were about the development of new competences including pre-school, basic and secondary education levels.

A new project "School 2030" was launched in 2017, financed by ESF. It is also called competence based Project.[12] The aim of the project is to develop, test and gradually implement the new content and approach to teaching that pupils could develop knowledge, skills and competences for living in the twenty-first century, to be ready to adapt to unusual situations, to make decisions for their lives. The project aims to work out new standards, guidelines, curriculum, learning materials, materials for teachers, including children with special needs, as well as instruments for diagnostics. To reach the aim the teachers learn to work together, to use different materials, test new approaches. 6000 teachers are involved in professional development management teams of schools. They learn to create new learning environment for students and teaching staff as well. The teachers have to change their thinking—they work in teams, in pairs and they guide the learning in the class, they notice every child and think about his/her development. Special attention is devoted to inclusion of every child in the learning for reaching the results set in standards. The big tasks are put forward for teacher education institutions to rearrange the study programmes according to competence driven approach. After hot and deep discussions (about 12,000 people participated) in 2018, the Government approved new regulation on the curriculum for integrated primary and lower-secondary education. The new curriculum will be gradually introduced in all schools from September 2020. Schools will be more autonomous in planning their teaching work, but at the

[12]ES Project "School 2030", available at: https://www.skola2030.lv/.

same time more responsible for the results. The new curriculum will cover seven study fields:

- Languages,
- Social and civic,
- Culture awareness and self-expression,
- Natural science,
- Mathematics,
- Technologies,
- Health and physical activity.

It does not mean that the subjects will disappear, accordingly they will be integrated in the corresponding fields.

The following transversal skills have to be developed through curriculum such as:

- critical thinking and problem-solving,
- creativity and entrepreneurial skill,
- cooperation,
- civic participation,
- digital skills.

Great attention is paid to the development of most important values such as:

- responsibility,
- diligence,
- enterprise spirit,
- honour,
- wisdom,
- kindness,
- compassion,
- moderation and restraint.

The new curriculum will offer acquisition of digital skills from first grade. All students will learn programming in grades 7–9. Learning of second foreign language will start at grade 4. The new curriculum in schools will be introduced gradually.

Latvia's *Education Development Guidelines 2014–2020* put forward the medium-term challenges, priorities and solutions in the education system. The areas for action are grouped under three goals: education environment, individual skills and effective management, that does not contradict with the ESF project School 2030.[13]

The project "School 2030" is financed by ESF—6,000,000 EUR, which is the investment in the development of young generation. It is overall project encompassing all levels of education including pre-school education in which standards are confirmed and which will be introduced in practice in 2019–2020 study year.[14]

[13]Guidelines for the development of Education for 2014–2020. Available at: https://rio.jrc.ec.europa.eu/en/library/guidelines-development-education-2014-2020.

[14]ES Project "School 2030", available at: https://www.skola2030.lv/.

The changes are also planned in the use of the Latvian language in ethnic minority schools. The Parliament of Latvia on March 2018 passed the final reading amendments to the Education Law and the Law on General Education under which education programmes of ethnic minorities will have to start gradual transition to Latvian-only upper-secondary education, creating necessary conditions for all upper-secondary students to be able to integrate in vocational and/or higher education institutions of Latvia in a more efficient way. The transition to the state language will happen gradually. In 2020/2021, all general subjects in grade 10 in general education schools will be taught in Latvian, and as of 2022/2023, all general subjects in upper-secondary education level will be taught in the state language, but ethnic minority students will continue study of their language, literature and cultural subjects in their family language. The Ministry of Education and Science will undertake support measures to improve the professional competence and state language skills of teachers working in minority schools. This new regulation on the language of instruction will provide the opportunities for ethnic minority youth in vocational and higher education, where Latvian is the language of instruction, as well as it will improve their competitiveness in the labour market.[15]

Lately great attention is also paid to adult education and non-formal education. Interest-related education as a part of non-formal education has stable traditions already from Soviet time. The most popular are clubs, circles, ensembles connected with cultural and sport activities, where the girls dominate the boys. Lately ICT technologies, robotics take a stable place for boys.

The education system in Latvia is highly decentralized. The MoES is responsible for drafting policy and legislation, as well as organizing and co-ordinating its implementation. Latvia has 119 municipalities responsible for providing ECEC, primary and secondary education closest to students' residences and non-formal education. Tertiary education institutions have autonomy to design education programmes, establish rules and regulations, hire staff and distribute the funding allocated to them. Almost all funding from primary to secondary level, including post-secondary non-tertiary education, comes from public sources. Compulsory education is free of charge, with the exception of pre-schools, where parents pay for school meals (although there are municipal subsidies for lower income families) (IMF 2013; OECD 2016a, b, 2017).

Education is affected by multiple demographic factors that have contributed to declining student enrolment numbers: such as rural-to-urban migration, immigration, low fertility rates and an ageing of population. Due to these factors, some schools in the countryside and even in big cities have been closed or reorganized. So the total number of general education schools has dropped from 824 in 2014/2015 to 790 in 2016/2017, as well as the number of vocational schools, from 63 to 51 (IMF 2013; OECD 2016a, b, 2017).

[15] Amendments to the Education Law and the Law on General Education, approved by government (2018), available at: https://www.mk.gov.lv/en/aktualitates/government-supports-amendments-law-education-and-law-general-education.

Characteristics of system of Education in Latvia[16]

Rights to Education

Every citizen of the Republic of Latvia, holders of non-citizen passports issued by the Republic of Latvia, citizens of European Union, European Economic Area countries and Switzerland, permanent residents of the European Community holding a residence permit for Latvia, stateless persons in possession of a travelling document issued by the Republic of Latvia, third country nationals or stateless persons who are in possession of a valid residence permit for the Republic of Latvia, persons having refugee or alternative status and persons who have received temporary protection within the Republic of Latvia have equal rights to education in Latvia.

Legislation

- Law on Education (1998)—a framework law containing definitions of all types and levels of education which defines general principles and determines competence of governing bodies.
- Law on General Education (1999)
- Law on Vocational Education (1999)
- Law on Higher Education Establishments (1995)
- Law on Scientific Activity (2005).

Governance of the Education System

The education system is administered at three levels—national, municipal and institutional. The Parliament (Saeima), the Cabinet of Ministers and the Ministry of Education and Science are the decision-making bodies at national level. The Ministry of Education and Science is the education policy development and implementation institution. It oversees the national network of education institutions, sets educational standards and determines teacher training content and procedures.

Tuition Fee

The tuition fee for pre-school, basic and secondary education in a state or municipality founded educational establishment is funded from the national or municipal budget. A private educational institution usually sets a tuition fee for providing education.

In higher education institutions the state covers tuition fees for a certain number of students' places, so called "budget places". Each higher educational institution has the right to set a tuition fee for the other students' places. At the same time any student has a possibility to take a state guaranteed loan for his/her studies in higher education programmes. A foreign citizen pays for his/her education fee in accordance with the agreement concluded with the educational institution.

[16] Available at: http://www.aic.lv

Available at: http://viaa.gov.lv/eng/information_networks/euroguidance_eng/education_in_latvia).

Available at: http://www.national-policies/eurydice/file/latviadiagram-2018-2019_enLatvia_Diagram2018-2019.

Pre-school Education

Children are involved in pre-school from the moment they start attending kindergartens. Pre-school education is available from the age of 1.5 years. It is mandatory to participate in pre-primary education programmes for five and six year old children who do not attend pre-school education institutions to be prepared for school. 2019–2020 is the first year pre-school educators will use the new standards worked out in the project, "School 2030". These are completely new guidelines based on the development of competences.

Basic Education

9-year single structure basic education (primary and lower secondary education) is compulsory for all children from the age of 7 and is generally completed till the age of 16.

Assessment of Educational Achievements and Issued Documents

In primary school, in grade 1, knowledge and skills in all subjects acquired by pupils are assessed in a descriptive way without grades. Starting with grade 2, core subjects including the Latvian language, minority language and mathematics, but in grade 3 also foreign languages are assessed in a 10-point scale. But beginning from grade 4, pupils' achievements in all subjects are assessed in a 10-point scale.

At the end of basic school students take centralized national examinations, and the number and content of these examinations is determined by the Ministry of Education and Science. Pupils having received assessments in all subjects of the basic compulsory education curriculum and the centralized national examinations receive a Certificate of basic education and a transcript reflecting their grades.

Special Education and Inclusive Education

Special education schools or special education classes, groups, individuals within general education schools provide education for children with special needs and different problems. Inclusive education, inclusive schools are of a special care of the state to guarantee the equal rights to everybody to get the adequate education. It is also stressed in the Guidelines for the development of education 2014–2020 as well as in ESF Project "School 2030".

Secondary Education

There are two types of programmes at the secondary education level:

- academic secondary education programmes (without specifically emphasized subjects; with special emphasis on subjects);
- vocational secondary education and training programmes. (with special emphasis on specific vocational/professional areas (for example, in arts, music, business, and sports).

When completing academic secondary education programmes, students take centralized national examinations. The content and procedure of these examinations is determined by the Ministry of Education and Science, and approved by the Cabinet of Ministers. School leavers have to take at least 4 compulsory centralized examinations, where three subjects are determined by the Ministry of Education and Science, and one subject is chosen by the student himself/herself.

A Certificate of secondary education and a certificate of the centralized exams passed with scores are awarded to all students who have received a positive assessment in all the subjects including the chosen profile, and the national examinations. The two certificates give students the right to continue education in a higher education programme.

Vocational Secondary Education and Training

Studies in vocational education prepare learners for working in a specific profession. The National Vocational Education Standard and the Occupational Standards or qualification requirements as well as the sectoral qualifications framework determine the curriculum of vocational secondary education programmes. During studies great attention is paid to practice, thus learning in the working place.

Depending on the type of vocational education programme, all students who have successfully passed the final subject and qualification exams are awarded a diploma or certificate: a certificate of basic vocational education and training, certificate of vocational education and training, a diploma of vocational secondary education.

Higher Education

The study process in higher education is organized according to Bologna process and Laws and regulations in Latvia.

Each higher education institution has its own admission board and criteria. From the year 2004 entrance examinations are replaced by the results of the national centralized secondary education examinations. Higher education institutions have the right to set additional requirements concerning specific prior education or training, special aptitude or previous qualification (for example, in arts, music, sports). Two groups of programmes can be distinguished: academic programmes (based upon fundamental and/or applied science), leading to a bachelor's degree or master's degree and professional programmes, and leading to the qualification.

Tertiary education institutions have a certain autonomy to determine organizational procedures, establish internal rules and regulations, hire staff, distribute allocated funding and design programmes. Approximately 40% of higher education institutions (HEI) are private.

Postgraduate Education

A master's degree or the equivalent degree (graduates of 5–6 year professional higher education programmes in Law and Medicine can continue education at postgraduate level directly) is required for admission to doctoral studies (Ph.D.). Doctoral studies last 3–4 years full-time. They include advanced studies of the subject in a relevant study programme and scientific research towards doctoral thesis. Publications in internationally quoted scientific journals, participation in conferences and seminars are required before public defence of the thesis.

Grading System

Educational achievements are assessed in a ten-point system: 10-with distinction, 9-excellent, 8-very good, 7-good, 6 -almost good, 5- satisfactory, 4-almost satisfactory, 3-weak, 2-very weak, 1-very, very weak.

Adult Education

Adult education that has old traditions in the history of Latvia with Folk Universities and different education centres are considered as a part of the system of education, in the frame of which people have the possibility to develop further personality, to satisfy personal interests and acquire new skills to stay in the labour market.

10.2.2 Enrollment Rate and Retention Rate

Enrolments by level of education (ISCED 2011)		
(At the beginning of the school year)		
	2015/2016	2016/2017
Enrolments	**417,672**	**421,078**
Pre-primary education (Level 0)	92,095	94,249
children aged 0–2 (including)	17,667	19,247
children aged 3–6 (including)	74,428	75,002
First stage of basic education (grades 1–6)	120,308	121,506
Second stage of basic education (grades 7–9 and vocational education)	56,128	56,282
(Upper) secondary education (grades 10–12 and secondary vocational education)	60,343	61,078
Post-secondary non-tertiary education	4516	5049
First stage of tertiary education (higher education)	81,972	80,623
Second stage of tertiary education (doctoral studies)	2310	2291

According to Latvia Statistics in Brief—2018, the total number of enrolments in education has increased. In 2016, 94.2 thousand children attended pre-school education institutions, which is the highest indicator recorded during the recent years. Most children attended local government pre-school education institutions, while 8 thousand or 8.5%—private kindergartens. The number of private pre-school education institutions has risen twice since 2010, and the highest increase was observed in Riga. It means that later the enrolment number could increase.

Worse situation is observed in higher education. Student number has dropped by 35% over the decade. In the academic year 2017/2018, 81.6 thousand students entered 54 higher education institutions. Enrolment by field of education and training; at the beginning of the school year 2017/2018 demonstrates that the most favourite fields for studies are social sciences, business and law—34 (%), the lowest figure—agriculture—1.7% and education—7.3%.[17]

10.2.3 *Government Expenditure on Education*

Early Childhood Education and Care

Local governments own public pre-school education institutions and their establishments. They are responsible for salaries of teachers, administrative and technical staff, learning materials, maintenance of buildings and utilities. State budget is provided for the salaries of teachers providing compulsory pre-school education for 5-and-6-year olds. In 2016, the local governments became responsible for providing financial support to parents whose children between ages 1.5 and 4 and are not benefiting from public childcare in municipal ECEC institutions.[18]

Elementary and Secondary Education

Local governments own schools of general education at elementary and secondary level. At these schools, the wages for pedagogical staff are allocated from the state budget while the maintenance and utilities costs are covered through the local government budgets. Besides that state gymnasiums receive extra finances because they also fulfil other functions in the field of teachers' further education and regional centre of methodology.[19]

Latvia uses the funding model, "money follows the child". It was introduced in school year 2009/2010.

General education schools are independent in:

- the development and implementation of education programmes,
- selection of employees,
- financial and economic activities, and
- other activities in accordance with the Law.

The Law on Education states that it is a head of a school who is responsible for the operation and performance of the school, as well as rational use of intellectual, financial and material resources.

Free lunches to all pupils from grade 1–4 are guaranteed by state in Latvia.

Another form of support for students and families are the EU co-financed programmes such as: "School Fruit Scheme" and "European School Milk Scheme",

[17] Latvia. Statistics in Brief 2018|CSB.

[18] The Education Law, available at: https://likumi.lv/ta/en/id/50759-education-law

Law on Budget and Financial Management, available at: https://www.google.com/search?client=firefoxd&q=Law+on+Budget+and+Financial+Management.

[19] Ibidem.

that provide children with fruit, vegetables and dairy products free of charge three times a week.

The state provides all necessary finances for schools established for children with special needs, boarding schools, schools and classes of social correction.

Vocational Education

The state directly supervises and provides funding for vocational schools. It is foreseen to pass vocational schools owned by the state to local governments after the regional reform is completed. So far as schools remain owned by the state, they are financed through the responsible ministries—Ministry of Education and Science, Ministry of Culture and Ministry of Interior Affairs.

Higher Education

In 2015, the Cabinet of Ministers endorsed a new model for financing tertiary education, proposed by the World Bank, to increase its quality, internationalization and labour market relevance. The new model is based on three pillars that aim to provide balance between stability, performance and innovation. This model combines stable core funding with two additional funding allocations based on performance and innovation (World Bank, 2014).

Overall, public expenditure on tertiary education is low and spread over a large number of institutions. With a population of just two million, Latvia has 58 accredited higher-education institutions, including both the public and private sectors. The country exceeded the EU 2020 education target of 40% of 30–34-year-olds holding university-level qualifications. In 2015, the ratio of 30–34-year-olds holding university-level qualifications was 41.3%, up from 39.9% in 2013. The IMF has warned that the current system is unsustainable due to a disproportionately high number of institutions, limited financing and falling student numbers. In 2017, the Bank of Latvia recommended a drastic reduction in the number of higher-education institutions, from 56 to 20, as well as a reduction in the number of study programmes, from over 900 to less than 500. In 2016, the government reformed higher education financing, focusing on improving salary levels for teachers. These reforms have been met with substantial resistance but are still being implemented. The physical and communication infrastructures of 29 institutions were modernized between 2011 and 2013, supported by public funds in the amount of 65.3 million LVL. In 2014, the World Bank published a study that, among other things, analyzed financing models for higher education (World Bank 2014).

Higher education institutions in Latvia are funded through different sources, including state funds, student fees, EU structural funds or other sources of international funding. Some 31% of expenditure at tertiary level came from household funds in 2013 (above the OECD average of 21%). Higher education institutions can also receive donations and grants from individuals and other private entities. The number of state-funded places is decided yearly by the MoES according to the Law on Higher Education Institutions. The decision is based on the demands of the labour market and in accordance with the long-term strategy of the Latvian economy. In the 2014/15 academic year, 40% of students were state-funded, while 60% paid tuition fees. Some areas of study, including natural sciences, ICT, engineering and mathematics, have recently been targeted for more allocation of state funds. Private higher education institutions are free to set their own tuition fees, although they can receive state funding in certain agreements with the Ministry (OECD 2016a, b, c, 2017).

10.2.4 Teachers' Professional Development

Initial Teacher Education

The teachers are educated in accordance with the two main models of teacher education: integrated/concurrent and consecutive. Both the models correspond to the basic trends and requirements of modern teacher training in Europe. Some universities implement both models, for example, University of Latvia implements the integrated model of teacher education. In this model the students are linked to educational establishments already from the first study year through the observation practice. The studies in the integrated model are organized in an interdisciplinary mode. Students have an opportunity to master both the subjects of pedagogy and psychology closely linking the acquisition of these subjects with the specifics of teaching methods of the particular subjects that are chosen for the specialization. The subjects to be taught at school are acquired from the point of view of the future profession. For instance, the education of the future teacher of the Latvian language is not directed towards the broad academic philological studies but more the mastering of the basics of those branches of science which will be necessary in their everyday teaching work. Thus students are centred on acquiring the applied linguistics, intensive mastering of the teaching/learning methods. They are directed to observation and doing. The active teaching practice is integrated in the whole process of studies. After successful studies in the integrated model, the student is awarded the professional bachelor's degree in education sciences and the qualification of the teacher of the specific subject. The studies take 4 years.

During the second model—consecutive model—the students first acquire the bachelor's degree in the specific branch of science within 3 years of studies. In this case, the student has a possibility to continue his/her studies in the professional programme for a year, a year and a half, two years. During that time the student masters the subjects of pedagogy and psychology cycles, the methods of teaching of the specific subject, carries out the teaching practice. As a result of the studies the student receives the teacher's qualification of the respective subject. The latest trend in Latvia is that in the second cycle of studies after the consecutive model the student is also awarded the master's degree in educational sciences. The length of these programmes is half a year or a year longer if compared with the professional programmes.

Professional Development of Teachers

Professional development is defined as activities that develop an individual's skills, knowledge, expertise and other characteristics as a teacher. The definition recognizes that development can be provided in many ways, ranging from the formal to the informal. Continuing professional development (CPD) is mandatory in Latvia for teachers at all education levels. Teachers themselves are responsible for acquiring the in-service training at least 36 h in three years' period. Usually teachers are planning CPD in cooperation with the head of the school and according to teachers' needs and interests. At the same time, it is possible that CPD can be credited within 12 h of self-development and experience modules that includes seminars, conferences, in formal adult education programmes. CPD programmes are divided in type A and type B programmes. CDP programmes A are ensured by education institutions, teachers' professional NGOs, institutions subordinated to the ministries. Usually A programmes consist of modules where the choice is given to the teachers—to form the training from different programmes. Amount of a module is at least six hours, both including theoretical and practical parts. Five modules are offered to develop:

- general competences of teacher
- education content and didactics
- management of education process
- teacher's self-development
- teacher's experience (participation in conferences, seminars, master classes etc.).

Cabinet of Ministers has approved Regulations on the Necessary Academic and Professional Qualifications of Pedagogues and Professional Competence Development Procedures for Pedagogues. This document defines the procedure of CPD for teachers.[20]

Type B programmes are offered to teachers willing to teach in future the other subject or to work in the other level of education. Training amount of type B programme is at least 72 h. Developers and implementers of B type programmes are initial teacher educating institutions. In both cases teachers receive a certificate after mastering of the A and B type programmes.

CPD training is not fully financed from the state budget, but most municipalities cover these costs at least partly. Many courses of CPD are paid by teachers themselves especially in the cases when teachers wish to attend the courses in the different field not concerning the subject taught in school.

[20]Regulations on the Necessary Academic and Professional Qualifications of Pedagogues and Professional Competence Development Procedures for Pedagogues (2018) Cabinet Resolution No. 569 of 11.09.2018, prot. Nr. 42 14. §.

10.3 New Progress of ICT in Education

10.3.1 Different Aspects of the Use of ICT in General Education

Information technologies are tools that are used or created to address issues of interest and needs to wide range specialists practically in all fields of the state. Because of that there is a wide range of participants of smart specialization area "Information and Communication Technologies", which can be divided into five subgroups: (1) Educational institutions, (2) ICT enterprises and companies of other sectors, (3) Scientific institutions, (4) Industry associations and (5) Other organizational structures.

Already in 90 s, there were heated discussions about the use of ICT in education. Even in that time the educators spoke about several aspects: how to develop skills to work with ICT, how to learn to use ICT in real life.

The initial plan envisaged equipping schools (mainly secondary schools) and institutions of higher education with computer sets, and training teachers and university faculty. A new subject-informatics was introduced in secondary schools. A new syllabus was designed, textbooks and study aids were published. Teachers of mathematics and physics were the first to be trained and attached to the teaching of informatics in schools. It was a new subject in school curriculum.

ICT integration in education system of Latvia is analyzed taking into account results of international comparative educational studies (IEA COMPED and SITES). The introduction of ICT into the curriculum of other subjects started as well. The teachers were confronted with a task to acquire skills to work with ICT and to use ICT in the class. These were 2 big tasks for teachers and for staff in higher educational institutions as well (PISA 2012).

Technologies have developed very rapidly, which are quite difficult for elderly generation to follow the development of them as well as to master skills to work with them.

With increasing digitalization and more flexible work forms, 90% of future workplaces will require digital skills, but nearly half of Latvia's population do not have sufficient skills in this area.[21]

At the same time, the Eurobarometer data for Latvia show that self-evaluation of digital skills for daily tasks and work is significantly higher than DESI indicates. 79% of the respondents consider that their digital skills are sufficient for daily tasks, 85%—their skills are sufficient for their current job.

[21] Available at: http://www.tvnet.lv/tehnologijas/internets/653079-37_eiropas_iedzivotaju_darbspejiga_vecuma_klibo_digitalas_prasmes;

Digital Economy and Society Index (2017)—Latvia. available at: http://ec.europa.eu/newsroom/document.cfm?doc_id=43022.

Special Eurobarometer 460 "Attitudes towards the impact of digitization and automation on daily life", May 2017.[22]

ICT in educational establishments are used very widely for:

- developing of data base (staff, students)
- preparing documents
- organizing and managing of study process (e-class)
- developing learning materials
- making different presentations, video, movies
- communicating, getting of information, e-mailing
- projecting, using internet-bank, playing games
- listening to music
- reserving different services.

Currently education system reforms in the frame of ESF "School 2030" are taking place in Latvia. It also obviously affects the digitalization of education. Now the content developers suggest to pay greater attention to the mastering of Informatics. According to these suggestions, the students will start to master informatics in the integrated way already from grade one but as a separate subject starting from grade four till the end of basic education. The aim of the acquisition of the ICT skills is to teach to understand how these skills can be used in different real situations, in different subjects, how to develop presentations, how to carry out data processing, how to develop videos, etc., Because of that great attention is paid how the teacher guides the understanding of the students and the development of ICT skills for the reasonable use of technologies in other subjects, at home and during out of class activities. At the same time teachers have to think over tasks for developing understanding of safety in the internet as well as the personal etiquette of the use of internet. There are big tasks put forward for every subject teacher to make lessons more interactive, catchy by using different ICT and learning materials. Different ICT tools are being used in special education schools according to their specific needs. Special learning materials are being prepared for more successful studies as well as for teachers for better guidance of the students. In the frame of ESF projects, ERASMUS + activities different learning games are being prepared for mobile use.

It is worth mentioning that there are distance education schools in Latvia. The average age of the student is from 12 to 45. The studies are organized in virtual environment ensuring the support system in both ways—face to face and virtually. This is a good opportunity for emigrant families if they wish their children to study in the Latvian language. This is also the opportunity for those who has dropped out of school for different reasons. Great attention is being paid to the use of ICT tools in non-formal education. Thus in interest-related education different circles, groups, activities are offered based on ICT—such as robotics, informatics, programming, designing, video and film making. It gives an input in organizing of leisure time

[22]Special Eurobarometer 460 "Attitudes towards the impact of digitisation and automation on daily life" (2017). Available at: https://www.google.com/search?client=firefox-b-d&q=special+eurobarometer+460.

for students to avoid useless playing of Internet games. Schools and families work together to reach the balance of useless game playing and learning. The platform, "Drošs internets" (Safe Internet) is very helpful for children and parents to learn about safety problems in internet. In all these processes, the teachers play a decisive role. Different new programmes on different levels, modules, courses, seminars, conferences, discussions are used to educate teachers in the field of reasonable use of ICT tools in preparing lessons, learning materials, parents' meetings, out of class activities, etc.

It is possible to conclude that smart pedagogy is developing very rapidly to promote the development of new technology rich learning environment.

10.3.2 ICT in Higher Education Institutions

Higher education activities in the field of ICT are directed in several directions. Information technologies may be acquired in 25 state-funded and private educational institutions.[23]

All educational institutions are included as key participants of the smart specialization area of information and communication technologies due to the following reasons:

- there is an acute shortage of and growing demand for employees of different levels of qualification in IT development, education and science;
- the necessity to develop specialists for ICT in education and science, that is of utmost importance.

Courses of Informatics are practically included in all study programmes to develop further ICT skills accordingly to specific needs of the future qualification. Due to reforms in education now (School 2030), new programmes are being developed to equip teachers with the latest tendencies of the use of ICT in the teaching and learning process.

Professional certification is an important form of education in the field of ICT. It is possible to get the following certifications in the cooperation with international organizations:

- Certification of IT professionals—Adobe, Cisco, IMB, ITIL, Microsoft, Oracle, Apple, Testing, Linux, Lotus and many others
- Certification of IT users—ECDL basic, ECDL start, e-Citizen, ECDL Advanced,
- Project management certification—PMP and others.

Technologies have influenced the whole learning process in higher educational institutions. It has moved from content-centred, from teacher-centred to student-centred approach, to competency and result-based curricula. The use of ICT by

[23]Detailed information available in the National Educational Opportunities Database (http://www.niid.lv/).

teaching staff and students promote the development of learning skills that are the key words for the twenty-first century.

Teaching staff in Universities systematically develops support system for students, including virtual learning materials, learning platforms, project-based tasks, developing tasks according to specialization. Every higher educational institution has the right to choose the virtual learning platform. International scientific data bases are available for practical use during the studies. Students are also offered virtual, distance education studies supported by detailed learning materials and prepared staff to work online.

Higher educational institutions offer also courses for the development of ICT in different sectors. Special courses are organized for higher educational staff to develop ICT skills for work in the auditoriums, designing learning materials, managing organizational activities in the institution.

Every higher educational institution has digitalized the management of teaching and learning process where students and staff have certain responsibilities.

There are 13 scientific institutions in Latvia operating in the field of computer sciences and information technologies, which carry out research, participate in different projects, organize courses and cooperate with educational establishments and industry.

It is worth mentioning that 12% of all projects approved under the “Horizon 2020” programme are in the field of ICT, including 10% in the ICT higher education and business sectors.

10.4 Policy and Strategy of ICT

The government together with different institutions considers the acquisition of ICT skills as an important factor to live and work in the contemporary society, to compete in the labour market, to reach the personal aims and to guide personal life in a happy family. Latvia recognizes the importance of digital skills and is taking action to reduce skills gaps in order to make Latvia’s private and public sector efficient and competitive. The below mentioned documents confirm it.

Sustainable Development Strategy of Latvia until 2030 and National Development Plan 2014–2020 includes intentions to promote a digital learning environment, improve e-services and promote digital skills through lifelong learning.[24]

EU-level initiatives such as Council Recommendations on Key Competencies of Lifelong Learning and Digital Education Action Plan have found its reflection in the mentioned document.

Information Society Development Guidelines 2014–2020, was developed to determine priorities of the ICT field for EU Structural Funds, with the aim to

[24] Available at: https://en.unesco.org/creativity/policy-monitoring-platform/latvia-2030-sustainable.

build a knowledge-based economy.[25] The Action Direction “ICT Education and E-Skills” includes the following activities: public awareness and readiness to use E-opportunities; development of E-skills of the population and entrepreneurs; increase of ICT competencies in public administration; preparation of ICT practitioners according to the requirements of the labour market; and promotion of algorithmic thinking and information literacy in educational programmes.

“Guidelines for the Development of Education 2014–2020” envisages activities for mastering of ICT skills in all stages of education through developing study materials and training teachers, as well as improvement of digital skills through lifelong learning programmes.

“Adult Education Governance Model Implementation Plan 2016–2020” stresses the development of digital skills for all citizens during their lives. State Education Development Agency is currently implementing an ESF project “improvement of professional competences of employed persons” in which the greatest attention is focused on the development of ICT skills.[26] “Guidelines for Inclusive Employment 2015–2020” foresees digital skills as priority skills to be acquired through training of unemployed persons and job seekers.[27]

Latvia’s Information and Communications Technology Association (LIKTA) unites leading industry companies and organizations, as well as ICT professionals to promote the development of information society and ICT education. LIKTA also coordinates the national Digital Skills and Labour coalition and implements targeted training projects, for example, ERDF project “Training of Small and Micro Enterprises for the Development of Innovations and Digital Technologies in Latvia”. Due to reasonable policy and optimism of work of ICT researchers and staff, Latvia has reached the following results: fast and accessible internet—6th the fastest internet in the world, 4th lower priced high-speed internet in the EU, wide covering of free WiFi network. People of Latvia are active users of e-opportunities: 75% use internet at least once a week, 5th place in the EU; news reading, 6th place in the EU, and internet banking users (81%). Digital access has been reached in state, municipal and public utility services.

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Chapter 11
Report on ICT in Education in the Republic of Lithuania

Vaino Brazdeikis

11.1 Overview of the Country

11.1.1 History and Geography

Lithuania is a European country located in the Baltic region. It is situated along the southeastern shore of the Baltic Sea, to the east of Sweden and Denmark. Lithuania covers an area of 65,200 km^2. It has around 99 km of sandy Baltic Sea coastline. Along with it Lithuania has a major warm-water port in the city of Klaipėda.

For centuries, various Baltic tribes inhabited the southeastern shores of the Baltic Sea. In the 1230s, Grand Duke Mindaugas united Lithuanian lands. During the fourteenth century, the Grand Duchy of Lithuania was the largest country in Europe. On March 11, 1990, a year before the formal dissolution of the Soviet Union, Lithuania became the first Baltic state to declare itself independent, resulting in the restoration of an independent State of Lithuania. Today Lithuania is a member of the European Union, the Council of Europe, Eurozone, Schengen Agreement, NATO, and OECD. The United Nations Human Development Index lists Lithuania as a "very high human development" country.[1]

11.1.2 Population

The population in Lithuania has been steadily decreasing for the last 25 years. In 2018, there were 2.8 million inhabitants, then 1990—3.7 million. Lithuania undergoes the

[1] Wikipedia (2019).

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process of the population aging. In 2005, the average population age was 39 years, while in 2018 it was 43 years (39 years for men and 47 years for women).

According to the 2011 census, the ethnic composition of Lithuania's population was Lithuanians (84.1%), Poles (6.6%), Russians (5.8%), Belarusians (1.2%), and people of other ethnicities (1.8%). There is no state religion in Lithuania. State educational establishments are secular.

11.1.3 The Political System

Lithuania is an independent democratic republic. The Parliament of the Republic of Lithuania (Seimas), the President, the Government, and the Judiciary execute the state power. The scope of the power of each branch is limited by the Constitution. The territory of Lithuania currently comprises 60 municipalities. The municipality has the right to self-governance.

11.1.4 Current Situation of Economic Development

Lithuania has an open and mixed economy that is classified as a high-income economy by the World Bank. According to data from 2016, the three largest sectors in the Lithuanian economy are—services (68.3% of GDP), industry (28.5%), and agriculture (3.3%). World Economic Forum's Global Competitiveness Report ranks Lithuania 41st (of 137 ranked countries).

According to data from 2017, Lithuanian main exports go to Latvia (11%), Russia (11%), Germany (7.3%), main import goes from Germany (12%), Russia (12%), Poland (10%). China is currently ranked 19th among export partners (1%) and 12th in terms of exports to China (3.2%).[2]

Long-term emigration and economy growth have resulted in noticeable shortages in the labor market. The unemployment rate in 2018 was 5.9%. As of the third quarter of 2018, the average gross (pre-tax) monthly salary in Lithuania is 935 euros.

The data above shows that though labor force in Lithuania is aging and shrinking, it is becoming more highly qualified. According to the CEDEFOP, by 2025, the share of Lithuania's labor force with high-level qualifications should rise to 53.9% compared to 30.6% in 2005.[3]

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[2] OEC (2019).

[3] CEDEFOP (2015).

11.1.5 The Status Quo of Sciences and Technologies

Lasers and biotechnology are flagship fields of the Lithuanian science and high tech industry. Twelve percent of Lithuanian laser exports go to China.

Lithuania is a cooperating state with European Space Agency, Associated Member State of CERN. Lithuania has a well-developed communications infrastructure. The country has 2.8 million citizens and 5 million SIM cards. The largest LTE (4G) mobile network covers 97% of Lithuania's territory. In 2017, Lithuania was top 30 in the world by average mobile broadband speeds and top 20 by average fixed broadband speeds.

Long-term project (2005–2013)—Development of Rural Areas Broadband Network (RAIN) was started with the objective to provide residents, state and municipal authorities, and businesses with fiber-optic broadband access in rural areas.

Information technology production is growing in the country, reaching 1.9 billion euros in 2016. FinTech companies came to Lithuania—a result of Lithuanian government and Bank of Lithuania simplified procedures for obtaining licenses for the activities of e-money and payment institutions. Europe's first international Blockchain Center launched in Vilnius in 2018.[4]

Based on the data from the survey on the use of IT in households, in 2018, 76% of households had personal computers, 78%—Internet access at home. In 2018, out of all persons aged 16–74, 80% were using the Internet. At the beginning of 2018, computers and broadband internet connections were used by all enterprises, mobile broadband connection—by 86.1% of enterprises.[5]

11.1.6 The Status Quo of Social and Cultural Development

The official state language, Lithuanian, along with Latvian, is one of the only two living languages in the Baltic branch of the Indo-European language family.

According to the Lithuanian population census of 2011, about 85% of the country's population speak Lithuanian as their native language, 7.2% are native speakers of Russian, and 5.3% of Polish. About 39% of Lithuanian citizens speak Russian as a foreign language, 20% English, 9% German, 6% Polish, 3% French. Favorable conditions have been created for recognized national minorities to teach their children in their native language, develop their culture, and profess their religion.[6]

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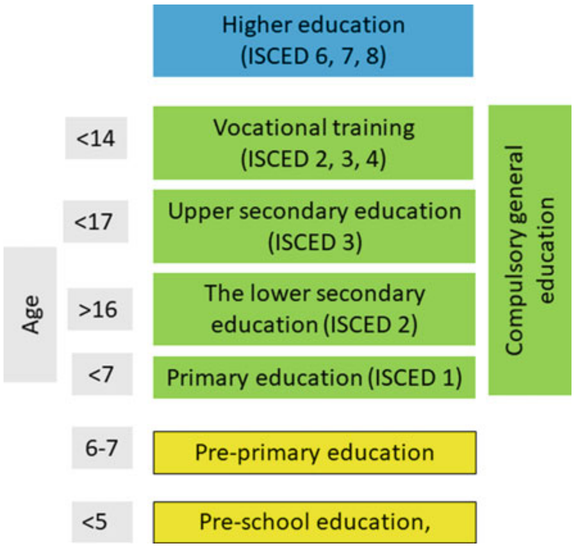
[4] Wikipedia (2019).

[5] Statistics Lithuania (2018a).

[6] Wikipedia (2019).

Fig. 11.1 Structure of the Lithuanian education system



11.1.7 The Relationship with China Under the "16 + 1" Cooperation Framework

Lithuania has desires in cooperating with China in the fields of port development, industry capacity, agriculture, and others sector. In 2015 Klaipeda port and, China Merchants Holdings Company Limited signed the memorandum of understanding on long-term cooperation.[7] On May 25, 2018, in Vilnius, Lithuania has organized the first-ever forum within the 16 + 1 framework Forum hosted ministers of agriculture from China and 16 Central and Eastern European countries.[8]

11.2 Overview of the Educational Development

11.2.1 Education System and Policy

The system of education (Fig. 11.1) in Lithuania includes:

- Formal education (primary, lower secondary, and upper secondary education, formal vocational education and training and higher education);

[7]Klaipėdos uostas stiprina bendradarbiavimą su Kinija, Klaipedos-uostas. http://www.portofklaipeda.lt/news/14430/575/Klaipedos-uostas-stiprina-bendradarbiavima-su-Kinija/d,archyve. Accessed 24 Apr 2019.

[8]Lithuania hosts 16 + 1 forum of China-CEE agriculture ministers, The Baltic Course. http://www.baltic-course.com/eng/forums/?doc=140323. Accessed 24 Apr 2019.

- Non-formal education (preschool education, pre-primary education, and other non-formal education of children and adults, including education complementary to formal education);
- Self-education;
- Educational assistance (vocational guidance, informational, psychological, socio-pedagogical, special pedagogical and special assistance of education, healthcare at school, consultation, in-service training of teachers, and other assistance).

Compulsory general education (primary education, lower secondary education, vocational general education) start in the calendar year when children turn seven years of age and end at the age of 16. Public sector general schools are free of charge. Primary schools, pro-gymnasiums, lower secondary schools (basic education schools), upper secondary schools, gymnasiums, and vocational schools deliver the compulsory education curriculum.

- The primary education (ISCED 1) curriculum covers four-year education. The purpose of primary education programs is the development of a healthy, active, and creative child who has acquired elementary literacy, social, informational, and cognitive skills;
- The lower secondary education (ISCED 2) curriculum covers six-year. The purpose of the basic education program is to provide an individual with the basics of moral, sociocultural, and civic maturity, general literacy and the basics of technological literacy, to cultivate national consciousness, to foster an intent and ability to make decisions and choices, and to continue learning;
- Upper secondary education (ISCED 3) is implemented by gymnasiums and other schools for persons aged from 17 to 19 years. The purpose of secondary education is to assist a person in the acquisition of general academic, sociocultural and technological literacy, moral, national, and civic maturity. Upon completion of the upper secondary curriculum and passing of mature examinations, the upper secondary education level is attained;
- Vocational training (ISCED 2, 3, 4) is provided by vocational schools. Vocational training is provided to individuals aged over 14. Students who have not yet acquired secondary education are provided conditions to follow the secondary education curriculum. Upon completion of a formal vocational education and training curriculum and (or) obtaining the required assessment of the skills acquired students are granted the appropriate level of qualification;
- Higher education (ISCED 6, 7, 8) comprises two types of institutions: universities and colleges. Studies may be of three cycles: the first cycle comprises professional bachelor's (in colleges) and bachelor's degree studies (ISCED 6, usually last 3 or 4 academic years, in universities), the second cycle master's degree studies (ISCED 7, usually last 2 academic years), and the third cycle doctoral studies (ISCED 8).[9]

[9]Ministry of Education and Science of the Republic of Lithuania (2010).

Key national strategic documents (Lithuania's Progress Strategy "Lithuania 2030," National Progress Program 2014–2020 and State Education Strategy 2013–2022) set out goals for the national education system. The strategic goal is to turn the education system in Lithuania into a sustainable foundation for the development of national welfare and to raise a young independent and innovative generation that will lead the country.

The current reform initiatives in the field of education were directed to further increase the quality of pre-primary, general, and vocational education, to promote accessibility and international competitiveness of higher education and to develop vocational training programs to better respond to the labor market needs. The main challenge faced by the education system is the decline in the number of pupils. According to the data of the Department of Statistics of Lithuania, the number of pupils studying in general education schools decreased by 45.2% between 2000/01 and 2016/17 school years (from 603,824 to 330,869 pupils).

Other key challenges for the education system is to reduce the share of 15-year-olds with low achievement in reading, math, and science, reduce the differences in student achievement between rural and urban schools.[10]

11.2.2 Students and Teachers' Profile

11.2.2.1 Primary Education

During 2017/18, academic year in elementary education studied 121,000 students (49% girls). Instructional language for 91% of student were Lithuanian, 5% Russian, 4% Polish. An average number of students in the classroom was 19 students. Students were touched more than 5 thousand primary teachers.

Students have the following subjects: languages (mother, foreign), mathematics, a perception of the world, arts, physical education, and moral education (religion or ethics). First foreign language for 99.06% of students was English. The grading system is not used at this stage.

11.2.2.2 Secondary Education

During 2017/18 academic year in secondary education studied 2435 thousand students. Students were taught in two types of schools: general schools—201.4 thousand students (49% girls), vocational schools—42.1 thousand students (42% girls). An average number of student in the classroom of lower general education schools—20 students, in the classroom of upper general education schools—24 students. Instruction language for 91.7% of students was Lithuanian, 4.5% Russian, 3.4% Polish, 0.5 others.

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[10]OECD (2017a).

Table 11.1 Higher education (student, 2017/18 academic year)

Institution	Student (thousand)	Female student (percent)	State financed (percent)	Average age	Foreign students (percent)
Universities	82.3	57.4	54.8	23.9	9
Colleges	35.4	24.1	50.4	24.4	1.6

Source Statistical department. Statistics Lithuania (2018b)

In 2017, general schools had 28.4 thousand teachers (89% women), vocational schools had 3.3 thousand teachers (69.1% women). Most teachers (98.1%) had high education diploma, 91.4% of teachers had a pedagogical qualification.

The core of the secondary program consists of the following subjects: languages, mathematics, social education (history, geography), natural sciences (biology, physics, chemistry), arts, information technologies, technologies, physical education, moral education. As the first foreign language, 99% of students choose English. 49.6% of students study two foreign languages, in this case, the second language was 80% Russian, 13% German, 4% French. Moral education choices were 56.3% religion and 41.7% ethics. The programs offered by vocational education schools combine secondary curriculum and vocational training. Most popular vocational programs were: Business and Administration, Engineering and Engineering Trades, Personal Services, Architecture and Construction.

In the year 2017, 23.9 thousand students graduated from secondary education. The successful completion rate for secondary education was 95%. Notably, 0.4% of students repeated the grade, as education is mandatory.[11]

11.2.2.3 Higher Education

Lithuania has two types of higher education institutions: 21 universities and 22 colleges (of which 7 universities and 10 colleges are private). At the beginning of the 2017/18 academic year, there were 117.7 thousand students in higher education, of whom 82.3 thousand studied in universities and 35.4 thousand studied in colleges (see more data in Table 11.1).

Instruction language for 98% of students was Lithuanian, 1.7% English, and 0.3% Russian.

In the year 2017, 8 thousand teachers (53% female) were working in universities and 2.6 thousand (66% female) were working in colleges.

Most popular programs were: Business and Administration, Health, Engineering and Engineering Trades, Social and Behaviors, Law, Information and Communication Technologies, Education.

[11] Statistics Lithuania (2018b).

Table 11.2 Enrollment rate

	2012		2015		2017	
	Gross	Net	Gross	Net	Gross	Net
Early childhood	98.7	81.9	104.9	87.0	110.1	88.2
Primary	101.8	98.9	102.9	100.0	104.3	102.5
Lower secondary	104.5	97.3	104.8	98.3	106.2	100.0
Upper secondary	120.4	85.0	114.0	85.2	113.5	88.1
Post-secondary	17.5	6.1	29.7	7.4	29.8	6.5
Bachelor's and masters	61.1	44.8	56.9	40.9	58.7	41.4
Doctoral studies	1.7	0.8	1.7	0.7	1.8	0.6

Source Statistical department. Ibid

In the year 2017, a professional bachelor's degree was obtained by 8.3 thousand graduates in collages and 11.2 thousand—bachelor's, 7.2 thousand—master's, 0.3 thousand—Ph.D. degree graduates in universities.[12]

11.2.3 Enrollment Rate

Enrollment rate in education present in Table 11.2.

11.2.4 Government Expenditure on Education

In 2017, the funds of education total 1731 million EUR and accounted for 4.1% of GDP (Table 11.3).

11.2.5 Education Research

11.2.5.1 Education Research Institutions

The public sector is predominant in Lithuania's research and development and innovation (RDI) landscape, the private sector still plays a relatively minor role, even if the share of innovative firms is increasing: 40.7% of firms introduced innovations over 2014, compared to 30% in 2010–2012.

Government agency MOSTA distinguishes biotechnology organizations "Sicor Biotech" and "Valentis" as pharmaceutical companies, engaged in the manufacture

[12]Ibid.

Table 11.3 Expenditure in education, 2017 year

	Total expenditures (mill. Eur.)	Expenditures on education, compared to GDP (%)	Expenditure per student (thousand. euro)
Preschool education	303.9	0.7	2.3
Pre-primary, primary, secondary education	829.9	2.0	2.4
Vocational education	106.6	0.3	2.1
High education	239.8	0.6	Colleges—0.9 University—1.9
Non-formal education	155.8	0.4	1.7

Source Statistical department. Ibid

of pharmaceutical preparations and laser technology companies: “Northcliffe Lighting” and “Artilux NMF” engaged in lighting equipment production and “Šviesos Conversion”—Creating Laser Technologies.[13]

Today, in teacher education the main actors are three centers: Vilnius, Šiauliai, and Kaunas Vytauto Magnus universities. Many researches in informatics and ICT implementation in education are doing Vilnius Universities, Kaunas Technology University, Vytautas Magnus University.

11.2.5.2 Education Research Programs

The main strategic objective in the National Program for the Development of Studies, Scientific Research and Experimental Development for 2013–2020 is to encourage the sustainable development of people and society, which improves the country’s competitiveness and creates conditions for innovation by developing studies.

In 2017, R&D expenditure amounted to EUR 371.7 million, total R&D expenditure accounted for 0.89% of GDP.[14]

11.2.6 Teacher’s Professional Development

11.2.6.1 Teachers’ Education and Training Systems

In Lithuania, teachers are trained in higher education institutions. The prospective teachers’ study according to preschool education, primary education, or concrete subject study programs.

[13]MOSTA (2017).

[14]Paliokaitė et al. (2018).

Teachers' conditions of service entitle them to continue professional development (CPD). The founder of the school ensures that teachers and other staff engaged in the process of education receive remuneration for their CPD for at least five days per year.

CPD providers charge fees for their services. The greater part of the costs related to professional development activities are covered from the state, municipal, or schools' budgets and some costs are covered by individual teachers themselves. Funds for professional development in the school budget depend on the number of pupils enrolled (the pupil's basket).

The teacher education centers regularly provide information about the plans for continuing professional development programs, seminars, and other events.

11.2.6.2 Teachers' Education and Training Programs

There are various forms of initial teacher education study programs. Bachelor's pedagogical studies last for 4 years (240 ECTS), while Professional Bachelor's pedagogical studies last for 3 years (210 ECTS). A study module on pedagogy comprises 60 ECTS. These study credits are usually distributed throughout one year.

CPD programs are prepared by teacher education centers or other providers. It can be found in Registry of the program in the AIKOS website.[15] The importance of teacher digital literacy is recognized. According to the Requirements for Qualification of Qualified Teachers (2014), teachers must acquire digital competencies by participating in digital literacy programs. Requirements for teachers' digital literacy programs include the following areas: information management, communication, content creation, security, solving digital literacy problems. The requirements are in line with the EU DigCompEdu Framework.[16]

11.3 New Progress of ICT in Education

11.3.1 Infrastructure

11.3.1.1 Campus Network Access

Today 95% of schools have an internet connection. Main network operator for education institutions is Lithuanian Research and Education Network (LITNET). LITNET connects all R&D institutions in Lithuania, including 15 universities and 40 research institutes, and serves 537 education organizations. The overall customer base of LITNET is about 400,000 end users. For all institutions, which are connected to this

[15] Aikos. https://www.aikos.smm.lt/. Accessed Apr 24, 2019.

[16] Digital Competence Framework for Educators (DigCompEdu), European Commission. https://ec.europa.eu/jrc/en/digcompedu. Accessed Apr 24, 2019.

Table 11.4 The internet for learning purposes

Indicator	2010	2012	2015	2016	2017
The percentage share of the population who use the internet for learning purposes	8	12	17	18	21

Source http://statistika.ivpk.lt/ivp-programa/15068

Table 11.5 Computer in schools (general education)

Year	Older than 4 years (PC percent)	OS win (PC percent)	Wi-Fi network (percent of schools)	Virtual learning environment (percent of schools)	Percent of computerizing teacher's workplace	Total computers per 100 student
2016	63.1	93.4	89.1	23.0	52.0	27.0
2017	62.9	92.9	93.1	25.2	54.0	28.0
2018	58.9	91.8	96.5	29.9	59.0	30.0

Source www.svis.smm.lt

network, digital data transmission services are provided as well as other innovated solutions in computer network technology and its services. LITNET is a part of the European academic network GEANT and provides the possibility to participate in different projects, which are executed in some other international computer network organizations (TERENA, CERT, etc.).[17]

Some education institutions, are using a private operator such as broadband, cable TV, etc.

11.3.1.2 ICT Development Indicators

One of the National Information Society Development Program for 2014–2020 "Digital Agenda for the Republic of Lithuania" task is providing more favorable conditions for teaching and learning, based on modern ICT. As the main indicator for measurement of this task is "percentage of the population who uses the Internet for learning purposes," achievement of 21% (Table 11.4) in 2017 shows that the Program task was successfully implemented (goals was 20% until 2020).

Another important indicator for monitoring ICT implementation in general education is "Percent of computerized teachers' workplace" (goal is 75% until 2020) (Table 11.5). As well as statistical indicators for every year, in general schools are using other indicators (Table 11.5):

- Type of computer (percent of computers) (general education);
- Schools, which have a Wi-Fi network, virtual learning environment (VLE) (percent of schools);

[17]LITNET. www.litnet.lt. Accessed Apr 24, 2019.

Table 11.6 Computers in schools (2017 09 01)

	Total PC	Total PC with access to the internet	Total PC used for teaching purpose	Number of PC used for teaching purpose per 100 student
General schools	90,110	85,017	63,140	19.4
Vocational schools	12,250	11,380	8721	20.7
Colleges	9506	9255	7048	19.9
Universities	24,358	22,854	14,257	17.3

Source Statistical department. Statistics Lithuania (2018b)

- Total computer per 100 students in general schools.

11.3.1.3 Computer-Student Ratio

For international comparison, Lithuania used data from Eurostat, PISA 2012,[18] PISA 2015,[19] TIMMS research, Europeans Commissions researches.

Main for all levels computer/student ratio is "The computer used for teaching purpose per 100 students (2017 09 01)" (Table 11.6).

11.3.2 Educational Resources

11.3.2.1 Digital Educational Resources

There is no special policy document on digital learning resources (DLR) in Lithuania. The Ministry of Education and Science has been investing in the development of digital media for more than twenty years. In conformity with the Ministerial legal acts, DLR purchase for primary and secondary schools can be funded either by European structural funds or by "student basket" (funding per pupil) or other funds. Businesses actively offer a variety of e-resources besides textbooks.

DLR is systemized and stored into several repositories:

- The main repository of recommended digital learning resources is the Educational Development Center website Ugdymo sodas[20];
- Schools can use the European Learning Resource Exchange service for schools[21]—LRE is a joint initiative of European Ministries of Education managed

[18]PISA Digital Skills, Compare your country. http://www.compareyourcountry.org/pisa-digital. Accessed Apr 24, 2019.

[19]OECD (2016).

[20]Ugdymo SODAS. https://sodas.ugdome.lt/mokymo-priemones. Accessed Apr 24, 2019.

[21]Learning Resource Exchange. http://lreforschools.eun.org/. Accessed Apr 24, 2019.

by European Schoolnet. Currently, there are over 220,000 OER from over 30 providers in LRE;

- Vocational training resources are also available on the dedicated vocational school website[22];
- In higher education exists two LieDM networks: association[23] and consortium,[24] as well The Lithuanian Academic Electronic Library (eLABa);
- Adult education resources are dedicated to a separate information system.[25]

11.3.2.2 Open Educational Resources (OER)

All materials created with the support of government funding, are free for all Lithuanian users. Research on OER for Primary and Secondary Schools was performed in Lithuania in 2012. One of the main conclusions is that currently there is a lack of a higher interactivity level of DLR in Lithuania. The majority of DLR with a higher level of interactivity is not free for use in Lithuanian primary and secondary schools, schools need to buy it from publishing companies, while most schools have a limited budget.[26]

Main challenges for using OER are teachers' competencies, language barriers/cultural differences (most OER is in English), the need to find new "business" models in dealing with business to make their content more open to school.

The OpenDOAR portal lists 12 Open Access (OA) repositories for Lithuania.[27] One of the National OA repository is the Lithuanian Academic Electronic Library (eLABa). The main goals of eLABa creation were the development of the environment and tools, allowing preparation, collection, long-term preservation, and permitting access to research and study e-documents, created in Lithuania. Functioning of the eLABa is based on the usage of the Fedora repository software and infrastructure. eLABa consists of 6 science and study e-document collections: ETD (bachelor and master theses, doctoral dissertations, and their summaries); Journals (periodic or one-time reviewed scientific and popular journals and other publications); Books (monographs, manuals, teaching books, their parts and others issues of science and studies); Proceedings (reports at scientific or methodological conferences, seminars, and other scientific and educational events); Working Papers (research, development activities and project reports, and other research and study materials, prepared in e-form); Empirical Data[28] (empirical data of research in humanitarian and social

[22] KPMPC. http://www.kpmpc.lt/kpmpc/profesinis-mokymai-3/programos-iristikiai/mokymo-mokymo-istikiai. Accessed Apr 24, 2019.

[23] Apie, LieDM asociacija. http://liedm.net/apie/. Accessed Apr 24, 2019.

[24] Apie LieDM. https://vma.liedm.lt/apie. Accessed Apr 24, 2019.

[25] Suaugusiųjų mokymosi informacinė sistema. https://www.smis.lt/. Accessed Apr 24, 2019.

[26] European Schoolnet (2017).

[27] Browse by Country and Region, OpenDOAR. http://v2.sherpa.ac.uk/view/repository_by_country/lt.html. Accessed Apr 24, 2019.

[28] Naujienos, eLABa. https://www.elaba.lt. Accessed Apr 24, 2019.

sciences). Higher education institutions also implement various projects for the application of OER. For example, Kaunas University of Technology portal[29] provides Massive Open Online Course (MOOC) to the public on information technology, management; Vytautas Magnus University scientists perform various studies in the field of application of OER.[30]

11.3.3 Learning and Teaching

11.3.3.1 Information Technology-Assisted Teaching

In the National Curriculum for Primary, Primary and Secondary Education (2015) information communication technologies (computers, tablets, interactive boards, mobile phones, cameras, laboratory equipment, etc.) are offered as a source of content, as a tool for exploration, and knowledge creation, as a teaching and learning organization tool, for teamwork and networking, assessment and self-assessment.

The Ministry of Education and Science initiates various activities to encourage teachers to use active technology in schools: annual exhibition “School,”[31] a database of methodological works,[32] recommendation, education advisers team on the mobile device,[33] etc.

It can be mentioned in various business initiatives such as “Samsung for the Future,” events of Non-Governmental Organizations (Computer Union Conference Computer Days,[34] annual conferences of the National Distance Learning Association ALTA[35] and others).

In 2014, “Action Plan for ICT Implementation in General and Vocational Education for 2014–2016” approved by ministry confirmed that:

- the majority (68%) of teachers learned to apply ICT during the lessons;
- the large part (40%) of teachers’ workplaces are computerized;
- Teachers and students can use educational portal E-mokykla, a majority of schools (80%) use e-diaries;
- over 60% of students (grade 8) use their own computers and mobile phones for learning;

[29]KTU atvirieji mokymai. https://open.ktu.edu/. Accessed Apr 24, 2019.

[30]Innovative Studies Institute, Vytautas Magnus University. http://studyonline.lt/en/study-of-innovation/open-educational-resources/. Accessed Apr 24, 2019.

[31]School 2018. https://www.litexpo.lt/en/exhibitions/school-2018. Accessed Apr 24, 2019.

[32]Ugdymo plėtotės centras. https://www.upc.smm.lt/expert/mddb/. Accessed Apr 24, 2019.

[33]Ugdymo plėtotės centras. https://www.upc.smm.lt/expertising/patarejai/rengimas.php. Accessed Apr 24, 2019.

[34]APIE LIETUVOS KOMPIUTERININKŲ SĄJUNGĄ. https://www.liks.lt. Accessed Apr 24, 2019.

[35]ALTA-NDMA. https://ndma.lt/alta/. Accessed Apr 24, 2019.

- Lithuania's Internet network is sufficiently developed, and computerization of the economy is growing.
- There is still low teachers' motivation to use ICT and only a minority of schools (32%) use virtual information systems for learning.[36]

The European Commission launched the second Survey of Schools: ICT in Education, the result[37] shows that 49% of Lithuanian students use a computer at least once a week (ISCED 2). Quit popular idea "Bring your own device"—more than 70% of Lithuanian students are using their own equipment for learning purposes during lessons (at least once a week) (ISCED 2).

11.3.3.2 Courses About Information Technology

Information Technology as a subject is teaching in compulsory lower secondary schools (grade 5–10). IT subject includes five areas: information; digital technologies; algorithms and programming; virtual communication; security, ethics, and legal principles. At the upper secondary level (grade 11–12), IT is an elective subject offered in basic and advanced modes. The advanced course includes electronic publishing, database design and management, and programming.[38]

Vocational schools provided some courses on programming (example: Java programmer, web developer), maintains of computer and other.

In higher education were 93 Informatics programs (aikos.smm.lt) with 4 subdirections: information system, informatics, informatics engineering, and application systems. Programs can be found in different names, for example: Bioinformatics, Internet of Things Engineering, Electronic Business Technologies, Financial Technologies, and others.

11.3.4 ICT Integration into Practices

11.3.4.1 The Ability for Faculty to Use ICT to Teach

Teacher's self-evaluation data (2016/2017 academic year) shows that approximately 93% general schools teachers use ICT for the subject they teach, but only 26% teachers share experience in virtual communities (Fig. 11.2).

According to the International Computer and Information Literacy Study (ICILS 2013) teachers using different ICT tools for teaching (Fig. 11.3). Most popular are Computer-based Information Resources (32%) and Word Processors or Presentation Software (29%). In class lessons, digital technologies are mostly used in

[36] Švietimo ir mokslo ministerija (2014).

[37] European Commission (2019).

[38] Dagiene and Stupuriene (2016).

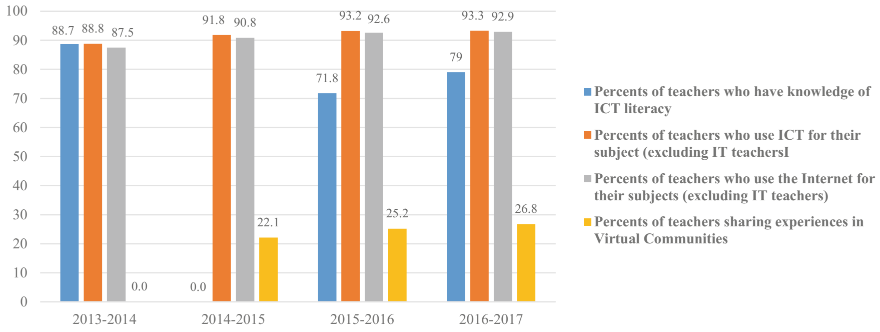

Fig. 11.2 Teacher's self-evaluation data. *Data source* www.svis.smm.lt

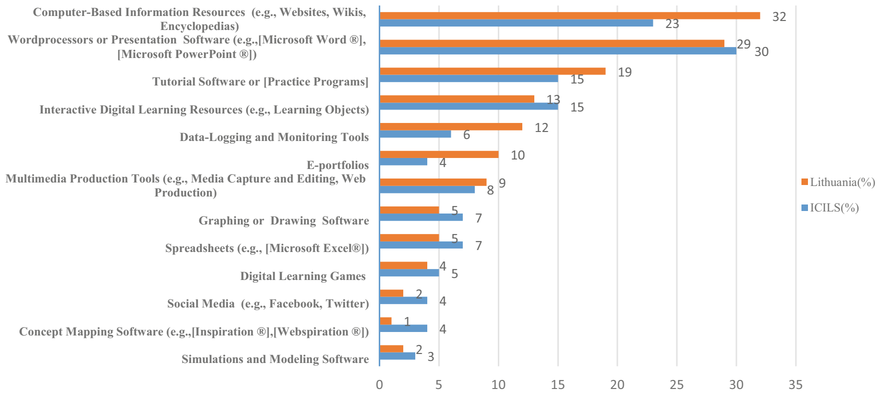

Fig. 11.3 Percentages of teachers using ICT tools for teaching in most lessons. *Source* ICILS (2013)

social sciences—21% teachers (international average—20%), the least—arts—8% (international average—11%) and foreign languages 14% teachers (international average—18%). Compared to the international context, Lithuanian teachers are very active in training—43% of teachers improve their digital qualification. Overall, teachers appeared to be using ICT most frequently for relatively simple tasks and less often for more complex tasks.[39]

11.3.4.2 The Ability for Students to Use ICT to Solve Problems

According to ICILS, 2013, in Lithuania, 55% of students use computers at school (54% international average) and 95% Lithuanian use them at home (international average 87%).

[39] Švietimo informacinių technologijų centras (2014).

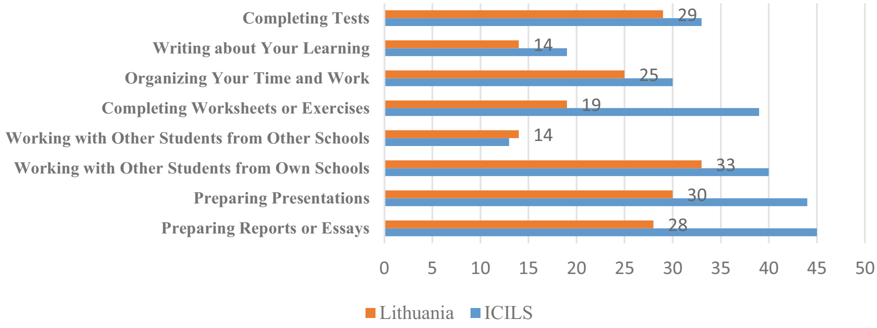

Fig. 11.4 Percentages of students using computers for study purposes at least once a month. *Source* ICILS (2013)

Lithuanian pupils' information and computer literacy (CIL) is similar to their peers abroad: the basic level—in Lithuania reaches 30% (international average—23%), second level—39% (International average—38%), third level—15% (International average—21%), the highest fourth level reaches 1% (international average—2%) Lithuanian students. Significant positive associations with CILs were: students' gender (female compared to male), students' expected educational attainment, parental educational attainment, parental occupational status, number of books at home, and ICT home resources. From data, we can see that Lithuanian pupils have basic skills but less successfully in performing creative tasks.

Mainly students are using computers in communication with other students from their own schools (33%), preparation of presentation (30%) and reports or essays (28%) (Fig. 11.4).[40]

PISA 2015 assessed students' performance in collaborative problem-solving; as well students were asked to report on the extent to which they use ICT at school and their self-perceived comfort with ICT. Students who use ICT most in their school score 29 points are lower in collaborative problem-solving, on average, than students who use ICT the least. In Lithuania, this gap is over 50 score points. PISA 2015 researchers considered that dependence on ICT may reduce the time students spend interacting and cooperating with each other, and thus may reduce their opportunities to learn how to collaborate. To other hands, the relationship between ICT use and performance in collaborative problem-solving is not necessarily one of cause and effect.[41]

Students' self-reported ICT competence is found to be positively related to performance in collaborative problem-solving. Students who rank in their country's top quarter of self-reported ICT competence score 11 points higher in collaborative problem-solving than students who rank in their country's bottom quarter, on average across OECD countries. In Lithuania, the difference is more than 40 score points.[42]

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[40] Švietimo informacinių technologijų centras (2014).

[41] OECD (2017b).

[42] Ibid.

11.4 Policy and Strategy of ICT

General school's computerization campaign started in Lithuania more than thirty years ago (1986), coincided with the appearance of the subject of informatics. In 1996, the State prepared a first computerization project for general education, vocational and higher schools, with a total value of 6 million USD. Later Lithuania had four strategies/programs/plans for ICT implementation in education: 2000–2004; 2005–2007; 2008–2012; 2014–2016.

Last "Action Plan for ICT Implementation in General and Vocational Education for 2014–2016"[43] seeks that after few years:

- Teachers will actively (50%) participate in virtual forums, exchange experience, distance learning (e.g., MOOC);
- All students will learn in virtual environments and have possibilities to self-assess their own learning outcomes. Assessment information will be available to teachers and principals to make decisions;
- Open content and other resources will be accessible by all schools in safe wireless networks. Students will use their own mobile devices for learning both at school and home (BYOD);
- Updated IT subject curriculum will be attractive to students, and it will offer both in a formal and informal way. About 15% of students will choose optional IT subjects in secondary schools. Students will be acquainted with IT possibilities already at primary classes.

In 2017/2018 the implementation activities were started with the following project in line:

- Development and implementation of digital education content;
- Creating a safe electronic space for children;
- Digitalization of student assessment/exam system;
- Improving the competencies of school's staff, which coordinate ICT activities;
- Transferring Information Technology subject to primary classes;
- Improving the monitoring of general educations;
- Development of vocational training and lifelong information systems and registers.

In the high education, the Government pushed activities to create integrated Lithuanian science and study information space. The program "Information Technologies for Higher Education and Science (2001–2006)" (ITMiS) included three main subprograms: Lithuanian Science and Higher Education Information System (LieMSIS), Lithuanian Academic Libraries Network (LABT), and Lithuanian Distance Education Network (LieDM). Today national action plans for infrastructure LITMIS 2017–2020[44] are working in the same three pillars: the Information system

[43] Švietimo ir mokslo ministerija (2014).

[44] LITMIS. https://www.litmis.lt. Accessed Apr 24, 2019.

for science and studies administration (EDINA[45]), Lithuanian Electronic Library Information System (eLABa[46]), and Electronic Study Information System (ESIS). In addition, several new common information infrastructures have been created: The National Open Access Research Data Archive (MIDAS[47]), Student and Graduate Career Management Information Systems (karjera.lt), and other information systems.

Other higher education infrastructure program LITNET 2017–2021[48] is planning update computer networks for research, study and education institutions.

ICT implementation finance is going from different sources: State budget, European structural fund, Municipalities or schools own resource (it is a small amount in "student basket"). Some initiatives with cooperation in the EU level can be financed with support from EU funds through Horizon, Erasmus, or other programs.

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[45]EDINA. https://www.edina.lt. Accessed Apr 24, 2019.

[46]Naujienos-eLABa. https://www.elaba.lt. Accessed Apr 24, 2019.

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Chapter 12
Report on ICT in Education in Montenegro

Boban Melović

12.1 Overview of the Country

12.1.1 History and Geography

Judging by numerous events from the past, we can say that the history of Montenegro is very colorful. Namely, the turbulent life of Montenegro was spiced up by many people, but its permanent strive for freedom remained dominant throughout its history. The name "Crna Gora" (Montenegro) was first mentioned in 1276 in the Charter of King Milutin. It is believed that its name was obtained by dense forests that covered Lovcen and its surroundings. The forests were so dark that their observation gained the impression of a "black mountain."

During the Roman Empire, the territory of Montenegro was actually the territory of Duklja (Doclea) (Montenegro Development Group 2008). During Crnojevic rule, in 1493, the first printing shop in the Balkans was opened, and one year later, in 1494, the first book was printed—"Oktoih" (Octoechos).[1]

Petar I Petrovic (1784–1830) is one of the most renowned persons in the Montenegrin history. Led by him, Montenegro strengthened its independence. The successor of Petar I Petrovic was Petar II Petrovic Njegos. During his rule, this superb ruler established the state institutions, administrative and state authorities. He wrote many literary works, such as "Gorski vijenac" ("The Mountain Wreath") and "Luca mikrokozma" ("The light of microcosm"), which made him one of the greatest writers of the world. At the Berlin Congress, Montenegro received full international recognition. The fact that Montenegro was the only country in the Balkans that successfully

[1] For further information see: http://ilovemontenegro.weebly.com/about-montenegro.html. Accessed Apr 17, 2019.

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fought against the Otoman Empire impressed Europe and Montenegro became a kingdom in 1910 (Eurydice 2018a, b).

With the fall of the Kingdom of Yugoslavia before the fascist Germany in World War II, Montenegro proved again that the spirit of freedom cherished by its people did not disappear. On July 13, 1941, a large number of Montenegrins stood up against the Italian occupiers.[2]

In the end of the twentieth century, and after the disintegration of former Yugoslavia, Montenegro remained in the union with Serbia. Most citizens at the referendum held on May 21, 2006 voted independence of Montenegro (Eurydice 2018a, b). Montenegro has been classified as an upper middle-income country by the World Bank and it is a member of the United Nations, the Council of Europe, the World Trade Organization, the Central European Free Trade Agreement, and a founding member of the Union for the Mediterranean (Commission of the European Communities 2006). Montenegro is also an applicant negotiating to join the European Union. Montenegro has made moderate but steady progress towards EU membership (Baća and Morrison 2018). Accession negotiations with Montenegro were opened in June 2012. So far, 32 negotiating chapters have been opened and three have been provisionally closed: Chap. 25 on Science and Research, Chap. 26 on education and culture, and Chap. 30 on International Relations (Internal data of the Ministry of Economics 2019). In June 2017 Montenegro became a member of NATO (European Commission 2018).

Constitutional name	Montenegro
Location	South Eastern Europe
Geographic coordinates	42°30'N, 19°18' E
Time zone	GMT + 1
Climate	Continental, Mediterranean and Mountainous
Population	622,159 (2016)
Area	13,812km^2
Territorial division	23 municipalities
Capital (population)	Podgorica (195,524)
Old Royal Capital (population)	Cetinje (16,757)
Political system	Parliamentary Democracy
Currency	EUR
Number of Airports	2 (Podgorica and Tivat)
Main port	Port of Bar

As we have stated, Montenegro is an independent country located in Southeastern Europe and it is often called "the Pearl of the Mediterranean." Croatia borders it to the west, Kosovo to the east, Serbia to the north-east, Bosnia and Herzegovina to the north-west, and Albania to the south-east. There is also Adriatic coast in the south-west. Montenegro's capital and largest city is Podgorica, and the city of Cetinje is the royal capital (Jovanović et al. 2017).

[2]Montenegro History, Visit Montenegro. https://www.visit-montenegro.com/montenegro/history/2/. Accessed Apr 2019.

Speaking about size, Montenegro shows off with the deepest canyon in Europe, the biggest lake in the Balkans, the longest underground river, the tallest people in the world. This is the land of the southernmost bay of glacial origin, the cleanest river and one of the last rainforests in Europe, the oldest olive tree, the last pelican resort and the warmest European town during summer.[3] Montenegro is a Mediterranean country with a very good strategic position. Actually, it is very good connected both to the other Mediterranean countries by sea and the major European hubs. The beautiful coast of Montenegro is 294 km long (Jovanović et al. 2017). Also, Montenegro is famous for its Kotor bay. Included in the list of the 20 most beautiful bays in the world. It is important to mention the fact that Montenegro has five extensive National parks. It is a biological "hot spot" of European and world biodiversity. (Naturetrek 2018).

12.1.2 Population

There were approximately 513 million persons resident in the EU-28 in 2018, and Montenegro is the smallest enlargement country in population terms, with 622 thousand inhabitants in 2016 (Eurostat 2019a, b).

The data about population is stated predominantly on the basis of the latest data taken from the Montenegro Population 2019 (World Population Review 2019). According to data from the report, the current population of Montenegro is 629,355 (April, 2019) based on the latest United Nations estimates. Montenegro has a fairly low population density of just 45 people per square kilometer (125/sq. mi), which ranks 168th in the world list of countries (and dependencies) by population. The median age in Montenegro is 38 years.

The capital and largest city, Podgorica, has a population of 156,000, or 30% of Montenegro's population. Montenegro is a very ethnically diverse country and it recognizes several ethnic groups. Major ethnic groups include Montenegrins (45%), Serbs (29%), Bosnians (8.6%), Albanians (4.9%), Roma (1%), Croats (1%) (World Population Review 2019).

12.1.3 The Status Quo of Social and Cultural Development

The official language is Montenegrin but Croatian, Albanian, Bosnian, and Serbian are all common and all mutually intelligible, except for Albanian. Serbian Orthodox Christianity is the most popular religion today. Islam does represent a majority in some areas of the country and accounts for 19% of the total population.

[3]For further information see: https://www.visit-montenegro.com/tourism/where-is-montenegro/. Accessed Apr 17, 2019.

Socioeconomic problems are exacerbated for the long-term unemployed, pensioners, women, as well as groups with a history of social exclusion, sexual minorities, people with disabilities, the Roma community, and refugees and internally displaced persons. As regards gender equality, the inclusion and participation of women at all levels of society remains a key challenge. In the 2016 elections, female representation in the parliament amounted to 23% (Women in national parliaments 2019). The distribution of both population and income reflects regional disparities between a more populated and richer south (coastal and capital areas) and the less developed northern municipalities.

12.1.4 Current Situation of Economic Development

Montenegro has a small, open economy, with a high level of trade and investment integration with the EU and the other countries of the Western Balkans. Montenegro relies on income from the tourism sector and has only a narrow industrial base.

Pursuant to the Fiscal Strategy for the Period 2017–2020, implementation of the fiscal consolidation measures continued in 2018, which resulted in a further reduction of the budget deficit. The fiscal consolidation measure introduced in 2018 which has the biggest impact is the increase in the standard VAT rate from 19 to 21% (Internal data of the Ministry of Economics 2019). Pursuant to the preliminary data on the central budget outturn, the central government budget deficit, including the liabilities from the previous period, is around 3.5% of GDP, which is in line with the most recent estimates of the Ministry of Finance. Based on the estimates, the general government deficit for 2018 is 2.7% of GDP.

According to the latest available data contained in the Economic reform Montenegro program 2019–2021 (Government of Montenegro 2019a), from January 2019, that is, according to final MONSTAT data[4] indicates that the Montenegrin economy generated real GDP growth of 4.7% in 2017 in purchasing power standards (PPS) reached 45% of the EU average. The strong growth also continued in 2018. GDP per capita in current price terms for 2018 is estimated at around €7.397, while in terms of purchasing power parity it is currently at the level of 46% of the EU average.

Tendency of growth of the Montenegrin economy remains above the expectations of domestic and foreign expert assessments. According to the final data of Directorate for statistics—MONSTAT, GDP real growth rate in 2017 was 4.7%, while, the 1st, 2nd, 3rd, and 4th quarter of 2018 saw growth of 4.5, 4.9, 5, and 4.8%, respectively, compared with the same period of 2017.

GDP components on the spending sideshow that the real spending of households was 4.4%, driven by an increase in household lending and revenues from tourism, while fixed capital formation recorded growth of 21.5%, as a result of the

[4]Statistical Office of Montenegro (2018).

completion of infrastructure projects and projects in the areas of energy and tourism. (Government of Montenegro 2019a)

On the other hand, consumer prices grew in 2018, with positive annual growth rates in all months. The increase in oil prices at the global level had the largest impact on inflation during that period, which, along with the weakening of the euro against the US dollar, spilled over continuously from external markets onto the increase in fuel prices in Montenegro. The second factor that affected the price increase, as we have already pointed out, was an increase in the general VAT rate from 19 to 21% and in the excise tax on tobacco and alcoholic and carbonated beverages on the domestic market. The estimate is that the average inflation for 2018 was 2.9%.

The registered unemployment rate was 18.4%, which is 4.2% lower than the previous year. The average gross and net monthly wages (wages without taxes and contributions) in the period January–November 2018 were €766 and €510, respectively, which is approximately the same level as in the comparative period of 2017. As a result of the dynamics of prices and nominal wages, it is estimated that real wages declined by 3.0% in 2018 (Government of Montenegro 2019a).

The current account deficit for the period January–September 2018 of €416.7 million was mainly covered by the net inflows of foreign direct investments, which made up 52.4%, while the rest was covered by net inflows of portfolio and other investments and reserve funds (Government of Montenegro 2019a). The recorded net inflow of foreign direct investments during the observed period was €218.4 million.

The current account deficit in the period January–September 2018 was €416.6 million, which represents an increase of 32.2% relative to 2017. The goods account deficit for the period January–September 2018 was €1.5 billion, or 12.6% more due to an increase in imports, which was to be expected because of the implementation of large infrastructure projects. Total exports of goods were €312.7 million, which represents an increase of 11.3%, due to higher exports of electricity, steel and iron, medical products, and aluminium. Total imports of goods amounted to €1.8 billion and were 12.4% higher as a consequence of imports of machinery and means of transport, oil and oil derivatives, ferrous and non-ferrous products, and various finished goods (Government of Montenegro 2019a).

It is anticipated that the annual real economic growth rate will be 2.8% in 2019, 2.3% in 2020, and 2.4% in 2021.

12.1.5 The Status Quo of Science and Technologies

Investing in scientific research and innovation is a key factor in the development of new technologies in the economy, stimulating competitiveness and opening of high qualification jobs. In this respect, the scientific research system and innovation system should be advanced in a way that contributes to knowledge-based economy.

In the period from 2016 to 2019, a large number of laws in the field of education from preschool to higher education were changed.[5]

Work on establishing a Science and Technology Park at the University of Montenegro continued and the innovative entrepreneurial center "Tehnopolis" is now fully operational. Promoting investment is particularly important in the context of participation in international science and innovation programs and opportunities arising from these programs. In that sense, encouraging networking is especially important, as it enables optimal use of international and EU funds for science and innovation and access to modern technologies and large infrastructures (Ministry of Science 2015).

The scientific potential of Montenegro is increasing. The number of scientific publications in international journals has been growing rapidly. The quality of Montenegrin publications is below average as measured by publishing shares in top-10% and top-1% most cited publications. (Ministry of Science and Hollanders 2018).

Establishing the Science and Technology Park in Podgorica (2018–2021), as well as encouraging the creation of excellence centers in the coming period is a significant part of the reform activities in the field of science (Ministry of Finance 2017). Proposed measures, in this field, from Montenegro Development Directions 2018–2021 are (Ministry of Finance 2017):

- *Strengthening human resources and research capacities* through:
  - Recruitment program of PhDs and PhD students Science;
  - Research Projects Financing Program.
- *Improvement* of international cooperation and networking through:
  - Improvement of participation in international and EU programs and collaborations within renowned science and research institutions;
  - Support for the establishment of the International Institute for Sustainable Technologies in South East Europe.
- *Strengthening* the synergy between science and economics through projects:
  - Establishment of the Scientific and Technological Park;
  - Financial support for research and innovation.

12.1.6 The Relationship with China under the "16+1" Cooperation Framework

Infrastructure is a key element in China's policy toward the Balkan region. A Chinese-built highway for Montenegro is anticipated to increase Montenegro's debt to nearly 80% of its GDP (Banović 2019). Montenegro was certainly attracted by

[5]For further information see: http://www.mpin.gov.me/ministarstvo. Accessed Apr 17, 2019.

the easily obtained Chinese loans desperately needed for infrastructure projects and development.

Montenegro has benefited from Beijings generosity—received a $500 million loan from Exim Bank for its share of the highway (Xinhua 2018). China Pacific Construction Group, one of China's largest construction companies, has begun building an expressway between Montenegro and Albania. The CCECC finished the Kolasin-Kos railway rehabilitation project in Montenegro last year. CCECC Montenegro Ltd. has a strong presence in the international market in the field of railway construction, its core business, and in road construction. The company has also shouldered its social responsibilities in countries where they operate.

Montenegro's policy toward China remains focused on development support and need to build the infrastructure. Chinese presence in Montenegro, investment (Chen and Zhigao 2018):

- Construction of a 170 km long highway financed at ¾ by China and built by a Chinese firm;
- Renewal of Montenegrin fleet with the construction of four vessels;
- Investments in several energy projects: hydroelectric, thermal power plant;
- Project to participate in the construction of motorway segments as part of the "Blue Corridor" project which will link Italy to Greece along the Adriatic coast.

The trade between China and the 16 CEE countries is more complementary than competitive, implying a bigger room for trade expansion. In 2016, using China as the benchmark, the average trade complementarity index between China and the CEE was 0.3733 and the least competing country being Montenegro, with which the trade specialization coefficient was 0.0729 (Chen and Zhigao 2018). As to the non-EU members, Montenegro serves as the example of the country heavily dependent on financial cooperation with China to the level which endangers its financial stability and also harm Montenegro's cooperation with EU and other global financial institutions.

Also, as an example of the growth of the number of Chinese entrepreneurs operating in Montenegro, we can mention the opening of a hospital and a Chinese medicine center in Montenegro. Namely, the first Chinese private health institution Specialist clinic in physics "China Medika" was registered in 2014 in Podgorica. In 2017, the Center for Traditional Chinese Medicine China–Montenegro was opened. Thus, the medical clinic of China Medica became the second center of Chinese medicine in Europe.

As an example of good cooperation between Montenegro and China, we can also find the export of Montenegrin wines to the Chinese market. According to official data on the import of wines by the Chinese customs office last year, Montenegro was ranked on the 18th position (Plantaze 2018).

12.2 Overview of the Educational Development

Education is seen as a key factor of societal development and Montenegro is continuously implementing reforms in this area in order to make educational system compliant with modern trends and quality (Melović 2019). In recent years, reforms have been done at all levels of education. Reforms were preceded by the adoption of new laws and amendments and changes for the appropriate level of education, and its harmonization with EU legislation.

12.2.1 Education Policy

Educational policy in Montenegro is created at the central level, which means the Ministry of Education is responsible for the overall educational policy. Data in this part of the work are given on the basis of the latest data available from Eurydice—Montenegro Overview. According to these data, the allocation for education from GDP is around 4.5% (Eurydice 2018b).

Education and upbringing are provided in preschool institution, school, educational center, resource center, by the adult education providers, universities, faculties, academy of art and upper secondary non-tertiary schools, all of which can be public or private. At up to the university public educational institutions, education is of secular character and the religious activity is not allowed except in the secondary religious schools. Teaching in educational institutions is performed in the official, Montenegrin language. Teaching is also performed in languages in official use (Eurydice 2018a, b): Serbian, Bosnian, Albanian, and Croatian. Education and upbringing are provided on the basis of the educational programs (curricula) adopted by the Ministry of Education upon the recommendation of the relevant council.

Montenegrin citizens are equal in their rights to education, irrespective of nationality, race, sex, language, religion, social background, or other personal ability. Foreign citizens who have a short-term residence or permanently reside in Montenegro, are equal in their rights to education with Montenegrin citizens. As regards higher education, a foreigner is entitled to be enrolled into a study program in Montenegro under the same conditions as Montenegrin citizens, in compliance with the article 100 of the Law on Higher Education and statute of an institution. Up-to-the-university institutions are autonomous in the realization of educational programs. Autonomy of the HEIs is guaranteed by the Constitution and the Law on Higher Education. Identified challenges in the preschool education system relate to insufficient infrastructure capacity to involve more children in preschool institutions. When it comes to primary education, the key challenge is to improve the quality of education that will directly impact students' achievements on international PISA testing. A special segment is an inclusive education where attention in the forthcoming period should focus on improving the conditions and quality of work with children with special educational needs. In order to achieve the goals set, future trends, and efforts in education area in Montenegro will relate to the following (Internal Data of the Ministry of Education 2019; Ministry of Finance 2017):

- Increasing the coverage of children from the age of three until entering school with preschool education.
- Infrastructure for primary education needs.
- Providing better access to education facilities for children with special educational needs as well as the quality of the teaching process.
- Further development of social partnership and active involvement of partners in planning, organization, and implementation of education and training.
- Improvement of the flexibility of VET through the development of modularized curricula based on key competences.
- Early school leaving prevention.
- Development of career guidance system for all types of education.
- Improvement of initial and continuing professional training of teachers with special attention dedicated to the education of teachers of practical training.
- Defining enrolment policy to better reflect labor market needs as well as Montenegrin mid-term and long-term development policy requirements.
- Improvement of working conditions at schools, school equipment and teaching aids upgrading and development of textbooks and relevant learning materials.
- Mobility and internationalization.
- Recognition of nonformal and informal education.

12.2.2 Education System

The education system of Montenegro consists of preschool education, primary education, general secondary education, upper secondary vocational education, upper secondary non-tertiary education, and higher education.[6] Adult education is part of the overall system and is being implemented for all levels of education.

Preschool education is implemented in crèche (children up to 3 years of age) and kindergarten (for children from three to six years of age) divided into groups according to age. Preschool education is not a prerequisite to attend primary school. According to the latest available data (MONSTAT—Statistical Office of Montenegro 2019a, b, c) for 2018/19, preschool education in Montenegro is being realized in 21 preschool institutions, with the network of 137 educational units, within which there are 682 educational groups. A publicly valid educational program is also being realized in 26 licensed private preschool institutions, which have 29 educational units and 74 groups. The coverage in the school year 2018/2019 was 21,663 children (11,494 boys and 10,169 girls), out of which 20,686 was enrolled in public and 977 children were enrolled in private preschool institutions. During 2018/2019, a total number of 1305 teachers are hired, so the approximate number of children per teacher is around 17. The procedure of building new kindergartens from the

[6] Ministry of Education (2019).

Council of Europe's Development Loan Facility continued throughout 2017 and 2018. Learning English for all children from the age of three until they start school has started since 2017 (MONSTAT—Statistical Office of Montenegro 2019a, b, c).

Primary education is compulsory and it's free for all children aged 6–15 years. It lasts for nine years divided into three cycles, which means that in Montenegro primary and lower secondary education are organized as a single structure system. According to the latest available data (Ministry of Education 2018), the educational process is being carried out in 163 parent institutions and 247 subsidiary institutions. In the school year 2018/2019, there are 67,700 children who attend primary schools and they are distributed into 3442 classes. The ratio of classes and pupils in regular primary education is 1:20, whereas the ratio of the number of teachers and pupils is 1:14 (Kalezić 2019a).

Primary music schools offer part-time education as an additional education of primary school level children. This kind of education is taken voluntarily.

General secondary education is performed in high schools—comprehensive schools (grammar schools). This education is not compulsory. Comprehensive schools may enroll persons who have completed primary education and are younger than 17. Education in high school lasts for four years. Secondary vocational education is also not mandatory, and is implemented in a period of two, three, or four years in secondary vocational schools. Secondary vocational education is also performed in art schools. According to the Report on work and conditions in the areas of Ministry of Education (Ministry of Education 2018), in the school year 2017/2018 there are 27,798 pupils who are being educated according to the programs of grammar school and vocational education. Out of that, 9025 children are being educated according to the programs of grammar schools. Regular secondary education at the end of the school year 2017/2018 was acquired by 6348 pupils, 435 of them acquired III degree of competence, and 5913 pupils acquired the IV degree of competence. 2140 (33.7%) finished general secondary education—Grammar school, and 4208 (66.3%) finished vocational schools.

Educational programs of general and vocational education in Montenegro in the school year 2017/2018 is comprised of 12 grammar schools, nine mixed schools which realize programs of vocational and general secondary education, 21 vocational schools, six art schools, and two educational centers. Educational offer of secondary vocational education in the school year 2017/2018 consists of 67 educational programs, out of which 17 educational programs last for three years and 50 programs last for four years (Ministry of Education 2018). It is possible to complete primary and secondary grades as part of adult education.

Higher education is acquired at the University of Montenegro as a public university, three private universities. At the public university, tuition fee for a certain number of students is provided from the State Budget, while other students bear the cost of tuition (Ministry of Education 2018). The Law on Higher Education prescribes free studies at public institutions for undergraduate students enrolled in 2017/2018 (over 3500 students enrolled in the first year of undergraduate studies at the University of Montenegro), while master studies according to the reformed study model will be free starting from the school year 2020–2021. It is a novelty that from this academic year at the University of Montenegro the studies will be realized according to the new model 3 + 2 + 3—undergraduate, master, and doctoral studies (Ministry of Education 2018). According to the date from Monstat (MONSTAT—Statistical Office of Montenegro 2019a, b, c), a total number of 20,250 students enrolled the undergraduate studies in the academic year 2018/2019. In the academic 2018/2019 year 2810 students enrolled the specialist studies, 606 students enrolled into master studies, whereas only 83 students enrolled the doctoral studies (Dubak 2019).

Also, in the education system, education of children with special educational needs (SEN children) is especially implemented. This type of education is provided for a specific level of education which corresponds to SEN children physical, intellectual, emotional, and social development.

12.2.3 Government Expenditure on Education

We have already stated that the allocation for education from GDP is about 4.5%. With the Draft Budget for 2019, the government plans to allocate more money for development, health, education, infrastructure, and agriculture, without additional fiscal consolidation measures. According to the Law on Budget[7] of Montenegro for 2019, *Transfers in education* are planned in the amount of €23,482,229.00. Additional support to education will be offered in 2019—for investing in constructing, reconstructing, and equipment for: Schools, kindergartens, and other educational institutions. Consumption expenditures in the Current budget which are being financed from the loan will be executed in the amount of their realization, as follows: World Bank for the Project for higher education, research, competitiveness; *European Investment Bank (EIB)* for the Project of investing into infrastructure in the field of education. The expenditures of the Capital Budget which are financed from the loan will be executed in the amount of their realization, as follows: *European Investment Bank (EIB)* for the Project of investing into infrastructure in the area of education. The Government will sign credit arrangements in 2019 or they will become effective with the *European Investment Bank (EIB)* for investing in infrastructure in the area of education in the amount of €18,000,000.00.

12.2.4 Teachers' Professional Development

Educational activities at educational institutions are conducted by preschool teachers, teachers, and professional associates (hereinafter referred to as teachers). The conditions of carrying out educational activities are defined by Labor Law, General Law on

[7]For further information see: http://www.gov.me/ResourceManager/FileDownload.aspx?rId=341877&rType=2. Accessed Apr 17, 2019.

Education, laws governing individual levels of education, Law on National Qualifications Framework, Rulebook on more detailed requirements, method and procedure of issuing and renewing the working license for teacher, principal, and assistant principal, Rulebook on types of titles, method and procedure of suggesting and awarding titles and other secondary regulations and decrees.[8]

Tasks of teacher, principal, and assistant principal can be carried out by a person with a license[9] to work. Teachers, principals, and assistant principals have the right and obligation to develop their skills covering various areas through professional development programs.[10] A teacher may advance toward adequate ranks: teacher-mentor, teacher-counsellor, teacher-senior counsellor, and teacher-researcher.

Teacher quality has a powerful impact on student performance (Mitrović et al. 2015). Organizations and institutions contributing to continuing professional development in Montenegro are (Cekic 2016):

- The Ministry of Education
- The University of Montenegro
- The Vocational Education and Training Center (VET Center)
- The Bureau for Education Services (BES).

The Professional Development at the School Level Handbook (Popović et al. 2017) is the new, updated, handbook for Montenegrin teachers of all subjects in preschool, primary, secondary, and TVET schools. According to the recommendation from the Strategy of Teachers' Education in Montenegro 2017–2024 (Ministry of Education 2016), there is special attention to the overall improvement of the quality of teachers' education; improvement of research work; development of mobility and European dimension; and development of evaluation procedure. Reforms in the field of teacher education in the EU aim primarily at upgrading to a higher qualitative level and the establishment of a continuous dialog between universities dealing with teacher education, culture of exchange and cooperation (Melović et al. 2016; Melović and Mitrović 2014).

Catalog of the vocational development program of the Bureau for the school year 2016/2017 offered 306 programs, and Center for vocational education offered 59 programs (Ministry of Education 2016). In the field of vocational education, a training program for teachers of practical teaching with employers is being implemented.

[8]Ministry of Education (2019).

[9]The license is a public credential serving as a proof of the required level of general and professional competences of a teacher, i.e., license to work at educational institutions. The license is issued for a period of five years after completing vocational exam. Teacher, principal, or assistant principal who do not have or who failed to renew the license cannot work at an educational institution. To obtain the license, in addition to application it is necessary to submit a proof of completed specific level of education (the relevant level seven of qualification framework, sublevel one (240 credits)), and completed vocational exam.

[10]Professional development programs for teachers are established by the National Council following the proposal of the Bureau for Education Services and Center for Vocational Education.

Also, the model of professional development at the kindergarten/school level was introduced as a part of the system of vocational development within the educational reform in all kindergartens, primary schools, comprehensive schools, mixed schools and secondary schools in Montenegro. In order to apply this model in kindergartens and schools, a manual (amended edition) vocational development at the kindergarten/school level was offered (Popović et al. 2013).

During the school years 2015/2016 and 2016/2017, the Project "Continuing Vocational Development of Teachers and Mentors in Vocational Education in Montenegro" was realized with the aim of supporting the continuous professional development of teachers of vocational–theoretical subjects in vocational education. The Project was supported by the European Training Foundation (ETF). Analysis of the results of this Project shows positive effects of the teacher training in enterprises.

The System offers the possibility of teacher improvement. So far, 129 teachers have received higher position title (67 mentors, 32 teacher-advisors, 23 teacher's senior advisors, and seven teacher-researchers).

There are no special programs for the initial education of future academic staff in higher education. A Ph.D. degree is required for those applying for academic staff positions. There are several levels of titles within the teachers' profession: college professor and college lecturer; assistant professor; associate professor; and full professor. Academic staff is elected by the Senate, based on a public call, for a period of five years, except for full professors who are elected as permanent staff for unlimited time period (Erasmus+ 2017).

12.3 New Progress of ICT in Education

It is a general assessment that the implementation of information and communication technologies (ICT) in Montenegro stagnates and does not follow the dynamics of their applications in Europe. For this reason, ICT applications need to be raised to a higher level in many spheres of social life, especially given that this is the world's fastest growing industry through a large number of innovations, whose development should be followed and encouraged (Internal data of the Ministry of Economics 2019). Below is a review of relevant ICT indicators in Montenegro (Table 12.1).

All the measures that are presented below in this document for raising the level of information literacy and the level of use of ICT in teaching need to be both monitored and implemented. Supplying with computer equipment, educating teaching staff, providing didactic software, and other measures which should be applied must be carefully designed and planned in order to be implemented.

Table 12.1 Relevant indicators of ICT in Montenegro

Indicator	2018 (%)	2020 (%)
Share of ICT in GDP	4.2 (2016)	10
Percentage of ICT professionals in relation to the total number of employees in enterprises	3.3	4
Percentage of ICT graduates in relation to the total number of graduates from all universities	9	12
Percentage of enterprises using digital marketing in their business	76.4	85
Percentage of enterprises using e-invoices	0.5	30
Percentage of the population with broadband internet access (30 Mb/s or more)	27.5	65
Percentage of the population with internet access 30 Mb/s or more, in relation to the total number of internet users	38.5	80

Source Majerič and Pevc (2018)

12.3.1 Infrastructure

Supplying with computer equipment for educational institutions should be a continuous process. Due to compulsory and optional IT subjects, it is necessary that schools own computer classrooms. The number of computers and computer classrooms depends on the number of students in a school. Besides purchasing computers, it is necessary to expand the network inside the school so that the other classrooms can be provided with the internet connection.[11]

All educational institutions up to the university level, a minimum number of computer equipment is provided (over 5000 computers, printers, projectors, scanners, etc.). The equipment is distributed into 162 primary schools, 49 secondary schools, 15 music schools, 22 preschool institutions, and three resource centers (Ministry of Education 2019). The number of computers in each institution is not the same but it depends on the number of students in schools. Age of the equipment is between 8 and 13 years, according to the year of the equipping the institution.

Apart from computer equipment, a new electrical installation was done in the institutions, whereas in the rooms where computer technology is used there is a computer network and the alarm system is installed. All parent units of educational institutions up to the faculty level have internet connection. In 173 institutions, internet connection is achieved via ADSL system, while in 60 institutions it is realized via the satellite connection.[12]

All of the main units of the educational institutions, up to the university level, have access to the Internet connection (ADSL—4 Mbps or satellite internet—8 Mbps). The regional units of the educational institutions are not covered by the Internet

[11] Data in this part of the Report are given dominantly on the basis Report of ICT in education, Ministry of Education Montenegro (2019).

[12] Elementary schools in rural areas in which there are no technical possibilities for installing ADSL.

Table 12.2 Indicators of ICT in Montenegro (2016–2018–2020)

Indicator	2016	2018	2020
Student–computer proportion	1:16 (elementary schools) 1:14 (secondary schools)	1:12	1:10
Internet coverage in regional school units (%)	0	50	100
Internet speed in main units	4 m bps fixed 8 m bps satellite	8 m bps fixed	20 m bps fixed
Percentage of teachers trained (basic IT skills) (%)	20	25	30
Percentage of teachers trained in IT security (%)	1.50	10	20
Percentage of use of teachers' web portal (%)	1	10	20

Source Ministry for Information Society and Telecommunications (2016)

connection. The computer–student proportion in primary schools is 1:16, and 1:14 in the secondary schools (Ministry for Information Society and Telecommunications 2016) (Table 12.2).

12.3.2 Teacher's Computer Literacy and ECDL Modules

When we talk about computer literacy of the employees in educational institutions, it is important to pay attention to the job they are doing. It means that the definition which is minimum knowledge of computer literacy which a certain employee needs to have is best to connect to the working position.

The Ministry of Education has already realized the project "ECDL[13] for digital Montenegro" which trained 2133 employees with the ECDL Start level, and all ECDL modules have already been accredited at the Bureau of Educational Services and can be found in the catalog of the teacher training 2014/15, and in compliance with the Strategy for implementing ECDL standard, the suggestion was to continue with this type of training (Ministry of Education 2019). ECDL modules are distributed into the following levels (Table 12.3):

Employed in educational institutions will be divided into a few categories based on which it will be defined what ECDL modules they should know (Table 12.4):

Existing ICT coordinators, school and regional, should attend the training and take the test for modules that they have not passed so far. All regional ICT coordinators have Core, and most of the school coordinators have Start. There is a small number

[13] *European Computer Driving Licenses*—ECDL is a European standard of IT education which is supported by the leading European institutions and economy. With over 15 million of certified users and network in 150 countries, ECDL is today the most widespread standard in the world.

Table 12.3 ECDL modules

Basic modules	Standard modules	Advanced modules
• Basics of computer use • Basics of internet use • Text processing • Tabular calculation-/s	• Presentations • Using the database • IT security • Online collaboration • Picture processing • Internet pages processing • Project planning • 2D CAD • Using the health information system	• Advanced text processing • Advanced tabular calculations • Advanced database • Advanced presentations

Source Ministry of education (2019)

of ICT coordinators who have not passed ECDL. Concerning the teachers who were trained and passed the process of certification through the project "ECDL for digital Montenegro" (2133 teachers), they achieved the level of ECDL start, so they need the training and certification for a few modules.

If we want to achieve a certain degree of using ICT in teaching in the further period, we should train and certify according to the ECDL standard at least 1200 employees in educational institutions, who will attend training on pedagogical implementation of ICT in the teaching process after the ECDL training. In order to complete this process successfully, it is necessary that the ICT competences are identified as priority areas of vocational development of the teachers. Thus, it is important that all ECDL modules are accredited at the Bureau of Educational Services every year (Ministry of Education 2019).

12.3.3 Educational Resources

The Ministry of Education, through the MEIS[14] project implements the most important part of ICT usage in education. The MEIS project consists of several activities, which will occur gradually: providing all educational institutions with computer equipment (more than 5000 computers and peripheral equipment), the provision of broadband, training for school-based ICT coordinators and administrative and staff, and computer training, the selection of regional ICT coordinator, and finally, the implementation of the MEIS application.

[14]Montenegrin Educational Information System.

Table 12.4 Employees in educational institutions and ECDL modules

Employees	Basics of computer use	Basics of internet use	Text processing	Tabular calculations	Presentations	Using the database	IT security	Online collaboration	Picture processing	Internet pages processing	Project planning	2D CAD	Advanced text processing	Advanced tabular calculations	Advanced database	Advanced presentations
School management (principals, deputy principals, secretary, pedagogue, psychologist, etc.)	√	√	√	√	√		√	√								
Teachers	√	√	√	√	√		√	√								
IT teachers (elementary schools)	√	√	√	√	√	√	√	√	√							
IT teachers in secondary schools	√	√	√	√	√	√	√	√	√	√						
Teachers of vocational subjects[a]	√	√	√	√	√	√	√	√	√	√	√	√				
ICT school coordinators	√	√	√	√	√	√	√	√	√	√	√	√				
ICT regional coordinators	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√

Source Ministry of education (2019)
[a]For the teachers of vocational subjects, it is necessary to prepare a more detailed suggestion according to the subjects, because it is not necessary for every teacher of vocational subjects to know all modules, for example teachers of economic field do not need to know 2D CAD

In addition to the above-mentioned activities that are foreseen in the MEIS Project, the Department of ICT has already implemented several services for schools (Ministry of Education 2019):

- All schools are provided with e-mail addresses and other services that go with Microsoft Live@edu package. E-mail addresses are recognizable as they all end with edu.me. All the addresses can be found on the www.skolskiportal.edu.me Portal.
- The www.skolskiportal.edu.me Portal for teachers has been created and it will serve for updates on news regarding the implementation of ICT in schools.
- The Department of ICT, in cooperation with Microsoft Corporation, has created "Window" magazine for teachers, whose purpose can be found on pilprozor.wordpress.com. This magazine is dedicated to ICT news related to education.
- The subdomain edu.me is administered by the Department of ICT so every school or educational institution can receive a domain for free.

Apart from the MEIS application, there are additional services which employees, students, and parents have at their disposal (Ministry of Education 2019). Thus, for example, the Ministry of Education has a portal School network[15] where one can locate all educational objects. There are contacts of all educational institutions at the same portal. Service which is visited most of all above-mentioned is the Portal for Parents, i.e., for reviewing the grades[16], where parents have insight into the success of their children, based on the date from MEIS database. The latest service is School statistics portal[17]. The portal is created in cooperation with the UNICEF office in Montenegro, as a part of the project for preventing dropping off from education.

12.3.4 Issues in ICT in Education

There were certain issues with regards to the implementation of ICT in the educational system recently and these are (Ministry of Education 2019):

- *System for monitoring the implementation of ICT in the educational system;*
- *Computer equipment availability;*
- *Digital materials;*
- *Education;*
- *Exchange of knowledge and best practices in the use of ICT in teaching.*

The digital environment has become a natural environment for children and young people, but the school has not yet, in line with the objectives of education, become

[15] http://www.skolskamreza.edu.me. Accessed 19 Apr 2019.

[16] Portal for Parents, which requires account number and password to login. https://www.ocjene.edu.me. Accessed Apr 19, 2019.

[17] https://www.skolskastatistika.edu.me. Accessed Apr 19, 2019.

an environment that strongly supports the development of digital and other related competences. Our students are a part of the global digital generation that in our conditions already reaches 95% of the use of computers and almost 96% of the Internet.[18] There is an obvious imbalance between teachers and students in digital literacy ("digital gap").

12.3.5 *Learning and Teaching*

Teacher's ICT Training

We have already stated that through the project "ECDL for digital Montenegro" around 20% of the teachers and the administrative staff in the educational institutions have been trained. The level of the development of the digital materials for teaching and learning is insufficient: didactic software, e-books, e-learning, etc. (Ministry for Information Society and Telecommunications 2016).

In the catalogs for teacher training of the Bureau of Educational Services (2012a, b) there are mostly accredited programs of training which concern the pedagogical use of ICT in teaching, but there is a small number of realized trainings. Ministry of Education has also realized a certain set of trainings, such as (Ministry of Education 2019):

- 500 ICT school coordinators (basic level)
- 20 ICT regional coordinators (advanced level)
- 20 teachers for Web design
- 30 teachers for algorithm and programming
- 2133 teachers for ECDL Start certificate
- 30 teachers for ECDL Core certificate
- 180 Elementary school students for ECDL Core certificate
- 10,000 employees in schools for using the MEIS application
- 150 employees in schools for using the ECDL IT safety
- 200 employees in schools for using the WordPress
- 60 employees in schools for Oracle database
- 120 employees in schools for Oracle Java Fundamentals.

The trainings which were organized by the Ministry of Education are mostly financed from the IPA Fund or through donations (Microsoft), while the smaller funds are allocated from the Budget.

Courses about Information Technology

School subjects studied in primary and secondary schools are divided into regular and optional subjects. Regular ICT subjects are (Ministry of Education 2019):

Elementary School

[18]Research on the safety of children on the Internet, Ministry of Information Society and Telecommunications, with the support of the Ministry of Education (2012).

- Computer science with technical education is taught in the V, VI, VII, and VIII grade with one class per week.

Comprehensive School (Grammar School)

- Computer science, taught in the I and II grade in comprehensive school with two classes per week.

Secondary Vocational School

- Computer science, taught in the I and II grade of vocational schools (four-year program) with two classes per week and for three-year programs in the I grade with two classes per week.
- Geoinformatics, taught in the II, III, and IV grades at two classes per week with the educational program Geodetic Technician–geometer;
- Graphic programs, taught in the II grade with three classes per week with educational program Graphic designer–associate;
- Graphic book design, taught in the II and III grade with two classes per week and in the IV grade with four classes per week with educational program Graphic designer-associate;
- Railway Information Systems, taught in the I grade with two classes per week with educational programs: Towing technician, Traffic transport technician, and Technical technician;
- Computer preparation of the press, taught in the II and III grade with two classes per week with the educational program Operator in the preparation of the press (for students with hearing and speech impediments);
- Computer exercises, taught in the I grade with two classes per week and in the II grade with four classes per week with educational program Architectural technician;
- Computer modelling, taught in the III grade with four classes per week and in the IV grade with five classes per week with educational program Technician for computer constructing and managing;
- Computer production management, taught in the III grade with four classes per week and in the IV grade with five classes per week with educational program Technician for computer constructing and managing;
- Computer basics, taught in the I grade with three classes per week with educational program Multimedia electro technician;
- Business Informatics, taught in the I grade with two classes per week with the educational program Administrator, in the II grade with two classes per week with the education program Sales Specialist, in the II and III grade with two classes per week with the education program Marketing and Trade Specialist II, III, and IV grade with two classes per week at the educational program Economic Technician;

- Applying computers in architecture, taught in the I grade with two classes and in II grade with three classes per week for the educational program Architectural technician and in the second grade with three classes per week with the educational program Interior designer;
- Applying computers in electrical engineering, taught in the II grade with two classes and in II grade with two classes per week for the educational program Electronics technician and in the III grade with two classes per week with the educational program electrical communications technician;
- Applying computers in civil engineering, taught in the I grade with two classes and in the II grade with three classes per week for the educational program Civil engineering technician and in the II grade with three classes per week with the educational program Civil engineering technician;
- Applying computers in graphics, taught in the III grade with two classes per week with educational program Graphic technician;
- Computer graphics and animation, taught in the III and IV grade with two classes per week with educational program Multimedia electro technician;
- Computer networks, taught in the III and IV grade with two classes per week with educational program Computer technician;
- Applying ICT in business, taught as a module in the I and II grade with two classes per week with educational program Tourist technician.

Optional ICT subjects are (Ministry of Education 2019):

Elementary School

- Production of graphics and image processing and photography, in the VIII grade, with one class per week;
- Introduction into programming, taught in the IX grade with one class per week.

Comprehensive School (Grammar School)

- Algorithms and programming, taught in the III and IV grade with three classes per week.
- Computer and web presentations, taught in the II and III grade of the comprehensive school with two classes per week.
- Business informatics, taught in the II and III grade of the comprehensive school with two classes per week.

Secondary Vocational School

- Digital print, taught in the IV grade with two classes per week with educational program Graphic technician;
- Graphic design, taught in the II grade with two classes per week with educational program Multimedia electro technician;
- Graphic design in fashion, taught in the III and IV grade with two classes per week with educational program Graphic designer–associate;

- Computer science in catering, taught in the IV grade with two classes per week with educational programs: Cooking technician and Serving technician;
- Internet and electronic business, taught in the III grade with two classes per week with the educational program Marketing and sales technician and Legal administration technician as well as in the IV grade with two classes per week for the educational program food technician;
- Computer typistography, taught in the I grade with two classes per week with educational program Graphic technician;
- Computer reprophotography, taught in the II grade with two classes per week with educational program Graphic technician;
- Computer audio and graphic programs, taught in the I, II, III, and IV grade with two classes per week with educational programs: musical performer–contrabassist, pianist, violist, violinist, violoncellist, flute player, guitarist, accordionist, horn player, clarinetist, saxophonist, solo singer, trombonist, trumpeter, and music associate;
- Computer networks basics, taught in the III and IV grade with two classes per week with educational program Computer technician;
- Computer software basics, taught in the I grade with two classes per week with educational programs: Computer technician and Telecommunications electrotechnician;
- Business informatics, taught in the I and II grade with two classes per week with educational program Freight Forwarding and Customs Technician;
- Computer graphics and internet, taught in the II and III grade with two classes per week with educational program Postal and logistics technician;
- Computer graphics and internet technologies, taught in the II grade with two classes per week with the educational program Electrical engineer technician and in the II and III grade with two classes per week with the following educational programs: Electrical engineer for refrigeration and thermal equipment, Electrical computer technician and Electrical technician of electronics, Electrical technician of telecommunications;
- Web Graphics, taught in the III and IV grade with two classes per week with educational program Graphic designer–associate.

In addition to training teachers to use information technology at the basic level, it is especially important that they are trained to apply them ICT in the teaching process itself, so that students can benefit more from the Internet and technologies as such. It is important to establish a system of distance learning and upgrade the curriculum with the aim of introducing a larger number of the IT subjects.

12.4 Policy and Strategy of ICT

12.4.1 Policies Related Educational Informationalization

By using ICT, time and money is saved, which contributes to increasing the quality of life and work with faster and easier access to information that is important to private and business life. In order to align with the Digital Agenda for Europe and the Single Digital Market Strategy, the Information Society Development Strategy until 2020 has been adopted, defining the strategic development directions in the field of the information society.

As stated in the last World Economic Forum report on global competitiveness in the field of ICT, Montenegro is a regional leader. This is also the case in the field of the development of the electronic government—Montenegro is ranked 45 in the competition of 194 United Nations member states. According to MONSTAT official data, the share of ICT sector contribution to Montenegrin GDP is 4.2%. In order to exploit the impact of the ICT to the economic growth, this sector is recognized as paramount for the economic development and strengthening of the national competitiveness.

The development of an open, competitive, advanced, and secure information society was accompanied by the increase in the number of the computer users and the Internet users, and also the progress achieved in the area of the broadband Internet access infrastructure. Significant advances have been made in the field of cybersecurity. All the main units of the educational institutions, up to the university level, are provided with the Internet connection, the information systems in health and education are established, the scientific and research activities in the field of ICT are enhanced. Legislation in the field of the information society is largely harmonized with the EU acquis.

By Strategy for the information society development 2020, growth of the basic and advanced digital skills is expected (Ministry for Information Society and Telecommunications 2016):

- the percentage of the ICT graduates in the total number of graduates should amount to 10% by 2020;
- the number of the ECDL certificates issued should reach 15,000 by 2020.

Also, the focus of the e-education segment is the proportion of available computers per student in schools, as well as the skills of the teaching staff, with the following aims:

- Computer–Student proportion should be 1:10 by 2020.
- The percentage of the teachers trained to work on computers should be 30% of the total teaching staff, while the percentage of the teachers skilled in the field of cybersecurity should be 20% of the total number of the teaching staff.
- The percentage of the scientific and research institutions in the field of ICT out of the total number of the licensed institutions should reach 30%, which will have

positive effects on the increase in financing the research in this field in relation to the overall budget for research and innovation.

12.4.2 ICT Financing Resource

In cooperation with the British Council, during the last year a pilot project “Schools for the XXI century” was realized with the aim to offer training and support for teachers in the field of critical thinking and problem solving, digital skills, and using the microbit computers. The project anticipated the teacher training, allocation of microbit to schools, working with children and finally competition for all schools from the project, where Montenegro won the third place at the competition held in April 2019. It is planned to continue this project with the British Council, in the way that in the next three years the project will be implemented in all primary schools, that is, all schools in Montenegro will receive microbit computers, which will serve as a great basis for entering the world of programming. Ministry of Education set up a cooperation with Oracle Academy, which enables that the teachers of Montenegrin schools can be trained according to the program of the Oracle Academy and it will offer support for 3000 students as a preparation for a successful IT career. 300 teachers will pass through the training. Until now, trainings for 180 employees have been realized. Training for another 180 employees is planned for the next school year (Dnevne novine 2019). It is also planned to renovate computer equipment and server infrastructures, which will be realized within the project with the European Investment Bank. This investment is worth around three million euros. In this way they will provide better conditions for teaching process from computer science subjects, as well as better and more stable work of the Information system of education. Although the internet connection in all main objects of educational institutions is organized via ADSL or satellite internet, it is being worked continuously on developing the internet connection speed in the existing facilities, and on introducing internet in subsidiary units. Thus, the internet connection was installed last year in 28 subsidiary units (Dnevne novine 2019). They keep working on improving the Information system of education, so there is an ongoing pilot project in 20 schools regarding the prevention of early drop off from school. The aim of this project is to identify the child which is in the risk of abandoning the school early based on grades, absence, and educational measures, and to give them full support which they need in order to prevent this event.

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Chapter 13
Report on ICT in Education in the Republic of North Macedonia

Valentina Gecevska

13.1 Overview of the Country

13.1.1 Geography

North Macedonia is a country situated in Southeastern Europe with geographic coordinates 41° 50′ N 22° 00′ E, bordering Serbia and Kosovo to the north, Bulgaria to the east, Greece to the south, and Albania to the west. The country is a major transportation corridor from Western and Central Europe to Southern Europe and the Aegean Sea. North Macedonia is a landlocked country but has three major natural lakes: Lake Ohrid, Lake Prespa, and Lake Dojran. It has a surface area of 25,713 km^2 with water area of 857 km^2, while its land area is 24,856 km^2.

13.1.2 The Political System

The political system of North Macedonia consists of three branches: Legislative, Executive, and Judicial. The Constitution is the highest law of the country.[1] The political institutions are constituted by the will of its citizens by secret ballot at direct and general elections. Its political system of parliamentary democracy was established with the Constitution of 1991, which stipulates the basic principles of democracy and guarantees democratic civil freedom.[2] Local government functions

[1]Republic of Macedonia Constitution 2019.

[2]Democracy Index (2016).

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are divided between 78 municipalities. The capital, Skopje, is governed as a group of ten municipalities collectively referred to as “the City of Skopje”. Municipalities in North Macedonia are units of local self-government.

13.1.3 Population

According to the latest population estimates (as at 31.12.2017) (source: State Statistical Office (SSO)[3]), the Republic of North Macedonia has 2,075,301 inhabitants, and regarding the percentage distribution, 50.1% are men, while 49.9% are women. The population density is 83 inhabitants per km^2. The Skopje Region is the most densely populated, while the Vardar region is the least densely populated.

13.1.4 The Status Quo of Society

North Macedonia is firmly committed to the processes of European Integration and ultimately of accession to the European Union. The country concluded the Stabilization and Association Agreement in 2001 which came into force in 2004 and the EU candidate status was awarded in December 2005. The National Programme for the Adoption of the Acquis (NPAA) was adopted in 2006 and it is revised and updated every year with activities deriving from the progress reports of the European Commission, as well as with short-term and mid-term priorities from the Accession Partnership Agreement which was adopted by EU Council of Ministers in 2008.

From historical and cultural aspects, throughout the millennia, North Macedonia marks a significant and rich civilization and cultural development in a material and spiritual respect. From an archeological point of view, it is one of the most attractive destinations with authentic history and culture, many archeological sites, fortresses, and towers since the time of the Roman, Byzantine, and Ottoman Empires. On the territory of North Macedonia there are about 35 smaller and bigger cities with their own history and culture, where the majority of the population lives. In the larger places, the country’s industrial capacities and state administrative institutions are predominantly located.

Almost the entire territory of North Macedonia intertwines eastern and western civilization, different cultures intertwine with their own distinctive feature and so they create a kaleidoscope of history and culture, tradition, customs, architecture, food, mostly marked by the Middle Eastern and Mediterranean influences. This reality is a functional unity of opposites and a sustainable system of development, cooperation, and co-existence among all ethnic groups on the territory of North Macedonia, mainly with Orthodox Christian religion, the second place belongs to the inhabitants of the

[3] State Statistical Office (2018a).

Table 13.1 Gross domestic product (State Statistic Office 2018)

Year	2016	2017
GDP at current prices (EUR) (million)	9657	10,014
GDP annual growth rate (%)	2.8	0.2
GDP per capita (EUR)	4659	4827

Islamic religion and there are also Catholics, Protestants, atheists, and members of other religions.

The National Strategy for Development of Culture in Republic of North Macedonia 2018–2022[4] has announced its main cultural priorities based on access to culture (freedom of creativity, equality, universal good) and most important principles to enable accessibility, inclusiveness, cultural democracy, and participation in cultural processes.

13.1.5 Current Situation of Economic Development

Republic of North Macedonia has achieved relatively stable growth over the last 15 years elevated its status from lower-middle in 2000 to upper-middle income economy. Among 188 countries, North Macedonia ranked 82nd in 2017[5] and is in the group of the countries with high human development, according to UNDP Human Development Report.

Country's gross domestic product in 2016 was EUR 9657 million or EUR 4659 per capita (Table 13.1) (State Statistic Office 2018). The real growth of GDP for 2016 was 2.8% (World Bank 2018). In the past ten years, the efforts toward maintaining macro-economic stability in the face of the global recession and the slowdown in the Eurozone resulted in the GDP growth, the GDP growth rate was the highest in 2007 (6.5%) and the lowest in 2012, when GDP shrank by 0.5%.

The inflation measured by the Consumer Price Index (CPI) in the last ten years has remained relatively stable, ranging from 8.3% in 2008 to −0.8% (deflation) in 2009. The penultimate three years have seen a negative inflation rate, while in 2017 the rate was 1.4%.

The increase in CPI by 1.4% in 2017, in comparison with the previous year, is a result of the higher indices in the groups: communication by 8.5%, alcoholic beverages, tobacco by 6.3%, transport by 5.5%, restaurants and hotels by 3.8%, clothing and footwear, recreation and culture by 1.0%, furnishings, household equipment and routine maintenance of the house by 0.5%, food and non-alcoholic beverages by 0.3%, while a decrease was registered in the groups: health and miscellaneous goods and services by 0.6%, education by 0.3%, housing, water, electricity, gas and other fuels by 0.2%.

[4] National Strategy for Development of Culture in Republic of North Macedonia (2018–2022).

[5] State Statistical Office (2018a).

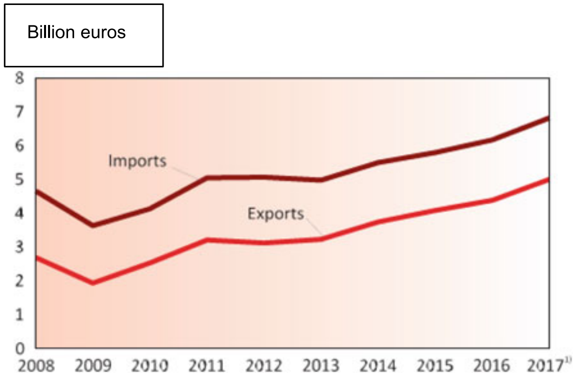

Fig. 13.1 Exports and imports of goods

The upward trend in import coverage by export that started in 2010 continued in 2017, as is presented on Fig. 13.1, based on the statistical data (State Statistical Office 2018a) and Mak Stat database.

In 2017, exports accounted for 42.3% of the trade volume, an increase of 4.3% compared to 2010. The share of imports in the trade volume has decreased continuously, reaching 57.7% in 2017. Compared to 2010, the share of imports in the volume of trade in 2017 decreased by 4.3%. Total imports and exports by products in 2017 are shown in the Fig. 13.2, provided by State Statistical office.

In 2017, according to the data provided by State Statistical office, from total export, the Republic of Macedonia exported 81.1% to EU28 countries, 11.7% to the Western Balkan countries, 0.7% to the EFTA countries, and 6.5% to other countries. From export to EU28, the most amounts go to Germany (57.9%), from export to the EFTA countries to Switzerland (92.8%), from export to the Western Balkan Countries to Serbia (37.4%) and from export to other countries to Turkey (23.9%) and China (17.1%), as shown in Fig. 13.3.

In 2017, according to State Statistical office, as shown in Fig. 13.3, of the EU-28 countries, North Macedonia imported the most from Germany (18.7%), of the Western Balkan Countries from Serbia (74.8%), and of other countries from China (21.6%) and Turkey (17.9%).

On the export side (Fig. 13.3), micro enterprises accounted for 38.9% of the value of external trade in the trade sector. Large enterprises generated 75.6% of the value of external trade in the industry sector. On the import side, small enterprises accounted for 28.7% of the value of external trade in the trade sector. Large enterprises generated 69.1% of the value of external trade in the industry sector (Fig. 13.4).

According to the data of SSO,[6] the number of active business entities in the North Macedonia in 2017 was 71,419, and compared to 2016 it decreased by 0.1%. The sections with the highest share in the structure of business entities are: wholesale and retail trade; repair of motor vehicles and motorcycles with 23,337 entities or 32.7% and manufacturing with 7885 entities or 11.0%, whereas the least represented were

[6]State Statistical office (2018c), State Statistical office and UN (2017).

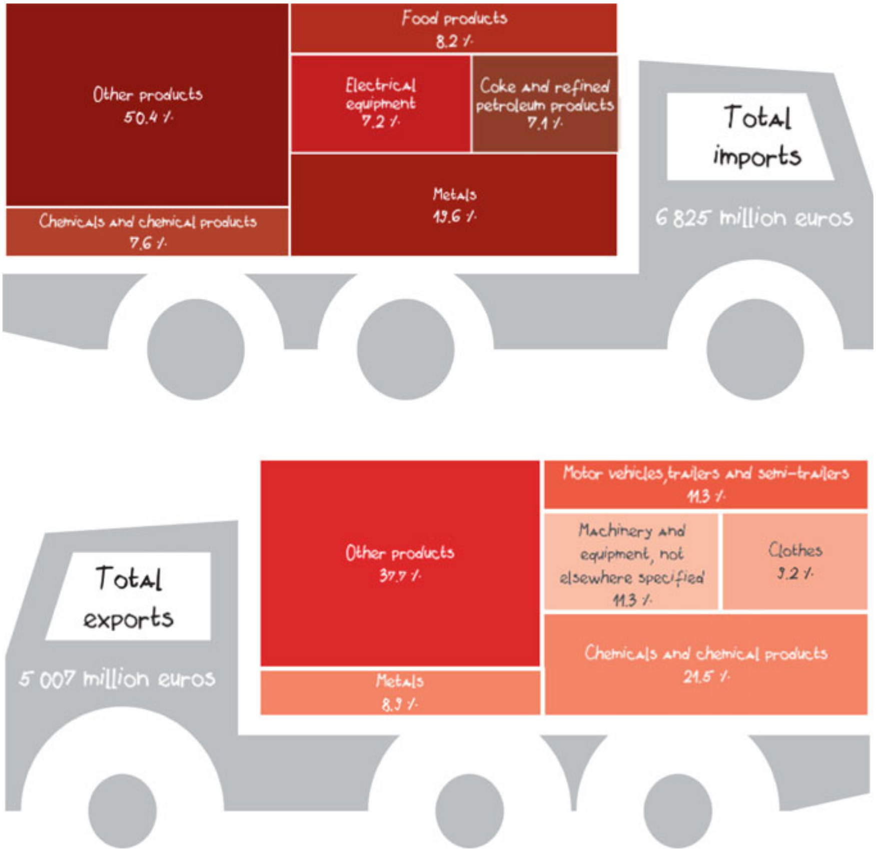

Fig. 13.2 Exports and imports by products, 2017

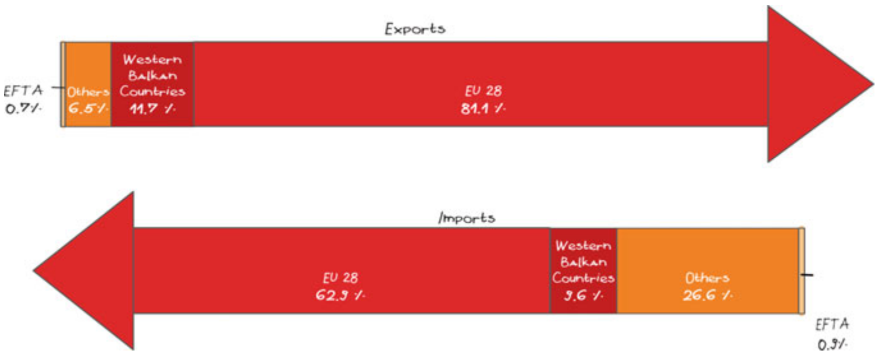

Fig. 13.3 External trade by economic groups of countries, 2017

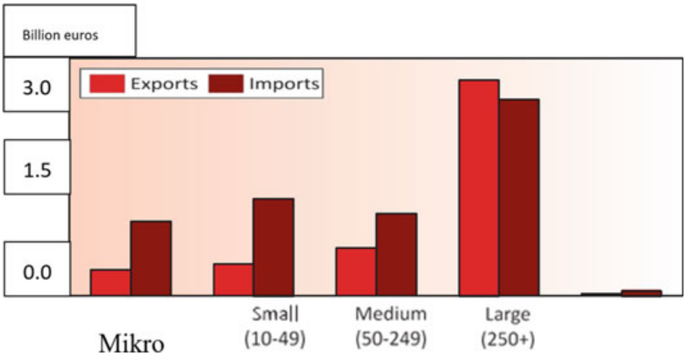

Fig. 13.4 External trade by sectors of activity and by employment size class, 2017 (State Statistic Office 2017)

Table 13.2 Basic structural business indicators[a]

	2016	2017
Enterprises	55,469	55,203
Persons employed	378,737	385,728
Turnover, in million denars	1,121,017	1,192,284
Value added, in million denars	248,289	260,285
Personnel costs, in million denars	118,377	126,371
Gross operating surplus, in mil denars	129,911	133,915

[a]Gross Domestic Product (2017)

the sections: electricity, gas, steam, and air conditioning supply with 172 entities or 0.2% and mining and quarrying with 201 entities or 0.3%.

Of the total number of active business entities (71,419), 8258 (12%) were registered in industry. Of the 8258 business entities registered in industry, 6712 had less than 10 employees (1–9), as part of micro segment.

The divisions—manufacturing of machinery and equipment (13.0%), manufacturing of food products (11.0%), electricity, gas, steam, and air conditioning supply (10.4%), and manufacturing of wearing apparel (9.0%) had the largest shares in the structure of industrial production in 2017.

According to the basic structural business indicators, shown in the Table 13.2, business entities in last year generated 6.4% more turnover and 4.8% more value aided than in previous year (State Statistical Office 2017, 2019).

According to Industry review,[7] the highest share in the total value added was registered in the manufacturing sector (26.6%) and the trade sector (23.5%). According to enterprise size, the biggest was the contribution of medium and large enterprises from the manufacturing sector (20.7%) and micro and small enterprises from the trade sector (11.1%), shown in Fig. 13.5.

[7]State Statistic Office and MakStat (2018).

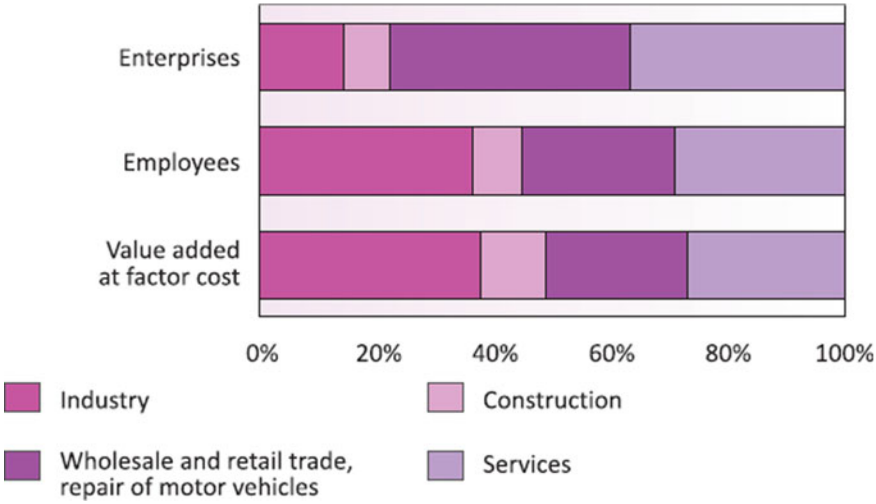

Fig. 13.5 Basic structural business indicators by activity sector, 2017 (State Statistic Office and MakStat 2018)

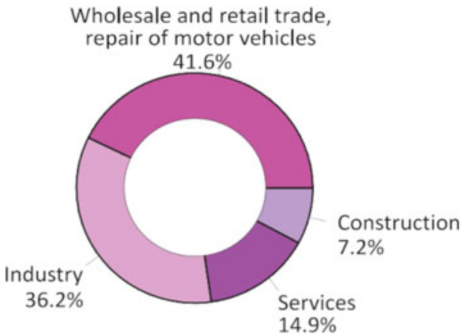

Fig. 13.6 Structure of turnover, 2017 (State Statistical office 2019)

As shown in Fig. 13.6, more than two thirds of the total turnover was generated in trade and industry (77.8%). The share of capital goods in last year increased mostly as a result of the newly opened enterprises in the Technological Industrial Development Zones.[8]

13.1.6 The Relationship with China under the "17 + 1"

The relations between the Republic of North Macedonia and the People's Republic of China are developing in the spirit of friendship, mutual understanding and respect

[8] Agency for Foreign Investment (2019).

for the sovereignty, territorial integrity, and equality of these two countries. Republic of North Macedonia and PR China have well developed bilateral economic and cultural relations. At present, these relations are on the highest possible level. The good bilateral contractual situation is a precondition for establishing and widening of the overall bilateral cooperation.

The development of the relationship between China and CEE countries is in accordance with the principles of China's foreign policy, and China treats each country equally in Europe, nevertheless the size of the country. "17 + 1" Cooperation shows that China develops relations with West European countries, but also has the interests to develop relations with CEE countries as well. Actually "17 + 1" Cooperation is a beneficial complement to the general China-EU relations. People in CEE countries are getting to know more about China, explore further opportunity with China, and stimulate the trade and investment with China.

Based on the previous successful cooperation between the Republic of North Macedonia and the PR China, as a country member in the "17 + 1" Cooperation, the North Macedonia, makes steps in the part of trade and investment promotion, development of infrastructure, scientific and technological cooperation, as well as cultural and educational cooperation. There is a need to underline the opening of the coordinative Centre for cultural cooperation between the countries of the "17 + 1" Process in Skopje in March 2018. In this context, the commitments to reaffirming the central role of culture in improving mutual understanding and cultural dialog as an important factor for further cooperation is the main role of the Centre for cultural cooperation of the "17 + 1" in Skopje, capital city of the North Macedonia. Furthermore, through the Centre are successfully completed fifth Symposium of Think Tanks of "17 + 1" Process, which was held in October 2018 in the Republic of North Macedonia and was organized by MANU (Macedonian Academy of Sciences and Arts) and the Ministry of Foreign Affairs. Next activity is the preparation of the upcoming meeting of ministers of culture at the "17 + 1" Process which will be held in the first half of 2019 in the Republic of North Macedonia.

13.2 Overview of the Educational Development

13.2.1 Education System

The education system of the North Macedonia comprises a mix of pre-school, primary (6–14 years), secondary (15–17/18 years), and higher education. Figure 13.7 represents the structure of the education system.

In 2017, there were 33,286 children up to 6 years old enrolled in 99 public and private pre-school institutions as kindergartens (State Statistical office 2018a). The number of children in kindergartens, centers for early childhood development in 2017 grew by 2.6% in comparison with 2016.

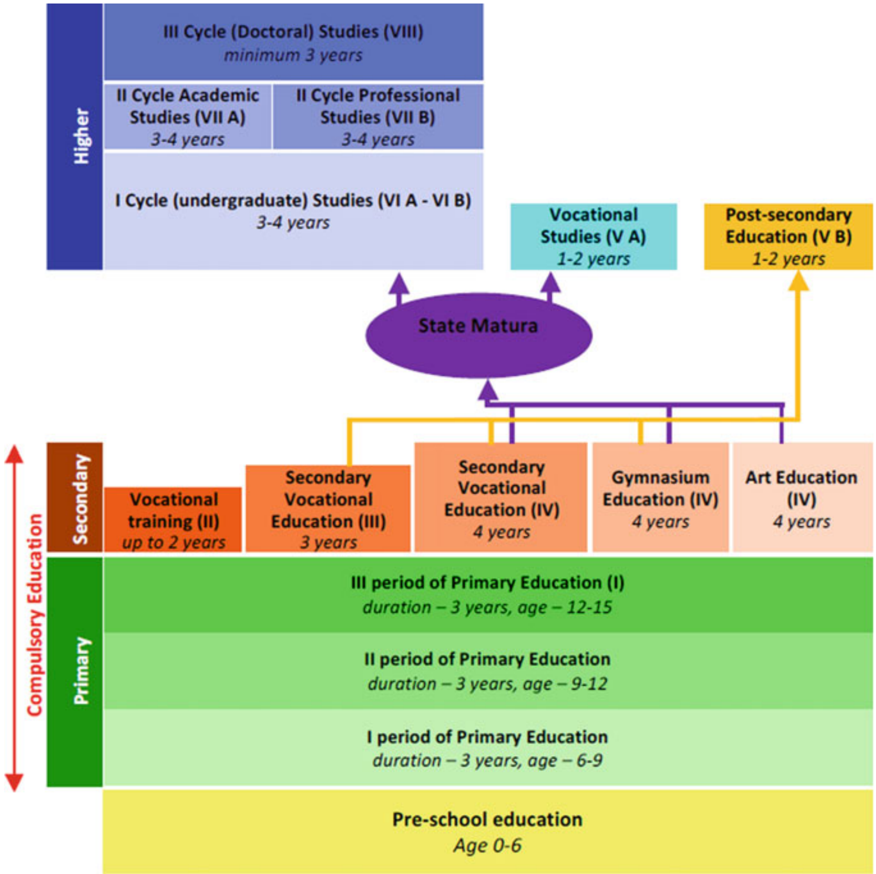

Fig. 13.7 Structure of the educational system according to MQF (Ministry of Education and Sciences 2018)

Primary education lasts for nine years and is compulsory and free for all pupils (6–14 years old). There are 347 primary schools in the country (around 1100 including satellite schools) (Ministry of Education and Sciences 2018). In 2017, there were 192,448 pupils in primary schools (State Statistical office 2018a).

The secondary education is also compulsory and free, and is divided into four streams: general secondary education (gymnasium), secondary vocational education, art schools, and education for pupils with special educational needs. Secondary vocational education may be of 3- or 4-year duration. At the end of 3-year vocational education the students take a final exam, without a right for university entrance. Graduates of the 4-year secondary education are allowed to choose between the final exams and state Matura or school Matura depending on whether they wish to continue education. Among existing 124 secondary schools, 108 are public and 16 are private (Ministry of Education and Sciences, 2018).

Table 13.3 Number of graduates (first, second, and third cycle) by scientific field

	2016	2017
Total	10,465	10,731
Natural sciences and mathematics	513	498
Technical-technological sciences	1572	1657
Medical sciences	962	900
Biotechnical sciences	368	373
Social sciences	5795	5971
Humanities	1255	1332

Higher Education is implemented at 3 levels: undergraduate, master, and doctoral studies. There are 6 functional public universities, 1 private–public university and 9 private universities, and 2 high vocational schools. In 2016/17, the 122 faculties within the universities had 61,488 enrolled students (first, second, and third cycle) and in 2017/2018, 60,010 enrolled students in the three cycles.

According to the data from the State Statistic Office,[9] graduated students (first, second, third cycle) in 2016/2017 were 10,465 and 10,731 graduates in 2017/2018. The total number of the graduated students (first, second, third cycle) in 2017 was 204% higher compared to 1992.[10] In 2017, 79.6% of the total numbers of graduates were students who had graduated from undergraduate studies (Table 13.3).

13.2.2 Educational Institutions

In the Ministry of Education and Science (MES), the Department of Primary and Secondary Education (4 units) and the Department of Higher Education (3 units) are responsible for the corresponding levels of education. The Department for European Union (3 units) is responsible for negotiation and integration into the community, coordination of projects and donors' support, as well as for the implementation, coordination, monitoring, and evaluation of the relevant IPA Components.[11] Due to the specification of vocational education and training and adult education system structure in the country, no individual unit is responsible for these sectors within the MES, coordination of this sector is a responsibility of the Unit for Secondary Education.

There are a number of public institutions responsible for different aspects of education. The Bureau for Development of Education (BDE) is a body of the state administration subordinated to the MES, assigned with performing expert tasks of significance to the development and promotion of education in the country.[12] Other

[9]State Statistical office (2018c).

[10]State Statistical Office (2018b).

[11]Ministry of the Education and Science of the Republic North Macedonia (2019).

[12]Ministry of Education and Sciences (2018).

bodies within MES and institutions connected to the education system are: Vocational Education and Training Centre, Centre for Adult Education, National Examinations Centre, State Education Inspectorate, and Pedagogical Service.

The main legal act for the sector is the Law on Higher Education. Version from 2008, it has provisions on harmonization of the country's higher education with the Bologna process and the European credit transfer system, as well as establishes legal base for status of the teaching staff and student's mobility. From May 2018, the new Law on Higher Education is in the power. A Law on Scientific Research regulates relations in the sphere of scientific research and international cooperation, with regard to transfer of knowledge, research, training, and application. In 2013, a Fund on Innovations and Technological Development (FITD)[13] responsible for coordination and strengthening of activities in the field of innovation was established according to the Law on Innovative Activities. In 2015, the Fund on Innovations and Technological Development started using the instruments for providing co-financing grants for: (1) the newly established start-up and spin-of trading associations, (2) commercialization of innovations, (3) transfer of technologies, and (4) establishment, operation, and investment in business technology accelerators.

Providing and assessing quality assurance in higher education, according to the Law on Higher Education, is a responsibility of the Board for Accreditation and Evaluation of Higher Education (BAEHE) established in 2011, which consists of 23 members. The Board is responsible for approval and recognition of higher education institutions and study programs, assessment of higher education provision quality, management, financing, academic, and other activities.

In different spheres of higher education are open questions,[14] such as: difficulties with issuance of the diploma supplement, lack of distance learning opportunities due to insufficient legal framework and low development of online learning platforms, actual non-existence of a tripartite cooperation between the state, academy, and businesses. The level of research funding remains unsatisfactory which results particularly in improper infrastructure of scientific research centers at the universities; access to global scientific data bases is limited and minor; there is no appropriate mechanism for commercialization of innovative solutions.

In 2014, the Republic of North Macedonia jointed "Horizon 2020" with other four Western Balkans countries and became an associate member with equal participation in all segments of a seven-year EU program for research and innovation that allows for mobility of prominent scientists, strengthens national research systems, and assists countries to integrate.

[13] Fund on Innovations and Technological Development of the Republic North Macedonia 2019.

[14] Ministry of Education and Sciences (2018).

13.2.3 Teachers' Professional Development

Upon conducting the policy and practice analysis of the teacher professional and career development in the Republic of North Macedonia, based on the recommendations from the analysis made by relevant institutions, the working groups consisted of representatives from the Ministry of Education and Science, the Bureau for Development of Education, the Vocational Education and Training Centre, the State Education Inspectorate, the National Examination Centre, the Syndicate for Education, Science and Culture, representatives from the teacher training faculties and faculties that educate student support staff and practitioners from schools, with the support from USAID, in cooperation with the foundation for educational and cultural initiatives step by step, developed the following documents for professional and career development of education staff in schools:

- Teacher core professional competences and standards
- Student support staff core professional competences and standards
- Professional competences for primary and secondary school directors
- Manual on performance monitoring and professional development planning for teachers and student support staff in primary and secondary schools
- Guideline on the manner and form of providing mentoring support to novice teachers and novice student support staff in primary and secondary schools

13.3 New Progress of ICT in Education

As part of the education process "computerization and digitization of education" has been intensively developed in the period after 2002, when the first donation from China was received and enabled a certain degree of mass use of ICT at primary and secondary schools in 2005, the relevant institutions and expert working groups were established and started the implementation of the National Program on Education Development the Draft Program on ICT Development in Education (2005–2015),[15] the National Policy on Information Society and the National Strategy on Information Society Development (2005–2015),[16] and lastly National Strategy for ICT from 2015,[17] which encompass the process of computerization and digitization of education in Republic of North Macedonia.

[15] National Strategy for Information Society Development of Republic of Macedonia: Action Plan (2005–2015).

[16] National Policy on Information Society and the National Strategy on Information Society Development (2005–2015).

[17] National Strategy for ICT (2015–2018).

13.3.1 Infrastructure

13.3.1.1 Campus Network Access

As mentioned in the introduction, Republic of North Macedonia is a developing SEE country recognized with strong commitment to ICT as a driver of national growth. The measurement of the degree for development of the Information Society, through monitoring core indicators as a continuous process, in North Macedonia is done by the State Statistical Office, which, since 2005, has been conducting the yearly statistical surveys by type of ICT users. The core indicators of measuring and monitoring are: equipment with certain ICT (e.g. computers, access, and type of the Internet connection), level and purpose of ICT usage, digital literacy, benefits and obstacles while using ICT by different type of enterprises, households, individuals, and the public sector.

According to the data of SSO, in the first quarter of 2018, levels of key ICT indicators in the country are: (1) Households with internet access at home are 79.3% and the participation of households with fixed broadband connection in the total number of households is 70.4% in 2018; (2) 79.2% of the total population aged 15–74 use the Internet, and 68.7% use the Internet every day where a mobile phone or a smart phone is the most used device for access to the Internet, by 81% of Internet users and mostly among persons aged 15–24 (91.8%). 74.9% of the people used computers, laptops, smartphones, tablets, or other portable devices at work.

According to Gavrilovska Lj and Atanasovski V,[18] North Macedonia boasts an impressive broadband penetration rate on a national level with 100% company Internet connectivity. The latest figures from Economic Development Program developed by the Ministry of Finance (MOF) of the country, have shown that access to fast NGA network coverage for 78% households and access to ultra-fast NGA network coverage is 43.8%.[19] Moreover, the Internet access in schools and WiFi-based public Internet access is already rolled out with very high percentage of national coverage including remote areas. Macedonian schools offer one web-enabled computer for every 1.2 children. University students and academics can freely access to knowledge and research resources via the academic network—MARNET (Macedonian Academic Research Network).

About UKIM,[20] there were several projects to build up the campus networking infrastructure. The first project dated prior to 2000, when the University network was built as part of MARNET. There are 4 campuses in the capital town of Skopje and they were connected by optical lines and the institutions located on various distributed sites with high-speed wireless networks. The major improvements were done with GEANT European gigabit network-related projects in recent years. Eduroam was established 15 years ago and is functioning as an interoperable infrastructure that allows the students and professors access to Internet wherever they are.

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[18] Gavrilovska and Atanasovski (2013).

[19] Ministry of Finance of Republic of Macedonia (2019–2021).

[20] Ss. Cyril and Methodius University (2019).

Primary and secondary schools were included in computer networks more than ten years ago, by providing computing and networking infrastructures at each elementary and secondary school.

There is no computer literacy problem in North Macedonia. Most of population uses computers and smartphone operating systems without any problems. Probably a small percentage of older population over 65 is not using the relevant technology.

13.3.1.2 Computer–Student Ratio

Installation of 100,000 computers at all primary and secondary schools throughout the country was made in a period of 6 years, around 2008–2014, in frame of the project of the Government of the Republic of North Macedonia "Computer for Every Child," implemented in coordination with the Ministry of Information Society (MIS) and Ministry of Education and Science (MES). At the universities, there are computer labs; at the biggest University Ss. Cyril and Methodius more than 3000 computers were installed. This is not relevant issue anymore, since most of the students use their own laptops.

13.3.2 Educational Resources

Having in mind that for more than a decade different projects were focusing on preparation of digital teaching/learning materials for Macedonian schools, there are several investigations made in order to see how the digital materials have changed the educational process and the approach of teachers (Atanasova-Jankulovska and Mitevski 2016; Pop-Angelova and Zdravev 2013).

13.3.2.1 Digital Educational Resources

Related to digital educational resources (DER), case of UKIM is that they started publishing textbooks in electronic version in the last 10 years. Also, a large number of DER cases at different faculty/university in the country have been implemented with digital contents distributed directly through professor-student line. At other educational levels, the most essential content for all elementary and secondary schools can be found online. During few years, testing has been realized electronically at the end of each semester in schools, realized by officials from the MOE. From 2010 there was a big initiative to translate the most university books in Macedonian language and more than 1000 books are available in this form.

The research (Vitanova et al. 2016) is done in order to ensure valid and reliable assessment of the extent and nature of ICT knowledge and skills of teachers in primary schools in R.N. Macedonia, as well as to identify the factors of teachers' views affecting the development of ICT competences, conducted in primary schools in the

Republic of North Macedonia. Research has found that the basic ICT applications which are used by 94% of the teachers are online and text editor. The application navigation in operating system was used by 90%, email by 89%, and multimedia presentations by 81%. Then, spreadsheets was used by 79%, and blogs was used by only 10% of the respondents. The lowest percentage of respondents—4% are using databases for the purposes of teaching.

13.3.2.2 Open Educational Resources

In the case of the education system in the Republic of North Macedonia, open education recourses (OER) are public resources for teaching, learning, and research, available under copyright licenses that enable free use by other persons. OER project usually starts "from zero" and the relevant projects are implemented by the teaching staff and in some cases students have initiated and enhanced OER projects.[21] Most OER projects are prone to the use of copyright licenses Creative Commons[22] or GNU Freed Documentation.[23] At different faculty/university, there are developed and used OER through Moodle Platform, Microsoft Office 365 Platform, or other in-house developed e-learning platforms.

In the country, the legislative framework that regulates open educational resources (OER) was developed according to national legislative (law on primary education, law on secondary education, law on higher education, law on adult education, law on e-Governance, law on free access to public information, "Concept on Nine-Year Primary Education," national strategies on developing education and e-contents, as well as other laws and regulations that regulate education and information society development). Numbers of different educational and scientific online archives are developed as results of projects implemented by state institutions and by other local, private, foreign, and international entities that work in the field of education, science, international cooperation, and ICT. OER gains importance given that North Macedonia is a developing country and requires higher rate of utilization of open resources and free educational tools and contents. From the aspect of different developed OER, it includes: (1) educational contents: curricula, courses, teaching digital contents, manuals, workbooks, teaching plans, modules, tests, video materials, (2) educational digital databases, (3) education tools: these include software to support the development, use, preparation of educational contents, as well as tools aimed to generate contents and create online communities in the field of education; (4) copyrights: creation of copyright licenses that would promote open publication of educational materials, and (5) open and free courses and training.

[21] E-Macedonia Publication (2012), Gusev et al. (2016).

[22] Creative Commons Global Summit (2019).

[23] GNU Free Documentation License (2019).

13.3.3 Learning and Teaching

The usage of ICT in education gives possibilities of introducing new technologies in classes that are widening and changing every day. One important finding that reappears is that transition from traditional teaching and learning into electronic will succeed with continuing implementation of appropriate methods and techniques (according to World Economy Forum[24]). This is also supported by an OECD finding (Hermans and Tondeur 2016) that crucial improvements were not visible in the countries that have made huge investments in ICT in schools, but first recommendation internationally is that together with introducing new technologies in schools, changes in approaches and practices should be introduced. Another recommendation emerging from several researches is that teachers should be adequately prepared with continuously built capacities in order to establish and maintain the quality results from implementation of ICT in schools, reasons of large number of training organized for teachers from primary and secondary schools in the country. Also, teachers should lead not only the implementation, but also the creation of digital educational materials in schools. This recommendation is on the level of demand in the country, not achieved yet.

Introducing and using ICT to support teaching and learning is time consuming for teachers, both as they attempt to shift pedagogical practices and strategies and when such strategies are used regularly. Successful teacher professional development models can be divided into three phases: (1) Pre-service, focusing initial preparation on pedagogy skills and use of various teaching tools (including ICT); (2) In-service, including structured, face-to-face, and distance learning opportunities, building upon pre-service training and directly relevant to teacher needs; and (3) On-going formal and informal pedagogical and technical support enabled for teachers by ICTs.

According to OECD—Students, Computers, and Learning: Making the Connection, they have identified three main stages for ICT to be highly valued and regarded by the teachers: integration, enhancement, and complementary. Those three main stages are recognized from MES and MIS in the country, and followed through design of teachers' trainings. Integration approach is about implementing right use of ICT in particular subject area with review of curriculum and related ICT resources and appropriate software skills in order to improve students' achievement. Enhancement approach is about using ICT to give great emphasis on the topic introduced. Complementary approach is when the ICT is used to aid and support the students' learning. This approach allows students to be more organized and efficient in which they can obtain the notes from computer, submit their works by email from home as long as they meet the deadline, and look for information from various sources provided online to fulfill the task given to them (Hermans and Tondeur 2016; Hussain and Morgan 2015).

The integration of ICT in classroom at all education levels is getting more important as it helps student in enhancing their collaborative learning skills as well as developing transversal skills that stimulate social skills, problem solving, self-reliance,

[24]World Economic Forum (2015).

responsibility, and the capacity for reflection and initiative. All these elements are core values that students need to achieve in an active teaching and learning environment (Ghani et al. 2014).

13.3.3.1 Information Technology-Assisted Teaching

University provides sufficient technology-assisted learning, especially at engineering areas, where simulation and other learning tools are used in realization of programs. Also, faculties (mainly in technical fields) have academic licenses for using of different software programs relevant to their study programs and courses.

The Republic of North Macedonia has invested a lot of installed hardware and software for education and teacher training. That installment offers environment where IT tools directly assist teaching process. The research (Atanasova-Jankulovska and Mitevski 2016) was aiming to determine the situation in country of usage of databases of digital educational materials (DEM) and to define recommendation for future improvements. DEM, as an organized collection of digital educational materials, its main aim is to provide materials that can facilitate the educational process by using the ICT technologies. Using DEMs in education will provide more information about the progress of students, and will also provide teachers with an opportunity to design own subset of materials that is suitable for them and their students. According to the research, it has found that teachers understand the importance of the professional development and are doing their best to use all available resources, especially with the help of technology, to improve own development. This teachers' attitude towards professional development is important because it also has found that teachers need training on understanding, using, preparing, and updating DEMs. The findings can be generalized for country that continuous capacity building is important for every institution; only part of the interviewed teachers had experience with databases of educational materials; teachers should be adequately prepared to develop, use, and update DEMs; usage of materials in national language is preferred; established practices and attitudes in schools should be targeted and revised in order to have efficient usage of DEMs.

13.3.3.2 Courses about Information Technology

Each faculty offers at least one IT oriented course with content of using Internet and document editing programs. Engineering-oriented faculties offer more courses, including those use simulation tools. Almost all higher education institutions and universities in the country offer an ICT curriculum. The most versatile programs along with dedicated ICT are being offered in the largest and oldest university in the country, Ss. Cyril and Methodius University in Skopje (UKIM). Faculty of Computer Science and Engineering at UKIM realizes plenty of courses with computers, and even mathematical disciplines are offered with IT support. The situation is similar at other faculties of computer engineering that work in frame of the other public and private universities in the country.

Secondary schools integrate several programming and web design courses besides the essential document editing and Internet use courses.

Primary schools offer one informatics course as an elective course in last year. In the country, it is initiative to adopt that as obligatory course in the programs of one of the last years.

13.3.4 ICT Integration into Practices

During the previous decade in schools in the Republic of North Macedonia, a lot of hardware has been installed, and teachers have received a lot of capacity building training: computers in schools are installed and connected on the Internet; numerous software applications have been translated and adopted for North Macedonian education; each teacher has received a laptop to facilitate own preparation for work and implementation of teaching activities (Vitanova et al. 2016). In R.N. Macedonia the government has implemented the integration of ICT in learning and teaching process. In addition, it is recognized that teachers' readiness and skills in using ICT are playing essential role in the use of ICT in education. Teachers need sufficient ICT skills to implement the technology and are required to have high confidence level to use it in a classroom setting. For that reason, large numbers of ICT training for teachers are realized. Here is the list of actions in the field of ICT education in North Macedonia[25]:

- Subject "Informatics" became obligatory in primary schools by 2007/2008 school year;
- "Computer for every child" primary education project in Macedonia, initiated by Government and supported by USAID;
- "Technology integration program" with integration of every classroom in primary and secondary education with use of client-server based technology;
- "Macedonia country of computer experts" with opportunity of training for basic computer skills of all citizens;
- "Free internet for all citizens" provided free dial up connections.

13.3.4.1 The Ability for Faculty to Use ICT to Teach

A lot of educated and specialized personnel have been employed at universities to teach relevant courses. Almost all faculties as university's members are computer centers that coordinate the computer labs and ICT infrastructure. This situation is for all public universities in the country and almost all private universities according

[25]E-Macedonia Publication (2012), Learning Series in Macedonia's Initiative Computer foEvery Child (2014).

to the rules for accreditation. The public universities have information systems for workflow data management with web based electronic platforms, for organizing and managing all students' data, such as iKnow e-platform of UKIM[26] and other more at other universities. Few universities mainly public have electronic bases of the published resources, up to authority of the teaching and scientific staff, mainly called repositories, such repository of the "Ss. Cyril and Methodius" University in Skopje[27] and repository of the "Goce Delcev" University in Stip.[28]

13.3.4.2 The Ability for Students to Use ICT to Solve Problems

The abilities of students to use ICT tools to solve problems at all education level in the country are on very good level. Students are using IT technology a lot in their education, especially in browsing and finding more learning resources on Internet. Due to the very successful projects to build a digital infrastructure at elementary schools, the students are well educated and enjoy the fruits of the new technology.

13.4 Policy and Strategy of ICT

13.4.1 Policies related Educational Informationalization

Several projects were realized to support use of IT in education, mainly in the period of establishing the Ministry of Information Society and by support of Ministry of Education and Science. The digital initiative was realized early enough to enable a good infrastructure and decrease the computer literacy. The essential educational material was also offered to students as part of their education.

Electronic testing was introduced at elementary and secondary schools to evaluate their knowledge at national level by the Ministry of Education and Science.

All relevant strategies and action plans for education informationalization, as policies frameworks, including the latest one covering the period of 2018–2025 proposes intensive use of IT in education. According to the last National Strategy for ICT,[29] there are projected follow measures for realization of the strategic goal No. 7—Improving formal and informal ICT education, including lifelong learning:

1. Practical training in ICT studies—Finding an instrument for better practical training in ICT studies that will be better in quality. This can be done by establishing direct cooperation between universities and chambers of commerce.

[26] I-Know Platform of the "Ss. Cyril and Methodius" University in Skopje, https://is.iknow.ukim.mk.

[27] Repository of the "Goce Delcev" University in Stip, https://eprints.ugd.edu.mk/.

[28] Repository of the "Ss. Cyril and Methodius" University in Skopje, https://repository.ukim.mk/.

[29] National Strategy for ICT (2015–2018).

2. Specialized secondary education in the field of ICT—It is necessary to establish a basis for the introduction of specialized secondary education in the field of ICT, through amendments to the law on secondary education. Advanced IT Skills Trainings—continuous implementation of the project "Trainings for advanced ICT skills" in order to increase the number of certificated persons through training for retraining to meet the needs of labor market.
3. Establishment of certification centers in formal education—Higher education institutions will open training centers as an instrument to provide certificates from international vendors (Microsoft, Cisco, Oracle, Adobe, Autodesk, etc.). This activity will also include adaptation of study programs to the faculties, where possible. Competitive advantage of faculties is reflected in well-trained human resources, to provide trainers for offering trainings to students and also to companies.
4. Establishment of alumni networks at the IT faculties—This measure envisages the establishment of alumni database and constant communication with students. The goal of the alumni network will be to inform graduates for additional training, and will also provide information on the achievements of graduates in various fields of their work (as an opportunity for additional training for new students).
5. Enrichment of curricula in elementary schools with ICT subjects—The measure focuses on improving the curriculum in elementary schools dedicated to ICT, following the positive experiences from the education system, from other countries. ICT subjects should be introduced, such as Fundamentals in programming, but mainly through using visual tools.

13.4.2 ICT Financing Resource

The Government supports all strategies and specified projects with the adopted action plans for sufficient funds. The projects funded mainly by programs of the European Commission have been realized with institutions from different level of education in the country. But the development of the digital society needs more financial resources in order to achieve, on one hand, infrastructure with broadband and digital connectivity and on the other hand, skilled ICT workforce.

Broadband infrastructure and services are fundamental components of today's digital economy and society. A fast and secure digital connection of high quality is a prerequisite for a modern economy and society. The requirements for high-speed networks are fast evolving and are necessary to absorb increasing data usage of future applications in tomorrow's digital society—e-government, e-health, e-procurement but also business-related and day-to-day household applications. The European Commission adopted a strategy on Connectivity for a European Gigabit Society (EGS)[30] on 14 September 2016. According to World Bank (World Bank ICT 2019), the Western Balkans region has significantly lower broadband penetration rates and the EC recommendations (European Commission 2018) are that Western

[30]European Commission (2016).

Balkan governments are responsible for identifying suitable digital (broadband) infrastructure projects in order to be in step with EGS.

Developing digital society depends on availability of skilled ICT workforce for service providers, as well as service users. Analysis of the ICT staff across all public institutions in North Macedonia is currently being conducted, focusing on the retention of ICT workforce and ICT skills demand. Activities are planned to inform and educate the citizens for the use of e-Services (National Portal for e-Services) and public awareness raising activities in the field of cyber security (National Cyber Security Strategy). For example, under the EU code week initiative, students and lecturers are stimulated to engage with programming and innovation activities, as an extra-curricular activity. A significant number of projects within the umbrella of EU code week will continue as long-term projects. Also another example, all 10–14-year old students in the public school system will be engaged within the "21st century schools programme in Western Balkans," for building their digital skills and employment prospects. The program will allow them to learn in a fun and innovative way by having access to free micro-bit pocket-sized, code-able computers in ICT classes and other subjects, helping them build their skills and confidence in computer literacy and coding.

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Chapter 14
Report on ICT in Education in the Republic of Poland

Bartlomiej Michalowicz

14.1 Overview of the Country

14.1.1 History

The history of Poland dates back to 966, when the first ruler Mieszko I was baptized and converted to Christianity. His son was crowned to become the first king of Poland. In the twelfth century Polish lands went into the period of fragmentation, which lasted for 150 years, just to become united again at the end of the thirteenth century. In the sixteenth century the Kingdom of Poland started to have close relations with the Grand Duchy of Lithuania, which led to the creation of the Republic of the Two Nations (the Polish-Lithuanian Commonwealth)—one of the largest countries in the political history of Europe. The end of the seventeenth century was the country's golden age, but then it went into a period of decline and it ceased to exist at the end of the eighteenth century due to three partitions conducted by its neighbors. In the meantime, some vestigial forms of the country emerged from time to time, but Poland did not regain its independence until the end of World War I, at the beginning of the twentieth century. The Second Polish Republic existed until 1939, the beginning of World War II, when its lands became occupied by German and Soviet armies. After WWII Poland found itself behind the Iron Curtain and governed by the communists (in 1952 the country's name was changed into the Polish People's Republic). The Polish United Workers' Party ruled in Poland until 1989. In 1980, after massive strikes, Solidarity trade union emerged (whose leader, Lech Wałęsa, became later the president of Poland). These events began the process of democratization and economic reforms, which allowed the Republic of Poland to join NATO in 1999 and the European Union in 2004.

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14.1.2 Geography

Poland is one of the biggest European countries. Its area extends 649 km from south to north and 689 km from east to west, covering over 300,000 km^2. Poland borders Russia, Lithuania, Belarus, Ukraine, Slovakia, the Czech Republic, and Germany. The northern border is partly a sea border (the Baltic Sea). Over 50% of the country's area is lowland, with elevation between 100 and 200 m above sea level. There are mountains along the southern border, with the highest point being Mount Rysy: 2499 m above sea level. Poland's climate is moderate, with average annual temperatures between 6 and 9 °C and precipitation of about 400 mm.

14.1.3 The Political System

The standing political structure in Poland was introduced by the Constitution of Poland[1] on the 2nd of April 1992. It is based on the principles of democracy, individual and religious liberty, freedom of convictions and association. The constitution divides the authority into legislative, executive, and judiciary. The Seym and the senate make up the legislative body. The Seym is the lower house of the Polish parliament. It consists of 460 MPs, elected in general elections, which are universal, equal, direct, and proportional, by means of secret ballot. The Seym is elected for a 4-year term of office.[2] The senate of Polish Republic—the upper house of the Polish parliament—consists of 100 senators, elected in universal and direct elections by secret ballot, in single-mandate constituencies for a 4-year term of office, which begins and ends with the term of office of Seym.[3]

The executive power is in the hands of the President (elected for a 5-year term of office) and the Council of Ministers with the Prime Minister at its head. The judiciary power is the responsibility of autonomous courts and tribunals. Another important Polish institution is the National Bank of Poland, whose primary responsibilities include keeping a stable level of prices while supporting the economic policy of the government.

The territory of Poland is divided administratively into three levels of subdivision: *voivodeships* (16 units), *powiats* (380 units), and *gminas* (2478 units).

In 1994 Poland decided to join the European Union and has been part of European Community since 2004. Currently operative legislative and political solutions in Poland are conditioned by the legal status binding all members of the EU.

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[1]Constitution of the Republic of Poland. http://www.sejm.gov.pl/prawo/konst/polski/kon1.htm. Accessed 27 Mar 2019.

[2]Dane o posłach wg stanu na dzień wyborów. http://www.sejm.gov.pl/Sejm8.nsf/page.xsp/poslowie_poczatek_kad. Accessed 27 Mar 2019.

[3]DANE O SENATORACH WG STANU NA DZIEŃ WYBORÓW. http://www.senat.gov.pl/o-senacie/senat-wspolczesny/dane-o-senatorach-wg-stanu-na-dzien-wyborow/. Accessed 27 Mar 2019.

14.1.4 Current Situation of Economic Development

In 2015 Poland was the 6th economy in the EU when it comes to the size of GDP—GDP (nominal) per capita was €11,123 (38.7% EU average). According to the data of IMF,[4] Poland was second in the EU as to the rate of growth of GDP per capita in the years 2004–2015. Between 1990 and 2015 Poland was the second fastest developing country among current members of the EU. Poland is considered by the UN as a "very highly developed" country when it comes to social development index (HDI for Poland was 0.855 for 2015, giving it 36th place in the world among 188 countries and dependent territories considered). Polish national debt amounted to about 51% GDP in 2015. Polish economy is of mixed type. The share of public sector in gross value added in 2015 totaled 19.8% and the private one—80.2% (including foreign one—16.6%).[5]

14.1.5 Population

At the end of June 2017, the population of Poland numbered 38,422,346 people. Population decline has been observed in Poland for 6 years. In 2017, 60% of population lived in cities and 40% in villages. The most populated cities were Warsaw, Cracow, and Lodz.[6] In the general number of people there were almost 52% of women.[7]

According to the Institute for the Structural Research EU, the process of aging of the Polish society has accelerated. It is anticipated that in 2050 people aged 65 and over will already constitute 31.5% of the population. In accordance with the forecasts of UN's Population Division, the demographic burden index (the ratio of people aged over 64 to people aged 15–64) in the perspective of the next 50 years will almost get tripled compared to the current number of 22%.

The most numerous group, constituting at least 61.8% of Poland's population, were people in the working age: 23,641,000 (men aged 18–64 and women aged 18–59).[8] There were 6,908,000 people (of which 51% were men) in the pre-working age and 7,873,000 (of which 32% were men) in the post-working age.

[4]Report for Selected Countries and Subjects, International Monetary Fund. http://www.imf.org/external/pubs/ft/weo/2016/02/weodata/weorept.aspx?pr.x=46&pr.y=9&sy=2003&ey=2015&sort=country&ds=%2C&br=1&c=946%2C137%2C122%2C181%2C124%2C918%2C138%2C964%2C182%2C960%2C423%2C968%2C935%2C128%2C939%2C936%2C961%2C172%2C132%2C184%2C134%2C174%2C144%2C944%2C178%2C136%2C112%2C941&s=NGDPRPC&grp=0&a=. Accessed 27 Mar 2019.

[5]Rocznik Statystyczny Rzeczypospolitej Polskiej (2016).

[6]Główny Urząd Statystyczny (2017).

[7]Ludność (2017).

[8]Ibidem.

The group of professionally active people numbered 17,260,000 while there were 13,433,000 professionally inactive people in 2016.[9]

Labor market analysis in the second quarter of 2017 shows that there were 16,281,000 people working, economic activity rate was 56.2%, employment rate amounted to 53.2% and the unemployment rate was 5.4%.[10] In 2016 the employment rate of people aged 20–64 in Poland totaled 69.3%.

Currently Poland has been one of the lowest employment proportions of the disabled people in the EU. This comes as a result of the lack of flexibility while designing work environment and in comprehension of body limitations.

14.1.6 The Relationship with China Under the "16 + 1" Cooperation Framework

Since the announcement of the "16 + 1" cooperation framework in Warsaw in 2012, Poland has been focused on its successful and constructive development. For Poland, the "16 + 1" cooperation framework has had an extra dimension in the cooperation with China, due to which mutual relationships can be intensified and economic interests' realization can be supported.

Within this project Poland has taken care, among others, of the cooperation mechanism for maritime affairs (Latvia 2017). The secretariat for maritime affairs may be used in the future to strengthen cooperation within the Maritime Silk Road and increase the role of Polish harbors and ports in trade exchange and investment cooperation with China.

Poland appreciates the multidimensionality of the "16 + 1" initiative. It allows deepening contacts with China not only at the level of administration, but also business, science, or culture. At the meeting in Bulgaria in 2018, Poland was represented by the Minister of Science and Higher Education. The Polish authorities believe that the "16 + 1" initiative may play an important role in the development of geographically balanced transport routes and logistic connections between the European Union and China. Poland declares its readiness to continue its involvement in the "16 + 1" format and expects intensification of contacts and the development of economic exchange as part of a comprehensive strategic partnership between countries.

Political dialogue between Warsaw and Beijing is very dynamic, and the best proof of this is many new initiatives, e.g. a "strategic partnership" and numerous cooperation mechanisms both at the central level; strategic dialogue, as well as the local level; the forum of regions. Poland is one of the first countries to have signed a memorandum on building an international "Belt and Route" agreement.

With the current legal form and the amounts provided, Chinese infrastructure investments are smaller than EU funds.

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[9] Ibidem.

[10] Aktywność ekonomiczna ludności Polski (2017).

14.2 Overview of the Educational Development

In 2017, public expenditure on education and upbringing from the state and local governments' budgets amounted to 71.9 billion PLN (3.6% of GDP).

Money for education and upbringing from the budgets of local governments (together with money received from the state budget) in the sum of 70.2 billion PLN was mainly assigned to running of primary schools—23.3 billion PLN (i.e. 33.3%), lower-secondary schools—9.6 billion PLN (i.e. 13.7%), kindergartens—11.5 billion PLN (i.e. 16.4%), vocational schools of various types (including art schools)—7.3 billion PLN (i.e. 10.4%) and upper-secondary schools—4.3 billion PLN (i.e. 6.1%).[11]

The analysis of education structure according to gender shows that women are a better educated group than men and more often achieve higher education degrees (in 2016 30.1% of women had a higher education degree, compared to 20.3% of men). At the same time, the percentage of people with only vocational, lower-secondary, primary, and incomplete primary education has decreased by 3.5% as well as the percentage of people with post-secondary and secondary education (by 0.2%).[12] The number of people with higher education among 15–64-year-olds in 2016 was 25.2% and with secondary and post-secondary education 34.9%.

14.2.1 Enrollment Rate, Years of Schooling, Academic Performance

The organizational structure of the education system in Poland is aimed at ensuring the right to education through teaching, upbringing and care. The system includes public and private nursery schools, kindergartens, primary schools, upper-secondary schools, post-secondary schools, art schools, and special needs education or institutions. Higher education is not included in the education system.[13]

Pre-school education (children aged 3–6) is considered to be the first level of education system in Poland. In 2017 81.1% of children aged 3–5 were subject to pre-school education.[14] A six-year-old child has to attend one-year kindergarten preparation for school.

Education obligation is imposed by the Constitution of Poland and lasts until the end of primary school. Education is obligatory until the age of 18. This obligation can be fulfilled in a public or private school, in a school for children or teenagers, but also outside of school (homeschooling).

Since September 1st 2017 there has been a new school structure in force in Poland:

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[11] Oświata i wychowanie w roku szkolnym 2017/2018 (2018).

[12] Główny Urząd Statystyczny (2017).

[13] Available at: https://pl.wikipedia.org/wiki/System_oswiaty_w_Polsce.

[14] Główny Urząd Statystyczny (2017).

<table>
<tr><th>Until 31st August 2017</th><th>Since 1st September 2017</th></tr>
<tr><td>Primary school (6 years) (obligatory)</td><td rowspan="2">Primary school (8 years) (obligatory)</td></tr>
<tr><td>Lower-secondary (3 years) (obligatory)
Existing until 31st August 2019.</td></tr>
<tr><td>Upper-secondary schools to choose from by pupils:</td><td>Secondary schools to choose from by pupils:</td></tr>
<tr><td>General upper-secondary school (3 years)
They offer the matriculation examination that leads to the receipt of the matriculation certificate</td><td>General upper-secondary school (4 years)
They offer the matriculation examination that leads to the receipt of the matriculation certificate</td></tr>
<tr><td>Technical upper-secondary school (4 years)
They offer external examinations confirming vocational qualifications and the matriculation examination that leads to the receipt of the matriculation certificate</td><td>Technical upper-secondary school (5 years)
They offer external examinations confirming vocational qualifications and the matriculation examination that leads to the receipt of the matriculation certificate</td></tr>
<tr><td rowspan="2">Basic vocational school (3 years)
They offer external examinations confirming vocational qualifications</td><td>Basic vocational school level I (3 years)
They offer external examinations confirming vocational qualifications</td></tr>
<tr><td>Basic vocational school level II (2 years)
In professions that have a continuation on the technician level
They offer external examinations confirming vocational qualifications in the profession taught at the level of a technician and the matriculation examination</td></tr>
<tr><td colspan="2">Special school preparing for vocation (3 years)
For mentally handicapped students in a moderate or severe degree and for students with multiple disabilities</td></tr>
<tr><td colspan="2">Post-secondary school (up to 2.5 years)
They offer people with secondary education external examinations confirming vocational qualifications</td></tr>
</table>

The results of the end-of-school examinations, conducted at the end of primary and lower-secondary education, can also be the indicators of the condition of Polish education. Between 2009 and 2011 there was a considerable increase in the average amount of points obtained from the whole test, whereas a decrease was observed in 2012. Students attending schools in big cities had better marks than those who studied in towns or villages. The final exam at the end of primary school is continued at the lower-secondary level in three areas: humanities, math and science (STEM), and languages. In the years 2009–2011 a downward trend was noticed in the amount of points obtained by students. The achievements of lower-secondary students are less dependent on the location of their school than in primary education.[15]

The standard of education in Poland is quite high and comparable to teaching standards in other countries. On the basis of observation of lower-secondary students'

[15]Dzieci w Polsce. https://www.unicef.pl/Co-robimy/Publikacje/Dzieci-w-Polsce. Accessed 27 Mar 2019.

results, as part of OECD coordinated Programme for International Student Assessment (PISA), which is repeated every three years, we can draw conclusions about the quality of the education system in Poland. The study tests the skills of 15-year-olds in three competence fields: reading and interpretation, science, and mathematics. In the field of understanding science, Poland came twentieth among the countries that took part in the study (eleventh in the EU). The results achieved by Polish students were worse in comparison to the previous study. In the field of reading and interpretation, Poland came twelfth (fifth in the EU) and when it comes to the mathematics, Poland came fifteenth (ninth in the EU).[16]

Until 2017 lower-secondary graduates mostly preferred general upper-secondary schools, but there has been a systematic increase in the interest in schools allowing acquiring a profession (technical upper-secondary schools and basic vocational schools). Last year the percentage of secondary students attending technical upper-secondary schools was 38.8% and basic vocational schools 14%.

General and technical upper-secondary schools' graduates can take the matriculation examination, which grants access to tertiary education (university, polytechnic, college). 258,372 upper-secondary graduates took the matriculation examination in May 2016.[17] The number of graduates that passed the exam was 205,361 (79.5%).[18]

For many years the most popular faculties among tertiary students have been social studies, journalism, information, economy, administration, and law (34.4% graduates in 2016), but recent years have seen an increase in the popularity of fields of study connected with science, technology, industry, and building.[19]

Polish adult education in a broad sense (people aged 25–64), in all its forms, has a very low position among the EU countries. The rate of Polish adults participating in education was almost two-thirds lower than in the EU countries and in 2016 amounted to 3.7% (with average for 28 EU countries being 10.8%).[20]

14.2.2 Policies and Measures Taken for Educational Inclusiveness, Educational Equity and Educational Quality

There are regulations in Poland with guidelines regarding the education of students who are disabled, socially maladjusted or at risk of being so. The school is required to provide comprehensive help to such students. Chronically ill pupils in kindergarten or school have the same rights as any other children.

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[16]Ibidem.

[17]Centralna Komisja Egzaminacyjna w Warszawie/Central Examination Board in Warsaw. Available at: https://cke.gov.pl/images/_EGZAMIN_MATURALNY_OD_2015/Informacje_o_wynikach/2016/sprawozdanie/Sprawozdanie_ogolne_2016.pdf.

[18]Ibidem.

[19]Ibidem.

[20]Ibidem.

Disabled students who can attend school, but require some of the classes in individual form or in small groups, have such classes at school. Special education (at the level of primary, lower-secondary and upper-secondary schools) takes place in independent special schools or in general schools which have one of the following classes: special, integration, or therapeutic; there are also special educational centers, various educational institutions or medical ones (including health care resorts and facilities). Students, whose health condition makes it impossible for them to attend school, are able to have classes at home. Special education is organized even for 24-year-olds and primary school education can be prolonged until the student is 20.

There has been a noticeable increase in the number of integration classes—from 515 in the school year of 1995/1996 to 3927 in the school year of 2010/2011 in primary schools and from 234 in the school year of 2000/2001 to 2083 in the school year 2010/2011 in the case of lower-secondary schools.[21]

An individual educational and therapeutic program is created for disabled students. It is required and supervised that the school cooperates with the parents in terms of organizing education of disabled children and adapting the conditions of such education to the type of disability.

14.2.3 Teachers' Training and Development

14.2.3.1 Initial Teacher Training

The legislation regulates the standards of teacher training and indicates which institutions and in which mode can train future teachers.

Qualifications required to practice the teaching profession are provided at university or polytechnic. Moreover, future teachers have to obtain pedagogical qualifications, which allow them to work in school. Studies with a teacher specialization track prepare their graduates for comprehensive realization of all school goals: educational, pedagogical, and custodial.[22] There are about 670 institutions in Poland that train teachers and every year each of them promotes from a dozen or so to a couple of thousand teachers.[23]

In Poland there are also public and private pedagogical colleges, teacher training colleges, and foreign language teacher training colleges. The main purpose of their existence is training teachers in such specialties in which universities or polytechnics are not able to provide enough teachers to satisfy the needs of education.

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[21] Dzieci w Polsce, unicef. https://www.unicef.pl/Co-robimy/Publikacje/Dzieci-w-Polsce. Accessed 27 Mar 2019.

[22] PODSTRONY. http://www.pedagog.uw.edu.pl/strony/awilkomirska/index.php?id=6. Accessed 27 Mar 2019.

[23] Organizacja kształcenia nauczycieli. https://sites.google.com/site/ksztalcenienauczycieli/organizacja-ksztalcenia-nauczycieli. Accessed 27 Mar 2019.

Owing to basic psychological and pedagogical competences that they gain, teachers should individualize the education process; become a tutor and a guardian. Education in the field of information technology and using it in the didactic process as well as learning a foreign language in order to achieve a high level of competence in it, measured by all-European standards, have become the leading elements of training future teachers.

14.2.3.2 Teachers' Professional Development

Operating of the educational system is based on activities performed by teachers and other employees of educational units.

Teachers in public schools and other public educational institutions work under the regulations of the Teacher's Charter. This act states in details the conditions of teachers' work, their responsibilities and rights and also specifies professional promotion grades and teachers' remuneration.

In the school year 2016/2017, there were 498.3 thousand teachers employed in all types of schools and kindergarten units (in conversion to full-time teaching jobs). Currently, the public sector encompasses 87% of all teacher full-time jobs and the private sector—13%.[24]

The biggest group of teachers worked in primary schools (184.9 thousand full-time jobs) and in lower-secondary schools (98.2 thousand). Teaching staff of upper-secondary (together with post-secondary) schools numbered 117.4 thousand teachers in the school year of 2016/2017 (employed full-time and part-time, the number converted into full-time jobs).[25]

The legislator determined four grades of professional promotion possibilities for teachers in the Teacher's Charter. The career path starts with trainee teacher grade. After one year of work and passing the exam with positive marks, one can achieve the grade of contract teacher. After a further three years of work, filing documents required for the exam and finally after passing the exam, the teacher obtains the appointed teacher grade. Afterwards it is possible to gain the highest grade, i.e. chartered teacher (after minimum 4 years). Teachers have to raise their qualifications within the framework of professional promotion system. In the school year 2016/2017, the majority of the teaching staff was composed of chartered teachers (54.9%). Appointed teachers accounted for 23.1% of pedagogical personnel, contract teachers—15.1%, trainee teachers—4.0% and teachers without any promotion grade—3.0%.[26]

[24] Oświata i wychowanie w roku szkolnym 2016/2017 (2017).

[25] Ibidem.

[26] Ibidem.

14.3 New Progress of ICT in Education

In the age of digitization, informatization of schools and educational institutions in Poland has become a standard. Computers and the Internet are used in the learning process in the informatics labs, libraries with public access to computers and the Internet, classrooms and lecture halls. Digitization has involved the school administration, too, so we have electronic school registers and timetables, e-learning, electronic accountancy, and electronic systems of registration of students and their service.

All-Polish Educational Information System[27] has existed since 2005 and it came to life by act of law. It was created in order to gather one consistent information database in the field of all-Polish statistical reporting.[28]

14.3.1 Infrastructure

In teaching computer science and information technology (IT) it has been emphasized for years to teach such elements as logical and algorithmic thinking, use of computer applications, search and use of information from different sources, use of computers and basic digital devices, and application of these skills in other school subjects.

Computer and Internet access in schools has significantly improved in the recent couple of years, especially in primary schools. In 2011, the percentage of schools equipped with computers intended for students' use and with Internet access was 96% of primary schools in cities and 93% of primary schools in the countryside, with lower-secondary schools the percentage was accordingly 84% in cities and 80% in the countryside. However, many schools still use long-serving equipment in informatics labs, which was supplied by the projects of ministry of education in 2004–2008.

Renewal of the Internet infrastructure in schools and teaching programming are two actions that were taken by Polish government in 2017. An All-Polish Educational Web is planned to come into existence—it is going to be an ICT web that connects all schools in Poland (about 30.5 thousand) and ensures access to educational contents.[29] In the new curriculum, the number of IT lessons has been increased from 210 to 280 h. Since 2017 programming has been included in the IT subject, which is obligatory for all primary students. The government appropriated 500 million PLN from the EU program Digital Poland for building the infrastructure of Internet access for schools.

[27] Modernizacja SIO, Centrum Informatyczne Edukacji. https://cie.men.gov.pl/modernizacja-sio/. Accessed 27 Mar 2019.

[28] Available at: http://www.sio.edu.pl/index_urzad.php?pokaz=strona&id=3.

[29] POLSKA SZEROKOPASMOWA. https://www.polskaszerokopasmowa.pl/artykuly/klucz,cyfryzacja-i-szybka-siec-w-szkolach-to-priorytet-resortow-cyfryzacji-i-edukacji,akcja,wydruk.html.

Another 124 million PLN will be assigned to training teachers and pupils from grades 1–3 to learn programming.[30]

The vision of modernizing education increasingly indicates cultivating learner's independence and responsibility for their own development and education while gradually abandoning the model of absolute teacher authority. One of the prioritized directions of this change is the use of information and communication technologies. Employment of the potential of such technologies in education indicates that it is becoming absolutely essential to recognize the openness of educational resources. At present, the vision of using modern technologies at school is based on common involvement in creating, using, and distributing free educational resources by students, teachers, parents, and educational institutions.

14.3.2 Educational Resources

There are two groups of entities in Poland that make open resources accessible—public institutions and non-governmental organizations.

2012 saw the acceptance of the first government program for funding open educational resources for the needs of Polish education system, the long-term project "Digital school", which assumed equipping schools with computer equipment and digital teaching aids, ensuring equipment for the students, raising teachers' competences, and creating open educational resources.

The second government project, "Our ABC-book" (since 2014), presumes development and release of state-funded textbooks for grades 1–3 in primary school, made accessible on free license, similarly to e-textbooks. The project is not exactly an open resource, though, as the graphics are not on free license.

One of the first initiatives of public institutions has been the Polish digital library Polona—a project of the National Library of Poland which digitized Polish cultural heritage holdings that are in the public domain.[31] In 2005 the Ministry of National Education launched portal Scholaris.pl—open for general use platform containing free electronic educational resources for all stages of education, treated as the learning portal for teachers, currently managed by the Centre for Education Development.[32]

Open educational resources are also made accessible by academic institutions.

Apart from public institutions, non-governmental organizations are the second important group of entities which make open resources accessible.

As one of the first NGOs, Modern Poland Foundation in 2007 provided access to the website Wolne Lektury (Free Set Books)—an Internet library of school set books and literature classics which are in the public domain or available on free licenses.[33]

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[30] Ibidem.

[31] Nowa Cyfrowa Biblioteka Narodowa Polona. http://intro.polona.pl/. Accessed 27 Mar 2019.

[32] Scholaris. http://www.scholaris.pl/. Accessed 27 Mar 2019.

[33] Biblioteka internetowa Wolne Lektury. http://wolnelektury.pl. Accessed 27 Mar 2019.

In 2009 Orange Foundation began first in Poland grant program which used the openness principle. It introduced the obligation of free licenses for the results of cultural education projects funded from OF grants. It allowed 450,000 children and teenagers using Internet and technology in a safe and useful way, installed multimedia learning and entertainment places for children in 80 hospitals, helped 900 social organizations in their campaigns in favor of developing digital competences of Poles and many more.[34]

A foundation called Center for Citizenship Education makes its own resources accessible on open-source licenses and it also trains teachers in the field of creation and usage of open educational resources and new media in education.[35]

A big database of lesson plans made available on Creative Commons licenses is offered by the Panoptykon Foundation (which manages portal Cyfrowa Wyprawka[36]—Digital School Supplies—which includes lesson plans on the topic of safe usage of new technologies). Modern Poland Foundation creates access tools for free cultural goods, builds media education programs, makes available lesson plans, exercises and materials for classes about media education.[37] Digital Centre Project: Poland is carrying out the project "Otwarte Zabytki" (Open Monuments) and manages open information website about monuments. All educational materials created within this project are made available as open educational resources.[38] Another interesting example of using open educational resources is the program "Mistorzowie Kodowania" (Masters of Coding) managed by Samsung Poland. Educational materials about teaching programming in primary schools are made available on free license.[39]

14.3.3 ICT Integration into Practices

Polish teachers are aware that if they want to educate effectively and prepare their students for life, as the idea of long-life learning suggests, they should use modern information and communication technologies for teaching purposes. Research indicates that more than half of active teachers have the experience of e-learning (or blended-learning), in the form of online courses, educational projects, post-graduate studies, training courses, IT courses, or language courses. The most commonly acquired skills were the use of multimedia interactive board in class, distant education methodologies and the use of ICT in education, or the use of multimedia in the education process. Less often, the teachers took part in more specialized courses,

[34]Fundacja Orange. https://fundacja.orange.pl/. Accessed 27 Mar 2019.

[35]Centrum Edukacji Obywatelskiej. https://glowna.ceo.org.pl/. Accessed 27 Mar 2019.

[36]Cyfrowa Wyprawka. http://cyfrowa-wyprawka.org/. Accessed 27 Mar 2019.

[37]Fundacja Nowoczesna Polska. https://nowoczesnapolska.org.pl/. Accessed 27 Mar 2019.

[38]Otwarte Zabytki. http://otwartezabytki.pl/. Accessed 27 Mar 2019.

[39]Mistrzowie Kodowania. http://mistrzowiekodowania.samsung.pl/. Accessed 27 Mar 2019.

such as computer graphics, computer lab administration, website creation, or the use of an e-learning platform in the didactic process.

Teachers conduct classes using an interactive whiteboard and appropriate software. They apply interactive exercises and electronic materials attached to textbooks. Discussion forums, blogs, and social websites are treated by the majority as forms of out-of-school contact, not as tools indicated in the education process. A small number of teachers conduct lessons in a computer lab where each student has access to a computer.

14.4 Policy and Strategy of ICT

The development of the information society in Poland was initiated in 1997 when the Organization for Economic Cooperation and Development of OECD set up a Working Party for Indicators on Information Society (WPIIS). The definitions and methodology for the development of data on various aspects of the information society were formulated.

14.4.1 ICT in Enterprises

In the planning of development and the study of the effects of implementation in various areas, among others IT competences, the rapid development of information and communication technologies forces to take into account the use of advanced online services and electronic economy, e-commerce, security in networks and IT systems as well as investment and expenditure on ICT, the development of issues related to the use of open-source tools and the impact of ICT on the environment, mobile Internet access, use of social media and services in the cloud.[40]

The 2016 research indicates that there were 2278 companies operating in the ICT sector in Poland, of which 89.4% provided ICT services. IT services were offered by about 75% of companies dealing with ICT services, where 70.5% of ICT workers were employed.

95.6% of Polish enterprises (below the EU average) made use of computers in their activities. The number of enterprises using broadband connections increased. In 2018 84.0% of enterprises had a fixed broadband connection, while the mobile

[40]Społeczeństwo informacyjne w Polsce. Wyniki badań statystycznych z lat 2013–2017. https://stat.gov.pl/obszary-tematyczne/nauka-i-technika-spoleczenstwo-informacyjne/spoleczenstwo-informacyjne/spoleczenstwo-informacyjne-w-polsce-wyniki-badan-statystycznych-z-lat-2013-2017,1,11.html?contrast=black-white. Accessed 27 Mar 2019.

ones—67.6%. About 13% (2017) of enterprises in Poland employed ICT specialists. The number of companies selling and buying online increased.[41]

Almost two-thirds of the companies carried out administrative procedures only electronically, without paper documents.

In 2016, over 94% of enterprises used the Internet to contact public administration bodies. About half of the companies invested in the purchase of ICT equipment mainly from the finance, insurance, and energy sectors.

14.4.2 ICT at Work

In 2018, 59% of professionally active Poles used computers, laptops, smartphones, tablets, other portable devices or computerized devices, or equipment at work. The difference between professionally active inhabitants of towns and villages reached 28%.

14.4.3 ICT in Households

The percentage of households with at least one computer has systematically increased in recent years (in 2018 it was approx. 83%). Over 80% of households had Internet access, mainly broadband, at home. In 2017, 72.7% of people aged 16–74 regularly used the Internet. The highest percentage were students (99.9%), people with higher education (96.9%), as well as residents of big cities (82.0%). The most common purposes of using the Internet in Poland include reading, downloading magazines, and using e-mail. Statistics show that over half of Polish Internet users are e-consumers.

The percentage of citizens aged 16–74 using e-government services in 2018 is around 35%. Most often applications and forms are submitted this way. The research conducted in 2017 showed that in the group of people aged 16–74 using the Internet, approximately 30% were people with a low level of general digital skills, about 25%—people with a basic level of those, and 21% of the above-mentioned digital skills.

The use of advanced information and telecommunications technologies also covers having smartphones. The results show that over 60% of Poles aged 16–74 have a smartphone. Most preferably the device is used by the youngest, as well as by primary school learners and university students.

[41] Społeczeństwo informacyjne w Polsce w 2018 roku. https://stat.gov.pl/obszary-tematyczne/nauka-i-technika-spoleczenstwo-informacyjne/spoleczenstwo-informacyjne/spoleczenstwo-informacyjne-w-polsce-w-2018-roku,2,8.html. Accessed 27 Mar 2019.

14.5 The Main Sources of Financing Educational Projects in Poland

14.5.1 European Union

In the period 2014–2020, the EU allocated over PLN 80 billion to the European Social Fund. About 13.2 billion euro was allocated from this pool for Poland. Funds from the European Social Fund are used at two levels: national and regional. At the national level, there is one Operational Program—Knowledge Education Development (POWER), which received EUR 4.4 billion, i.e. approximately 34% of the total funds. The remaining over 66% funds were divided between 16 regional programs.[42]

Projects supported by the European Social Fund are addressed to various social groups. The ESF characteristic feature is that there are two types of beneficiaries: beneficiaries (project promoters) and target group/final recipients (project participants).

Beneficiaries include various types of employee and employer organizations, non-governmental and charity organizations, universities, government and self-government administration bodies, public and private institutions related to education, health services, etc. and enterprises. They take part in and then implement the projects.[43]

The Knowledge Education Development (POWER) Program, at the national level, to which 4.4 billion euro is allocated from the European Social Fund, provides for six types of activities, including the following:

- Effective public policies for the labor market, economy, and education—ESF allocation EUR 739 million: implementing system and structure reforms in selected areas of public policies, key for the Europe 2020 strategy and national reform programs.
- Higher education for economy and development—ESF allocation 1056 million: supporting the quality, efficiency, and openness of higher education as an instrument for building a knowledge-based economy.

Activities aimed at improving access to education, improving the quality of education and training play an important role at the level of regions. Schools got support in the field of teacher education and development, equalizing educational opportunities of students, and equipping the educational and scientific base of schools. Regional and local authorities use ESF funding in projects improving the efficiency of institutions and services provided. The implementation of information technologies and initiatives related to e-government plays an important role, as it aims at increasing the access of citizens to information and better service by local authorities.

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[42] Czym jest Europejski Fundusz Społeczny, Portal Funduszy Europejskich. https://www.funduszeeuropejskie.gov.pl/strony/o-funduszach/europejski-fundusz-spoleczny/przeczytaj-o-europejskim-funduszu-spolecznym/. Accessed 27 Mar 2019.

[43] Ibidem.

The use of EU support brings about many advantages. However, receiving EU subsidies is also dependent on numerous obligations. First of all, you need to complete the investment in accordance with the application, respect the time limits and settle it correctly.

14.5.2 The Norwegian Financial Mechanism and the Financial Mechanism of the European Economic Area (The So-Called Norwegian Funds and EEA Funds)

These funds are related to Poland's accession to the European Union and the simultaneous entry of our country into the European Economic Area (EU + Iceland, Liechtenstein, Norway). The Norwegian Financial Mechanism and the Financial Mechanism of the European Economic Area (the so-called Norwegian and EEA Grants) are a form of non-returnable foreign aid granted by Norway, Iceland, and Liechtenstein to new EU members. In return for financial assistance, donor countries benefit from access to the internal market of the European Union (although they are not its members).[44]

Negotiations for the launch of the third edition of the Norwegian and EEA Funds in Poland have now come to an end. For this edition, the donors (Norway, Iceland, Liechtenstein) allocated over 2.8 million euro. Poland will be the largest beneficiary and will receive 809 million euro for projects.

As part of the fund, 12 programs are planned to be launched, including: Entrepreneurship development and innovation—85 million, Research—110 million, Education—20 million.

It is assumed that the first calls for proposals of the 3rd edition of the Norwegian and EEA funds 2014–2021 will take place in 2019.

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[44] Available at: https://www.eog.gov.pl/strony/dowiedz-sie-wiecej-o-funduszach/poznaj-zasady-dzialania-funduszy/obszary-wsparcia/badania-naukowe-i-stypendia/.

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Czym jest Europejski Fundusz Społeczny, Portal Funduszy Europejskich. Retrieved March 27, 2019 from https://www.funduszeeuropejskie.gov.pl/strony/o-funduszach/europejski-fundusz-spoleczny/przeczytaj-o-europejskim-funduszu-spolecznym/.

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POLSKA SZEROKOPASMOWA. https://www.polskaszerokopasmowa.pl/artykuly/klucz,cyfryzacja-i-szybka-siec-w-szkolach-to-priorytet-resortow-cyfryzacji-i-edukacji,akcja,wydruk.html.

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Chapter 15
Report on ICT in Education in Romania

Carmen Holotescu, Gabriela Grosseck, and Diana Andone

15.1 Overview of the Country

15.1.1 Geography

Romania is a country located in Southeastern Central Europe, North of the Balkan Peninsula, on the Lower Danube, within and outside the Carpathian arch, bordering on the Black Sea. The area is about 92,043 miles^2 (238,391 km^2). Almost all of the Danube Delta is located within its territory. It shares a border with Hungary and Serbia to the west, Ukraine and the Republic of Moldova to the northeast, and Bulgaria to the south.

15.1.2 Population

According to NIS (2018) Romania has the ninth largest territory and the seventh largest population (with 19.50 million resident population) among the European Union member states. Its capital and largest city is Bucharest with more than 2 million people. Other large cities are Iasi, Cluj Napoca, Timisoara, or Constanta. Romania's population lives in 320 cities and towns and 12,956 villages.

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Other facts about Romania:

- The main ethnic groups are Romanian 84%, Hungarian 6.1%, Gipsy 3.1%, German 0.2%, Ukrainian 0.2%. As for religions the majority is Christian Orthodox 81%, with a presence of Roman Catholic 4.3%, Reformed 3%, Greek-Catholic 0.7%, Unitarian 0.3%, Jewish, and others.
- Romania's National Day is December 1st.
- Romania's flag is three-colored, the colors being placed vertically in the following order from the flagpole: blue, yellow, red.
- The currency is Leu (plural Lei, abbreviations Lei or RON).

15.1.3 History

The name "Romania" comes from the Latin word "Romanus" which means "citizen of the Roman Empire." Romania history includes periods of rule by Dacians, the Roman Empire, the Kingdom of Hungary, and the Ottoman Empire. As a nation-state, the country was formed by the merging of Moldavia and Wallachia in 1859 and it gained recognition of its independence in 1878. Later, in 1918, they were joined by Transylvania, Bukovina, and Bessarabia. At the end of World War II, parts of its territories were occupied by the USSR and Romania became a member of the Warsaw Pact. With the fall of the Iron Curtain in 1989, Romania started a series of political and economic reforms.

Since December 1989, Romania has pursued a policy of strengthening relations with the West in general, more specifically with the United States and the European Union. It joined the North Atlantic Treaty Organization (NATO) on March 29, 2004, the European Union (EU) on January 1, 2007, while it had joined the International Monetary Fund and the World Bank in 1972, and is a founding member of the World Trade Organization.

15.1.4 The Political System

- The legal system is based on European models and the Constitution of 1991.
- The electoral system is a universal direct suffrage over the age of 18. Parties must win at least five percent of the national vote to gain representation in the Parliament.
- The Head of State is President of the Republic, currently Mr. Klaus Werner Iohannis (elected on November 16, 2014). Romania's president can serve two consecutive five-year terms.
- The National Government is led by the Prime Minister, nominated by the political party—or political alliance—with parliamentary majority, approved by the President of Romania, and confirmed by the Parliament. The present Government has

been nominated by the political alliance formed by the Social Democratic Party (PSD), and the Liberal-Democratic Alliance (ALDE).

- The presidency of the Council of the European Union is currently (as of January 2019) held by Romania (https://www.romania2019.eu/home/).

15.1.5 General Situation of Science and Technology

Through history, the Romanian researchers and/or inventors have made notable contributions to several scientific fields, such as: aeronautics, medicine, mathematics, computer science/engineering, (bio)physics, (bio)chemistry, biochemistry, and biology. Here are some Romanians that changed the life without even knowing:

- In *Aeronautics*, three names made history: Traian Vuia made the first airplane to take off on its own power, Aurel Vlaicu built and flew some of the earliest successful aircraft, and Henri Coandă discovered the Coandă effect of fluidics.
- In *Biology*: Victor Babes discovered more than 50 germs and a cure for a disease named after him, *babesiosis*; Nicolae Paulescu discovered insulin; Emil Palade received the Nobel Prize for his contributions to cell biology; George Constantinescu created the theory of sonics; Lazăr Edeleanu was the first chemist to synthesize amphetamine and also invented the modern method of refining crude oil; Costin Neniţescu found new methods for the synthesis of pirilium salts, carbenes, tryptamine, serotonin, two new syntheses for the indole nucleus, and a new method of polymerization of ethylene; Emil Racoviţă—founder of biospeleology (the study of organisms living in caves).
- In *Mathematics*, there are several scientists that distinguished themselves as well. Among them Stefan Odobleja—the ideological father behind cybernetics. Another important fact, from the recent history, is that Romanian mathematics team is the first in Europe and tenth in the world.
- In *Physics*, as notable inventors we have Mihai Gavrilă, specialized in quantum theory and discoverer of the atomic dichotomy phenomenon; Alexandru Proca, known for the first meson theory of nuclear forces and Proca's equations of the vectorial mesonic field; Stefan Procopiu known for the first theory of the magnetic moment of the electron in 1911 (now known as the Bohr-Procopiu magneton); Theodor V. Ionescu's patent for 3D imaging in cinema and television in 1936; Eugen Pavel is the Romanian scientist who invented the Hyper CD-ROM, a 3D optical data storage medium that has a storage capacity of 1,000,000 GB, equal to 10,000 classic CDs; Ionel Solomon known for the nuclear magnetic resonance theory in solids, Solomon equations and photovoltaic devices.
- In *Engineering* Aurel Perșu contributed to the car's look as we know it today. He was the first to place the wheels inside the body of the car. The parachuted chair, an early form of today's ejector seat, was invented by Anastase Dragomir.
- Petrache Poenaru invented the world's first fountain pen.

- One of the first women to develop anti-ageing products was Ana Aslan, who discovered the anti-ageing effects of procaine, today found in Gerovital H3 and Aslavital products. She also founded the first Geriatric Institute in the world in 1952.
- And recently, a 20 years old Romanian computer scientist designed the cheapest self-driving car. While there are currently about ten self-driving cars in the world, Romanian Ionut Budisteanu's is the least costly, by far, at only USD 4000. Budișteanu won the Gordon E Moore grand prize at the 2013 Intel International Science and Engineering Fair (ISEF) for his low-cost, self-driving car.

Other interesting facts related with science are:

- A Romanian city was the first in Europe to have electric street lighting. It happened in 1889 in the Romanian city of Timișoara (the city was also the first European city to introduce horse-drawn trams in 1869).
- Bitdefender—one of the best antivirus/Internet security software suites—was developed by Romanian company Softwin.
- The nuclear physics facility of the European Union's proposed Extreme Light Infrastructure (ELI) laser will be built in Romania. Romania currently has 1400 MW of nuclear power capacity by means of one active nuclear power plant (Cernavodă) with two reactors, which constitutes around 18% of the national power generation capacity of the country. This makes Romania the 23rd largest user of nuclear power in the world.
- In early 2012, Romania launched its first satellite from the Center Spatial Guyanais in French Guyana.

15.1.6 The Relationship with China Under the "16 + 1" Cooperation Framework

In 2012, the "16 + 1" economic cooperation format was set up as an important part of China's foreign strategy in the context of the Belt and Road Initiative (B&R),[1] between the Central and Eastern European (CEE) countries and China. The "16 + 1" format refers to various mechanisms and collaborations between China and 16 CEE countries, representing a way to strengthen their economic relations. Since its inauguration, the "16 + 1" format has been widely accepted in CEE countries and has witnessed rapid developments. Each year, the China-CEE summit (including meetings of the China-CEE leaders at the level of Prime Ministers), is held along with the China-CEE Economic and Trade Forum. Thus, progress has been made in institutionalizing cooperation mechanisms in various fields, usually taking the form of an association, forum, or collaboration opportunity that facilitates contacts between China and CEE.

[1]The State Council. The People's Republic of China. The Belt and Road Initiative. http://english.gov.cn/beltAndRoad/.

The international literature already incorporates a significant number of papers about the economic and political aspects related to "16 + 1" framework. Up to date, in Romania there is little in-depth research and there are few relevant papers on this topic and even fewer about education and research. Therefore, writing about this issue is not an easy task and it still is in an exploratory phase.

Talking about the relations between Romania and China, the two countries refer to each other as being "old friends," invoking a "traditional friendship" that started almost 70 years ago and ties the two nations separated by more than 8000 km.[2] But when it comes to "16 + 1" format, Romania has an important role. Here are some optimistic milestones worth mentioning (Pantea 2018)[3]:

- The "16 + 1" 2nd summit was held on Bucharest in October 2013 and issued *The Bucharest Guidelines for Cooperation between China and CEE Countries*. As for Romania, in November 2013 it was the first country among the CEE countries, which Chinese Premier Li Keqiang visited and the meeting concluded with a *Joint Declaration on Deepened Bilateral Cooperation*.[4] The Chinese Premier said: "I believe that China-Romania cooperation may become a banner for China-CEE countries cooperation and that China-CEE countries cooperation will surely add new impetus to China-Europe relations."
- In 2013, the first Confucius Institute within the University of Bucharest was inaugurated on the 22nd of November, after the Agreement for cooperation was signed by the University of Bucharest and Hanban—the General Headquarters of the Confucius Institutes. Since then more than 10 institutes were opened in different cities.
- In October 2014, the 9th China-CEE countries Agro-trade and Economic Cooperation Forum was held in Bucharest, Romania. In the same year, China signed with Romania cooperation documents on the peaceful use of nuclear energy. Currently, China is Romania's main trading partner in Asia, but it is only on the 19th place among foreign investors in our country, with investments value of about USD 440 million in 226. The main Chinese investors in Romania in the last years are: Huawei, China Tobacco International Europe Company, Yuncheng Plate Making, Eurosport DHS, and ZTE. Some of the longer term projects touted by both countries regarding Chinese investment in Romania have yet to come to fruition: the memorandum of cooperation for the Cernavodă Nuclear Power

[2]Ministry of Foreign Affairs of the RPC (September 27, 2015). Xi Jinping Meets with President Klaus Iohannis of Romania. http://www.fmprc.gov.cn/mfa_eng/topics_665678/xjpdmgjxgsfwbcxlhgcl70znxlfh/t1302374.shtml.

[3]Embassy of the RPC in Romania (November 29, 2017). Five-year Outcome List of Cooperation Between China and Central and Eastern European Countries, http://ro.chineseembassy.org/rom/xw/t1515015.htm.

[4]Romanian Government (November 25, 2014). Joint Declaration by the Government of Romania and the Government of the People's Republic of China on deepening bilateral cooperation in the new circumstances. http://gov.ro/en/news/joint-declaration-by-the-government-of-romania-and-the-government-of-the-people-s-republic-of-china-on-deepening-bilateral-cooperation-in-the-new-circumstances.

Plant, the joint venture for the Rovinari Coal-Fired Power plant, as well as other projects including the Tarnița Hydropower Plant.

- In 2015, China signed interdepartmental *Memorandum of Understandings on Jointly Building the Silk Road Economic Belt with Macedonia and Romania.* In May 2015, Chinese Performing Arts delegation visited Hungary, Serbia, and Romania to purchase programs.
- Since 2015 in Beijing there is a Romanian Cultural Institute.
- The Romanian Energy Center (CRE) professional association was named at the Government meeting on September 21, 2016, through a Memorandum, as "pillar of the Centre for Dialogue and Cooperation in Energy (CDCEP) activity - the Romanian initiative within the '16 + 1' format of economic cooperation between Central and Eastern European countries and China." The Center for Dialogue and Cooperation on Energy Projects "16 + 1" (CDCEP 16 + 1) was established in October 2016, as a Romanian initiative within the "16 + 1" format, to provide a dynamic networking platform for advancing cooperation in the field of energy between the partner countries. The activity of the CDCEP "16 + 1" is coordinated by The Romanian Energy Center (CRE).
- In May 2017, Asian Infrastructure and Investment Bank (AIIB) approved Romania as a new prospective member. The China-CEE countries Political Parties Dialogue and the 3rd China-CEE countries Young Political Leaders' Forum were held in Bucharest, Romania in July 2017. Later the same year, in November, the China-CEE countries Energy Forum and Expo were held in Bucharest.[5] The Forum issued a white paper on energy cooperation dialogue and a minister's statement on conducting joint research for energy cooperation.
- In 2016 and 2017, "Martial Arts on the Silk Road" training sessions were held in Hungary, Romania, and Croatia. As for 2018, martial arts experts will be sent to Poland, Romania, and other CEE countries for "Martial Arts Silk Road" Training Camp.
- The Participants at the 7th Summit of China and CEE countries held in Sofia Bulgaria on July 7, 2018 support Romania in establishing a "16 + 1" Smart City Coordination Center.[6] Also, the participants support Romania in organizing a conference on the promotion of women entrepreneurship in 2019.
- Memorandum of cooperation in the field of transport and infrastructure between the Ministry of Transport of Romania and the National Development and Reform Commission of the People's Republic of China was signed in 2018 on the sidelines of the "16 + 1" summit taking place in Sofia. The memorandum reflects the firm common interest of the parties to deepen and diversify bilateral cooperation in two sectors that are key to economic development, such as transport and infrastructure. The document will strengthen the framework and the premises for

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[5]China Daily (November 3, 2017). Romania hosts the first Energy Ministerial Conference and Fair within the China—Central and Eastern Europe cooperation format. http://www.chinadaily.com.cn/bizchina/2017-11/03/content_34066287.htm.

[6]Embassy of The RPC of Finland (July 9, 2017). The Sofia Guidelines for Cooperation between China and Central and Eastern European Countries. http://www.chinaembassy-fi.org/eng/zxxx/t1577455.htm.

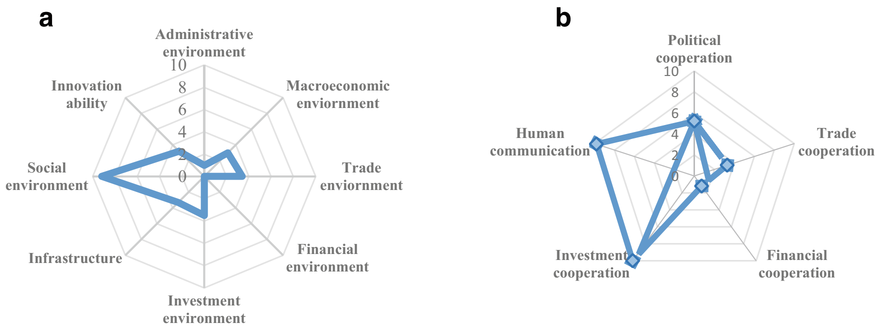

Fig. 15.1 **a** Radar chart of business environment of Romania, **b** radar chart of China–Romania bilateral cooperation. *Source* Xin and Chengyu (2017)

China's involvement in the materialization of some Romanian projects in these two areas whose development is a priority for the Romanian side.[7]
- China opened at Bucharest in 2018 the first Visa Center for China, the only one of his kind from CEE countries.

As shown in Fig. 15.1a, b, Romania is doing well in 2016 both in the business environment and bilateral cooperation (being outstanding in the field of investment and people-to-people exchange). There are still some modest areas such as the aspects of investment and financing, trade, infrastructure, innovation ability, and macroeconomy. This indicates that Romania should improve the political environment and financial environment. In addition, Romania is doing good in the field of politics and trade and the financial cooperation should be enhanced.

Education is to be found under one of the nine pillars of the "16 + 1" framework, namely, "culture-education-youth-sport-tourism." The Romanian's perspective of the cooperation in education between China and Romania, as a UE member, can be followed under the following aspects:

- Since three decades ago, Romania has recognized that there is a significant potential of cooperation with China, being one of the countries with the highest percentages of positive views on China (Oehler-Şincai et al. 2017). According to official declarations, Romanian authorities support bilateral cooperation and "One Belt, One Road" and "16 + 1" (seen as important channels of cooperation and mutual understanding). Nonetheless, this does not translate into practice through a high level of bilateral cooperation intensity. Therefore, at the educational level, Romania is *still low level of cooperation intensity with China* due to several factors, such as cultural differences (for e.g., China sees all countries in the bloc, although there are differences between CEEs countries educational systems), economic,

[7]Romanian Government (July 7, 2018). Prime Minister Viorica Dancila participates in the Summit of the China—Central and Eastern European Countries cooperation format. http://gov.ro/en/news/prime-minister-viorica-dancila-participates-in-the-summit-of-the-china-central-and-eastern-european-countries-cooperation-format#null.

regulatory (EU legislation—Romania is still sensitive at any negative signals from Brussels towards China) or lack of general knowledge and understanding of China (for e.g., only several academics know in detail the 16 + 1 mechanisms), etc.

- In spite of that, even if there have been proposed concrete measures of cooperation in the area of education and research, no large-scale project has been implemented until now, *only relative small-scale projects* (see the recent call for bilateral projects Romania–China by UEFISCDI[8]). In our opinion, it is needed a critical level of political will, understanding and trust between China and Romania in order to start significant bilateral projects. Besides, the EU legislation with all its limitations and constraints must be taken into account.
- There is a strong need for increasing awareness of the Chinese initiative in the field of higher education and its potential impact on the Romanian system.
- To focus more on Erasmus + program to facilitate student's exchanges, to increase teacher's and researcher's academic mobility, to create joint masters or research platforms, to held different conferences or other scientific events, etc.
- To *enable increased international collaboration in research and innovation.* Future collaboration between Chinese–Romanian HE institutions to be considered. There is a need to establish collaboration protocols between Romanian universities and prestigious similar institutions from China, to benefit from existing opportunities offered by such partnerships and/or networking.
- To *strengthen dialogue and cooperation* between our countries in the field of higher education/research, to develop/facilitate projects among Chinese and Romania university on key issues of collaboration such as doctoral education and training, university governance and academic leadership.

Although since 2012 all these activities have been integrated under the EU–China High Level People-to-People Dialogue (HPPD), the third pillar of EU–China relations (complementing the other two pillars—the High Level Economic and Trade Dialogue and the High Level Strategic Dialogue) there still is a need to open up space for dialogue and cooperation on a wide range of issues related to doctoral education, bringing real benefits to both Romanian and Chinese higher education institutions, policymakers, students, supervisors, employers, and relevant players.

Romania is a semi-presidential democracy based on a bicameral Parliament: the Chamber of Representatives or "Chamber of Deputies" (http://www.cameradeputatilor.ro/pls/dic/site2015.home?idl=2) and the Senate (http://www.senat.ro/). All members of the legislature are directly elected from Romania's 41 counties.

For further general information see:

- Romania in figures (NIS 2018) from National Institute of Statistics http://www.insse.ro/cms/en/tags/romania-figures
- Wikipedia: Romania, http://en.wikipedia.org/wiki/Romania

[8]Executive Unit for Financing Higher Education, Research, Development and Innovation (UEFISCDI) (2018). Mobility projects—Competition Bilateral Cooperation Romania–China. https://uefiscdi.ro/proiecte-mobilitati-pmrocn2018-141.

- POERUP project country report: Romania, http://poerup.referata.com/wiki/Romania
- Eurostat (2018). My country in a bubble, an interactive tool to compare EU countries on several indicators. https://ec.Europa.eu/eurostat/cache/BubbleChart/?lg=en#tableCode=tin00073.

15.2 Overview of the Educational Development[9]

Since the Romanian Revolution of 1989, the Romanian educational system has been in a continuous process of reform that has received mixed criticism. Romania's education system is centralized, both horizontally and vertically. All key responsibilities for education strategy, policy, and delivery are concentrated within the Ministry of National Education.[10] The 2011 Education Law[11] defined the current organization and operation of the education system and it consists of:

- The pre-university system that contains the following levels:

1. early childhood (0–6 years), consisting of the ante-preschool (0–3 years) and preschool (3–6 years);
2. primary education, including the preparatory class and grades I–IV;
3. secondary education, including:

(a) lower secondary education or secondary education, which includes classes V–IX;
(b) secondary education or secondary education?, which includes X–XII/XIII classes with the following channels: general, vocational and technological

4. vocational education lasting six months to two years;
5. pre-university tertiary education, including postsecondary education.

The pre-university education system also includes related units: "Houses of the Teaching Staff" (Teacher Training Centers), County Centers for Pedagogical and Psychological Assistance, School Inspectorates.

[9]For further general information see:
Wikipedia: Education in Romania, https://en.wikipedia.org/wiki/Education_in_Romania.
Kitchen et al. (2017), Romania 2017, OECD Publishing, http://dx.doi.org/10.1787/9789264274051-en.
MENCS (2015). State school education report in Romania, https://www.edu.ro/sites/default/files/Raport%20Stare%20invatamant%20preuniversitar%202015.pdf.
UNICEF Romania, https://www.unicef.org/romania/overview.html.
UNESCO Romania, http://www.ibe.unesco.org/en/country/romania.
EURYPEDIA Romania, https://webgate.ec.europa.eu/fpfis/mwikis/eurydice/index.php/Romania:Overview.

[10]http://www.edu.ro.

[11]http://keszei.chem.elte.hu/bologna/romania_law_of_national_education.pdf.

During 2016–2017 in Romania 3.642 million of the population were enrolled in school and 237.400 teachers (according to National Institute of Statistics), meaning one teacher for 15 pupils/students. Out of these, 95.7% were in public schools and 4.3% in private institutions: 15.2% in kindergarten (3–6 years), 47% in primary, and 18.5% in secondary level and high schools.

Kindergarten is optional between three and six years old. Since 2012, compulsory schooling starts at age six with the "preparatory school year" and is compulsory until tenth grade. Primary and secondary education is divided into 12 or 13 grades. There also exists a semi-legal, informal private tutoring system used mostly during secondary school, which has prospered during the Communist regime.

The results of the PISA assessment study in schools for the year 2012 placed Romania on the 45th rank out of 65 participant countries and in 2016 the Romanian government released statistics showing 42% of 15-year-olds are functionally illiterate in reading, though Romania often wins medals in the mathematical Olympiads and not only.

Higher education is aligned with the European Higher Education Area, the Bologna Agreement. As a result, most Bachelor's programs take three years to complete. However, some programs last longer—for example, some technical fields, medicine, and architecture. Master's programs take two years beyond the Bachelor's degree. Master's programs are a prerequisite for admission to Ph.D. programs. Ph.D. programs usually take three years to complete. Under special circumstances, the duration of the study may be extended by one or two years. Romania has a large higher education sector with 54 public universities and approximately 40 accredited private universities. Among them Alexandru Ioan Cuza University of Iași, Babeș-Bolyai University of Cluj-Napoca, University of Bucharest, and West University of Timișoara have been included in the QS World University Rankings' top 800.

According to EC (2017, 2018) Romania is reforming its primary and secondary curriculum for the first time in almost two decades. In a nutshell here are some highlights drawn out from EC (2017, 2018) (Fig. 15.2):

- Plans are underway to train teachers to teach the modernized curriculum. According to the Federation of Education Unions, Romania is the only country

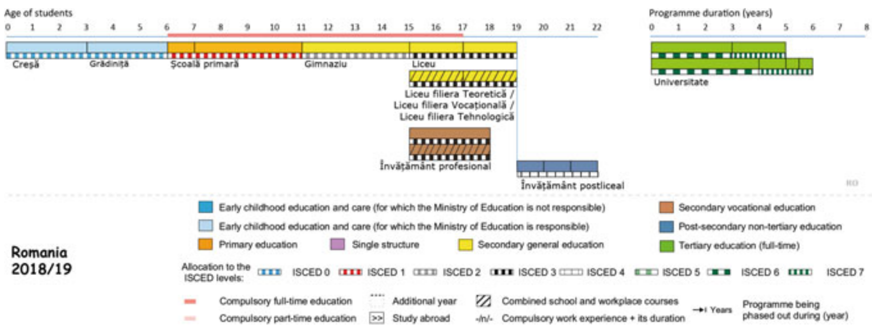

Fig. 15.2 Structure of the education system. *Source* EC (2018, p. 247)

in the European Union in which unqualified teachers are officially part of the education system—making up numbers 4500 strong in 2017. In this respect the Ministry of Education run between Nov 2017–Nov 2021, the “CRED: Relevant Curriculum, Open Education for all” project, financed by the ESF to support the ongoing curricular reform, with a total budget of EUR 42 million. The aim of the project is to facilitate the understanding of the new competence-based student-centered curriculum and modernize teaching practices. Almost 55 000 teachers and 2500 students in primary and lower secondary education will be trained in how to teach the new curriculum and how to adapt teaching to the specific needs of students, including students at risk of dropping out. The main output is to developed Open Educational Resources for classroom activities.

- Underachievement in basic skills remains one of the highest in the EU. This is due to educational factors and equity challenges. According to OECD today, 40% of Romanian 15-year-olds still lack the foundation skills they need for lifelong learning and productive employment.
- Access to quality mainstream education is particularly a challenge for students in rural areas and for Roma.
- Funding for education is very low. Romania spends the lowest amount on education in the EU at €248 per capita, compared to an EU average of €1400 per capita, which can be seen as a reflection in the funding which in turn creates a new teacher shortage. Furthermore, teachers in Romania on an average earn around €300 per month, which is around 10 times less money than some of their European counterparts.
- Early school leaving risks remaining high, with consequences for the labor market and for economic growth. According to EC (2018) Romania still has among the highest dropout rates in the EU in both primary and lower secondary education. The dropout rate at both levels has increased in the past decade.
- The labor market relevance of higher education is improving, but tertiary educational attainment is the lowest in the EU. Also there is an urgent need to adopt measures that aim to address quality and labor market relevance.
- Efforts to introduce dual vocational education and training are underway. Dual VET was launched in 2017 and it is organized at the initiative of interested companies based on a partnership contract between schools and employers and individual training contracts for students. According to EC (2018), in September 2017, 2412 students (the equivalent of 8% of students in professional schools) were enrolled in the first year of dual VET at European Qualifications Framework (EQF) level three and 106 dual classes in 68 schools were organized, in cooperation with 227 companies. The next step will be to set up the methodology for conducting entrance examinations to dual VET at EQF levels four and five.
- Adult participation in learning remains low despite the need for upskilling.
- Roma inclusion in education remains a major challenge. In this context, the 2018 European Semester country-specific recommendations call on Romania to “improve the provision of quality mainstream education, in particular for Roma and children in rural areas” (EC 2018).

Started with 2018, as mentioned in the EC (2018) Romania is preparing a strategy to modernize the entire educational infrastructure, to guide investment from national and EU funds, and address significant efficiency and equity challenges. This is related especially with the facts that in 2018 there are still huge differences from other EU countries:

- almost 10% of schools are overcrowded (particularly in urban areas), while 60% are underutilized (especially in rural areas);
- school transportation services are overall insufficient and inadequate, while accessibility worsens as student's advance through the school system;
- 38% of schools in rural areas have outside toilets, without running water or sewage (7% in urban areas) and only 20% have a library (60% in urban areas);
- several universities do not possess sufficient accommodation facilities.

Despite recent efforts, quality assurance in school, education remains largely focused on compliance and not on increasing standards (EC 2018). In his respect recent policy developments address some of the challenges around persistent inequality and low levels of acquisition of basic competencies. These include official documents as follows:

- UNESCO (2014). *Romanian Education for all*. Review Report (http://unesdoc.unesco.org/images/0023/002303/230309e.pdf).
- *Romania's national strategies developed under the Europe 2020 agenda*, which target some important systemic issues facing the education sector (https://ec.europa.eu/epale/sites/epale/files/strategia-nationala-agenda-digitala-pentru-romania-20202c-20-feb.2015.pdf).
- *The National Strategy to Reduce Early School Leaving* (https://www.edu.ro/sites/default/files/_fi%C8%99iere/Minister/2016/strategii/Anexe%20Strategie%20PTS.pdf) plans to improve the government's institutional capacity.[12]
- *The Strategy for Vocational Education and Training for 2016-2020* (https://www.edu.ro/sites/default/files/_fi%C8%99iere/Minister/2016/strategii/Strategia_VET%2027%2004%202016.pdf). The main objective of the strategy is related to contributing to the attractiveness, inclusion, quality, and relevance of vocational and technical education improved proposed measure to enhance the vocational and technical education system through reform curricula, teachers' training and management consolidation through stronger and creative links with the potential employers and the labor market.
- *Romania's Anti-Poverty Package* (https://www.edu.ro/sites/default/files/_fi%C8%99iere/Minister/2016/strategii/Pachet_integrat_pentru_combaterea_saraciei.pdf), launched in 2016, includes policies to narrow learning and attainment disparities between rural and urban areas (see *National Strategy on Social*

[12]*For further general information* see: EACEA (Last Modified On 27/08/2018). Romania. 6.3. Preventing early leaving from education and training (ELET). Available on https://eacea.ec.europa.eu/national-policies/en/content/youthwiki/63-preventing-early-leaving-education-and-training-elet-romania.

Inclusion and Poverty Reduction, http://www.mmuncii.ro/j33/images/Documente/Familie/2016/StrategyVol1EN_web.pdf).

- The Initiative of Romania President Klaus Iohannis, the country project "Educated Romania" (http://www.romaniaeducata.eu/), as the beginning of resettling Romanian society around values and the development of a culture of success based on performance, merit, work, and professionalism.

15.3 New Progress of ICT in Education

15.3.1 Digital Inclusion[13]

With the information and communications technology (ICT) sector accounting for 6% of the Romanian GDP in 2016, the country ranks fourth among 28 European Union (EU) countries with regard to these criteria, as specified by GISWatch Report (2016).

Also, Romania is ranked 10th in the world and 1st in Europe in terms of average Internet peak connection speed with 85 Mbit/s (Akamai 2016).

There were 12,082,186 internet users in Romania, representing 62.8% of the population, in mid-year 2017, according to Internet World Stats, June 2017 (http://www.internetworldstats.com/stats4.htm#europe), while five years before, the percentage was 39.2%. As specified by a study of the Romanian Institute of Statistics, in 2017, 92% of the population of 16–34 years old use computers and Internet, the percentage being 79.2 for those of 35–54 years old, and 44.8 for those over 55 years old.

Digital inclusion has been a high priority on the Romanian ICT Ministry's agenda since 2004, and is still present in the authorities' official statements and actions. An important step in facilitating equal access to ICT infrastructure was the 200 Euro Program, launched in 2004 in partnership with the Ministry of Education (http://www.edu.ro). By 2011, the program has helped 200 thousand students from low-income families purchase computers (GISWatch 2011).

Tangible results concerning digital inclusion in the country have also been achieved by the Knowledge Economy Project (2006–2013), which helped 255 communities get internet access, and supported small business development and local content creation. This effort was awarded the European Commission's Inclusion medal in 2008 in the Geographical Inclusion section.

In 2009, the Romanian Ministry of Communications and Information Society (MCSI) (https://www.comunicatii.gov.ro) adopted a Strategic Plan for 2010–2013 that set out the actions and programs for developing an efficient information

[13] *For further general information* see:
Wikipedia: Internet in Romania, http://en.wikipedia.org/wiki/Internet_in_Romania.
Romanian Institute of Statistics, http://www.insse.ro/cms/en.

society and knowledge economy, with the following directions of activity: Electronic Communications, Information Society, Structural Funds Management, and MCSI Administrative Capacity.

15.3.2 Internet and E-Learning

Developing the ICT infrastructure and internet connection for the Romanian education institutions, training teachers, developing quality online resources, and providing access to online learning spaces were the core goals of the following major programs (Holotescu 2012):

1. *SEI Programme* (System Educational Informatizat, Engl. IT-Based Educational System, http://portal.edu.ro/index.php/articles/c11/en: started in 2011, the project was implemented by the Ministry of Education in partnership with Siveco (http://siveco.ro), a company specialized in e-Learning, HP Romania, and IBM Romania, under the Romanian Government Strategy in the field of information and computer-aided education. It has equipped all the Romanian schools with 15,000 laboratories with 10–25 computers, with the latest technology and with internet connection, trained teachers and developed digital lessons. In 2012 the number of students per school computer was 4.6, better than the worldwide average value (OECD 2015).

SEI covers the following major activities in the education sector:

- Education. AeL (from Advanced eLearning) is the core of the SEI program, offering support for teaching and learning, testing and evaluation, content management, and training programs for more than 140,000 teachers; the program is meant to integrate the use of ICT in daily school practice, improving the teaching/learning process;
- School management and educational resources management;
- IT support for national exams—admission to colleges and professional schools (ADLIC), Baccalaureate;
- Creating National Education Database;
- Communication and collaboration—national education portal, http://www.portal.edu.ro—forums, newsletters, training sessions, educational initiatives.

Users and beneficiaries (four million) are situated at all levels of the education system: local, regional, and national level, being teachers, students, parents, managers, operators, policymakers, and the general public.

2. *RoEduNet* (Romanian National Research and Education Network—http://www.roedu.net): was initiated in 1993 and represents the Romania's research and education (R&E) network, that connects universities, schools, research centers, and cultural institutions across the country.

3. *Knowledge Economy Project (KEP)* (http://www.ecomunitate.ro/en/proiect): KEP was implemented by the Ministry of Communication and Informational Society between 2005 and 2013, and founded by the World Bank. The Ministry of Education, Research, Youth and Sport was a partner in this program, that has three components:
   - Expanded access to Information and Communication Technologies and improved digital literacy
   - Development and promotion of government e-services
   - Promotion of e-commerce and innovation support for SMEs.
   - During the KEP implementation, the access to knowledge was enabled for 255 rural/disadvantaged communities from 38 counties, addressing to over 1,8 million people (8% of Romania's population). The schools of these communities are the beneficiaries of ICT infrastructure, training of teachers, and inclusion of new technologies in education.
4. INSAM System (http://oldsite.edu.ro/index.php/articles/c924/): provides digital tools to improve quality assessment in the pre-university system, being a project implemented by the Ministry of Education and its partner Softwin (http://softwin.ro), a company specialized in e-Learning.

The system is based on specific digital resources (assessment items, standards, and performance descriptors) needed to improve evaluative processes and self-assessment of high school students, providing an Evaluation Guide for specific curricular area, progress reports and statistics, and discussions forum.

15.3.3 Open Education and Open Educational Resources

Romania is active in the open education movement mainly through the Open Educational Resources (OERs) and Open Educational Practices (OEPs) initiatives carried out by institutions, groups, communities and engaged individuals, and through specific projects or programs, in the following directions (Holotescu 2012; Holotescu and Pepler 2014):

- proposals at government level related to OER and Web2.0, which may become driving forces—but only a few of them appear in formal policies: in 2007, the Knowledge-based Economy Project (KEP) has formulated proposals related to OER (Holotescu 2007);
- the National Strategy on Digital Agenda for Romania 2020 (February 2015) considers the usage of OER and Web 2.0 in a formal and lifelong learning education as strategic lines of development for ICT in education (https://www.comunicatii.gov.ro/agenda-digitala-pentru-romania-2020/); the government program mentions the implementation of an e-learning platform and online repositories (http://gov.ro/ro/obiective/programul-de-guvernare-2017-2020);

- since the autumn of 2014, digital textbooks for pre-university education are freely available for download from a section of the Ministry of Education site (http://manuale.edu.ro); however the e-books are not published under open licenses and do not use open formats; also a project to implement an e-learning platform and online repositories for OERs was launched (http://edu.ro/rețea-de-resurse-educaționale-deschise-la-nivelul-inspectoratelor-școlare-județene);
- the Romanian Coalition for OER was launched in October 2013, gathering persons and organizations that support and promote the concepts of open access and OER (http://educatiedeschisa.ro); the coalition has published guides, has organized workshops and five National Conferences for Open Education, and formulated concrete OE-related proposals for the govern (http://www.inovarepublica.ro/educatie-deschisa-romania);
- the Educated Romania (2016–2019) is a project of the Romanian Presidency, conducting a broad public debate on education and research for a set of policies (http://www.romaniaeducata.eu);
- Relevant Curriculum and Open Education for All (http://www.ise.ro/cred) (2017–2021) is a project of the Ministry of Education and Institute of Education, which will train 18,000 teachers and will produce OERs (http://digital.educred.ro);
- open courses and webinars for teacher training in using OER and educational technologies: http://iteach.ro, http://suntprofesor.ro, http://oerup.eu, http://superteach.ro;
- directories and projects for open resources—http://forum.portal.edu.ro, http://dascali.ro, http://educatie.inmures.ro, https://kidibot.ro, http://digitaliada.ro, https://dacobots.com, http://livresq.com, http://digitaledu.ro, http://scoaladinvaliza.ro, http://doi.org/indreptardigital, https://www.mykoolio.com, https://asq.ro;
- open journals related to open education—http://iteach.ro/experientedidactice, http://www.elearning.ro;
- strong communities/events for open source, open access, open data, open licenses (the Creative Commons Romania version was launched on September 2, 2008, with the help of ApTI—Association for Technology and Internet, http://apti.ro/).

In the following we mention several ongoing institutional and inter-institutional MOOC initiatives, open for students and teachers training at all levels (Holotescu et al. 2014; Holotescu et al. 2016):

Platforms and MOOCs implemented by academic institutions:

- *UniCampus* (http://unicampus.ro): started in April 2014 by University Politehnica of Timisoara and Association of Technical Universities from Romania (rouni.ro), Unicampus offers MOOCs on a version of Moodle platform based on cMOOCs methodology;
- *NOVAMOOC* (http://novamooc.uvt.ro): development and innovative implementation of MOOCs in Higher Education, West University of Timisoara, WUT during 2015–2017. WUT offers its first MOOC on the Teachable Platform, Practicing English with Technology, https://west-university-timisoara.teachable.com/p/pet.

- *UniBuc Virtual* (http://www.unibuc-virtual.net): Credis—Department of Distance Learning from Bucharest University developed and ran three MOOCs for Teachers Training on a Google Apps-based platform;
- *Platforms and MOOCs implemented by companies and NGOs*:
- MOOC.ro (http://mooc.ro): developed by Moodle.ro, currently offers two MOOCs about Moodle and Articulate;
- *eStudent* (http://estudent.ro): MOOCs on psychology, communication, business, geography, and Romanian language developed by APIO, CTRL-D, and experts;
- *Startarium* (http://startarium.ro): platform nurturing an entrepreneurship ecosystem, which was implemented by a group of organizations and experts; the platform offers MOOCs, mentoring and crowdfunding for around 8,000 potential entrepreneurs who design and develop their start-up plans using the platform features;
- *Scientific events related to open education*:
- *Workshops and national conferences* organized by the Romanian Coalition for OER;
- *Workshops* organized by the Politehnica University of Timisoara during the Open Education Week (http://elearning.upt.ro);
- Since 2014, the International Conference eLSE has a special section dedicated to OER and MOOCs, co-chaired by the authors, now at 4th edition (http://elseconference.eu/pages/view?page=open_education_open_online_courses);
- The SMART Conference co-organized by the authors since 2013 is focused on open education too (http://academia.edusoft.ro/category/conferences);

The number of initiatives is not so large, but one can note the diversity of projects and the involved organizations in open education. MOOCs offered are free, contributing to institutions visibility and learning flexibility, and not yet generating income.

All represent institutional and individual projects, MOOCs not being mentioned yet in governmental documents.

The *drivers* for developing Open Education projects are:

- researchers and teaching staff, seldom the policymakers and managers of the institutions;
- companies and associations.
- The *main barriers* in the Open Education development and adoption could be considered:
- rigid policies in formal education related to curricular systems and assessment practices;
- the lack of possibility to officially accredit online courses, in spite of an impressive number of projects related to online courses over the last 15 years, and of the policy proposals coming from different organizations. Such courses can only be used in a blended approach in formal education;
- the lack of OE/OER/MOOC—related strategies at the national level in formal and continuing education;

- teachers' lack of time and interest to explore, understand, evaluate, and use new technologies, OERs, and MOOCs in the teaching–learning process;
- a reduced number of training programs for adopting open educational practices;
- lack of incentives, official recognition, and promotion for teachers implementing open educational practices.

More insights into e-Learning and Educational informationalization in Romanian could be found in the studies published by Marga (2002), Istrate (2007), Vlada (2009), Vlada et al. (2009), EC (2016), Goldbach and Hamza-Lup (2017) and EC 92017 and EC (2018).

The Romanian achievements related to Open Education were summarized in the EU OpenEdu study of Inamorato dos Santos et al. (2017). Also a recent article found that Romania is the fourth most productive country in OER-related studies, while the authors of this report are ranked to a top of researchers worldwide (Wang et al. 2017).

15.4 Policy and Strategy of ICT

Romanian has a "National Strategy on Digital Agenda for Romania" (2014–2020),[14] directly targets the ICT sector. The document takes over and adapts to the situation of the country and the elements of the Digital Agenda for Europe (Digital Single Market). The National Strategy on Digital Agenda defines the major role that the use of ICT will have to play in meeting the Europe 2020 objectives. The aims are to contribute to economic growth and to increase competitiveness in Romania, both by direct action and support of the development of effective Romanian ICT and through indirect actions such as increasing efficiency and reducing public sector costs in Romania.

Thus, there were set four areas of action, as follows:

- *eGovernment,*[15] *Interoperability, Cyber Security, Cloud Computing, Open Data,*[16] *Big Data and Social Media*—field which aims to increase efficiency and reduce costs in the public sector in Romania by modernizing the administration (an estimated impact on the Romanian economy of about 5% of GDP growth and 1% in terms of jobs);
- *ICT in Education, Health, Culture and eInclusion*—field which aims to support these technologies at the sectoral level (ICT investments to create a positive impact in the social context);

[14] Available at: https://www.trusted.ro/wp-content/uploads/2014/09/Digital-Agenda-Strategy-for-Romania-8-september-2014.pdf.

[15] *For further general information* see the Report *eGovernment in Romania* (2018). Available at https://joinup.ec.europa.eu/sites/default/files/inline-files/eGovernment_in_Romania_2018_0.pdf.

[16] See the National Action Plan 2018–2020, *Open Government Partnership*, available at http://ogp.gov.ro/wp-content/uploads/2018/11/Romania-2018-2020_NAP_EN.pdf.

- *eCommerce, Research and Development and Innovation in ICT*—field which aims at regional comparative advantages of Romania, and backs growth in the private sector (an estimated impact on the Romanian economy of approximately 3% increase at the GDP level and 2% in terms of jobs);
- *Broadband and digital infrastructure services*—field which aims at ensuring social inclusion field (an estimated impact is a GDP growth by 13%, increasing the number of jobs by 11% and reduce administration costs by 12% during 2014–2020).
- The strategy also establishes the following indicators for 2020:
- At least 35% of people use e-government systems;
- At least 60% of citizens use the Internet regularly;
- At least 30% of citizens make purchases online;
- Coverage with broadband communication networks (over 30 Mbps) of minimum 80%.

In terms of economics, full implementation of the strategic vision of the ICT sector in Romania will result in a total investment of around 2.4 billion euro.

Overall, concrete measures set out in the Strategy will lead to:

- Ensuring access to electronic public services for citizens and organizations;
- Improving access to the Internet by increasing the coverage of high-speed electronic broadband communications networks;
- Increased use of the Internet;
- E-commerce promotion;
- Increasing the number of cross-border electronic public services;
- Enhancing digital content and the development of ICT infrastructure in education, health, and culture;
- Supporting the growth of the ICT sector added value by supporting research, development, and innovation in the field.

At the recent Central and Eastern Europe Innovation Roundtable event (January 21, 2019), organized in Warsaw, the Secretary of the State with the Ministry of Communications and Information Society (MCSI), Mr. Ionut-Valeriu Andrei, said that "the development of the IT sector is one of the Romanian government's priorities." The focus will be placed on the implementation of 5G technologies, cloud services, Internet of Things (IoT), and Artificial Intelligence (AI). Moreover, in the context of Romania's holding the Presidency of the Council of the EU, the Romanian official invited the attendees to participate in the Digital Assembly 2019, an event organized in partnership with the European Commission and MCSI, which will take place in June (13–14) in Bucharest. It is expected to bring together high-level representatives and stakeholders from EU member states to discuss European digital policies and the implications of the latest technological developments.[17]

[17] *For further general information* see: The rise of Digital Challengers-How digitization can become the next growth engine for Central and Eastern Europe-Perspective on Romania. Report available at: https://digitalchallengers.mckinsey.com/files/Rise-of-Digital-Challengers_Perspective-on-Romania.pdf.

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Chapter 16
Report on ICT in Education in the Republic of Serbia

Ugljesa Marjanovic, Danijela Scepanovic, Nikola Zivlak, and Bojan Lalic

Abbreviations

EU	European Union
GDP	Gross Domestic Product
ECTS	European Credit Transfer System
CPD	Continuing Professional Development
ICT	Information and Communication Technologies
PISA	Programme for International Student Assessment
OECD	Organisation for Economic Co-operation and Development
ETF	European Training Foundation
DOL	Distance and Online Learning
SELFIE	Self-assessment tool for digitally capable schools

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16.1 Overview of the Country

16.1.1 History and Population

Located in South Eastern Europe, Republic of Serbia, as the Belt and Road Initiative country, is on its path toward European Union (EU). Formation of the first Serbian country happened under the rule of Nemanjić dynasty in the twelfthth century (Serbia.com, 2017). Today, Serbia is considered a developing country with 59% urban population with 62.8% of households who have Internet access (Stefanovic, Marjanovic, Delić, Culibrk, & Lalic, 2016). Population statistics come from decennial censuses, which count the entire Serbian population every ten years. Based on the last census (Statistical Office of the Republic of Serbia, 2017), the Republic of Serbia have more than 7 million citizens of whom 51.31% are female. Serbia has a comparatively old overall population (among the 10 oldest in the world), with the average age of 42.2 years (Statistical Office of the Republic of Serbia, 2017). Table 16.1 shows population characteristics.

16.1.2 Current Situation of Economic Development

According to the World Bank (2017) data, Serbia is considered as an upper-middle-income country with an average monthly net income of RSD 45,000 or $415, which is considered one of the lowest in Europe. The economy of Serbia is a service-based economy with the tertiary sector accounting for two-thirds of total Gross Domestic Product (GDP) and functions on the principles of the free market. The strongest sectors in the economy are energy, automotive industry, machinery, mining, and agriculture. Figure 16.1 shows the GDP per capita.

Table 16.1 Population in Republic of Serbia (Statistical Office of the Republic of Serbia, 2017)

	Total	Percentage
Population	7,186,862	100
Urban	4,271,872	59.44
Suburban	2,914,990	40.56
Gender		
Male	3,499,176	48.69
Female	3,687,686	51.31
Age		
0–14	1,025,278	14.27
15–64	4,911,268	68.34
65 and older	1,250,316	17.40
Average age	42.2	–

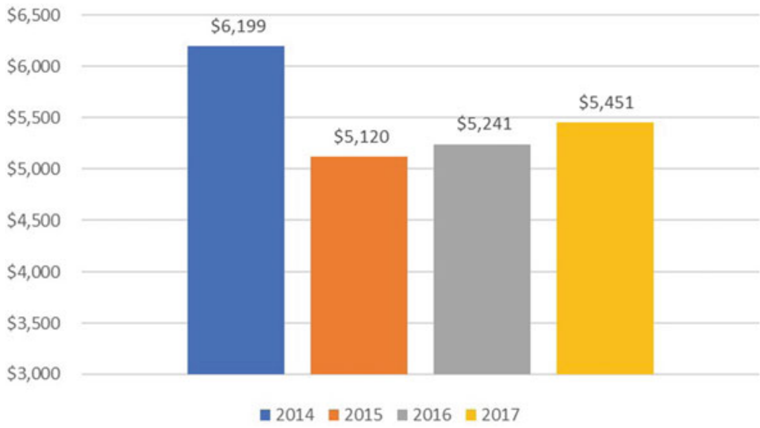

Fig. 16.1 GDP per capita – Republic of Serbia (World Bank, 2017)

16.1.3 The Political System

The Serbian political system is based on the principle of separation of authority between the executive, legislative, and judicial (Serbia.com, 2017). The holder of legislative authority is the National Assembly, and holder of the executive authority is the Government of the Republic of Serbia. The current president of the Republic of Serbia is Aleksandar Vučić.

One of the major documents 'Strategy for Education Development in Serbia 2020' is emphasizing the importance of Educational Development and sets out Serbian objectives of long-term development of education (Ministry of Education Sciences and Technological Development, 2012). Objectives are:

- raising the quality of the process and the outcomes of the education to the highest attainable level,
- increasing the coverage of the Serbian population on all levels of education,
- reaching and maintaining the relevance of education, and
- increasing the efficiency of the use of educational resources.

16.1.4 The Relationship with China Under the "16 + 1" Cooperation Framework

China is playing an increasingly active role in Serbia, part of its expansion in Central and Eastern Europe through its "16 + 1" mechanism One Belt One Road. Trade between China and Serbia tripled between 2005 and 2016, to $1.6 billion. Investments are rising because the Serbian government can move quickly as a non-EU member. Chinese companies are also actively building infrastructures. For instance, the Zemun-Borca Bridge, built by the China Road and Bridge Corporation (CRBC), using Chinese materials for 50% of the construction. The CRBC is also involved in building the Surcin-Obrenovac section of highway E793, which leads to a "China-Serbia industrial park". During the summer of 2018, it was also announced that a Chinese company, Shandong Linglong, would be investing $1 billion investment in a new tire company from April 2019 in Serbia's Zrenjanin Free Trade Zone, with a completion date of March 2025. A deal was also reached about China supplying military drones to Serbia, which will be producing some of the drone systems in the future.

16.2 Overview of the Educational Development

16.2.1 Education System and Policy

The structure of Serbia's compulsory schooling consists of four different levels—pre-school, primary, secondary, and higher education (Table 16.2) (Center for Education Policy, 2015).

Table 16.2 Education system in Serbia (Center for Education Policy, 2015)

<table>
<tr><th>Education level</th><th colspan="4">Structure</th></tr>
<tr><td rowspan="3">Higher</td><td>III cycle</td><td colspan="3">PhD students (180 ECTS)</td></tr>
<tr><td>II cycle</td><td>Graduate academic studies (60–120 ECTS)
Master professional studies (120 ECTS)</td><td>Specialist academic studies (60 ECTS)</td><td>Specialist professional studies (60 ECTS)</td></tr>
<tr><td>I cycle</td><td>Basic academic studies (180–240 ECTS)</td><td colspan="2">Basic professional studies (180 ECTS)</td></tr>
<tr><td rowspan="2">Secondary</td><td colspan="4">Secondary four-year education
(secondary vocational schools and grammar schools)</td></tr>
<tr><td colspan="4">Secondary three-year education
(secondary vocational schools)</td></tr>
<tr><td rowspan="2">Primary (compulsory)</td><td colspan="2">Grades 5–8
(different subject teachers)</td><td colspan="2" rowspan="2">Total duration: eight years</td></tr>
<tr><td colspan="2">Grades 1–4
(one general teacher)</td></tr>
<tr><td>Pre-school</td><td colspan="4">Preschool preparatory program (min. six months)</td></tr>
</table>

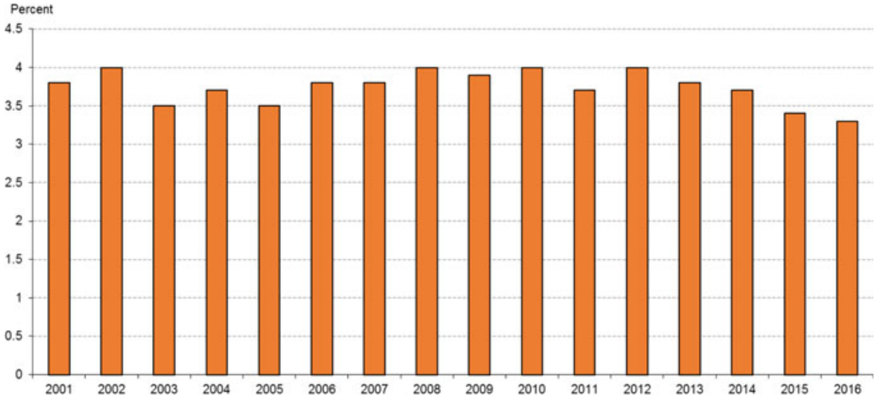

Fig. 16.2 Public expenditure on education as a percentage of GDP—Republic of Serbia (Ministry of Finance, 2018)

16.2.2 Enrollment Rate

According to data from the Statistical Office of the Republic of Serbia (2019) for the 2016/17 school year, 544,632 pupils were enrolled in primary schools, with an equal representation of boys and girls. Secondary schools enroll students who have completed compulsory primary education. In the 2016/17 school year, 250,011 pupils were enrolled in secondary vocational schools, with an equal representation of boys and girls (Vucicevic, 2019). At the tertiary level, 262,108 students were enrolled in the 2016/2017 school year (Vucicevic, 2019).

16.2.3 Government Expenditure on Education

In 2016, Serbia spent 3.3% of GDP on education (Ministry of Finance, 2018). In the previous 15 years the figures varied from 3.3 to 4.0%. Figure 16.2 depicts the data for all years. The distribution of expenditure in 2016 was as follows: 2.9% on pre-school, 45.3% on primary, 22.9% on secondary, and 28.9% on tertiary education (World Bank, 2017). If willing to get closer to the European Union, Serbia will need to continue structural reforms, accommodative monetary policies, and increased public spending on education, technology, and innovation.

16.2.4 Teachers' Professional Development

Continuing Professional Development (CPD) of teachers is a legal obligation in primary and secondary education (Maksimovic, 2016). The competences related to the professional development of teachers and the process of quality assessment are defined by the law. The funds for CPD are defined within the budget of the Republic of Serbia and within the budget of local self-government units, while the exact amount for each school is calculated based on the Professional Instruction for Class Formation and Mode of Financing in Primary and Secondary Schools (Maksimovic, 2016). CPD is planned in accordance with the needs and priorities of education, with the priority areas identified by the Minister of Education, Science and Technological Development, and on the basis of an overview of the developmental levels of all the competences required in the teaching profession (Maksimovic, 2016). The document Competence Standards for the Teaching Profession and Teachers' Professional Development (National Education Council of the Republic of Serbia, 2011), intended for all teachers, define teachers' competences. The CPD programs accredited by the Institute for the Advancement of Education are classified according to these competences in the relevant program catalog (each program needs to develop one of the listed competence groups). This document is intended to serve as a guideline for teachers' self-assessment, for the creation of CPD plans at the school level, and for the improvement of the teachers' CPD practice.

In the introductory provisions of the Standards of Competence for the profession of teachers and their professional development (National Education Council of the Republic of Serbia, 2011), it is stated that teachers should apply ICT in teaching. The standards for the application of ICT in teaching additionally define the provisions within the framework of the competence for the teaching field, subject, and teaching methodology:

- Knowledge—knows the technologies that follow the discipline and the subject taught;
- Planning—planning information on new trends and applying appropriate and available technologies in education;
- Realization—applies appropriate and accessible technologies in education;
- Improvement—continuously professional improvement in the field of scientific discipline to which the subject belongs, teaching methods and educational technology.

16.2.5 Education Research

In 2017, there were 280 research and development organizations in Serbia employing 22,782 researchers (Vucicevic, 2019). Scientists in those organizations published 10,093 research papers. The expenditure of all research projects in 2017 was around $400 million. Around 43% were financed from the state budget.

16.3 New Progress of ICT in Education

16.3.1 Infrastructure

Report from the Ministry of education sciences and technological development (Ministry of Education Sciences and Technological Development, 2017b) found that, when it comes to electronic systems for communication and information, almost every primary and secondary school in Serbia has an email address, 88% of schools have a website, 15% of schools have an electronic magazine, 12% of schools have a school blog, 8% of schools have an electronic grade book, and only 6% of the schools have a learning management system. In the higher education ecosystem, all universities have website, internet access, and an email address.

Through the "Digital School" project, which was launched by the Ministry in charge of telecommunications and information systems in 2011, about 95% of all primary schools (2808) obtained a computer-equipped classroom (Ministry of Education Sciences and Technological Development, 2012). Even though Serbia had invested heavily in IT equipment, it is still lacking behind. Based on results from PISA 2012 (OECD, 2015), in Serbia mean number of 15-year-old students per school computers is 8.76 compared to OECD average of 4.66 (Fig. 16.3).

On the other hand, the same report found that 82% of 15-year-old students are using computers at school (Fig. 16.4). This is slightly above OECD average of 71.8%. In Serbia, 95.7% of 15-year-old students have at least one computer at home and 73.5% also have an internet connection (Brolpito, Lightfoot, Radisic, & Scepanovic, 2016).

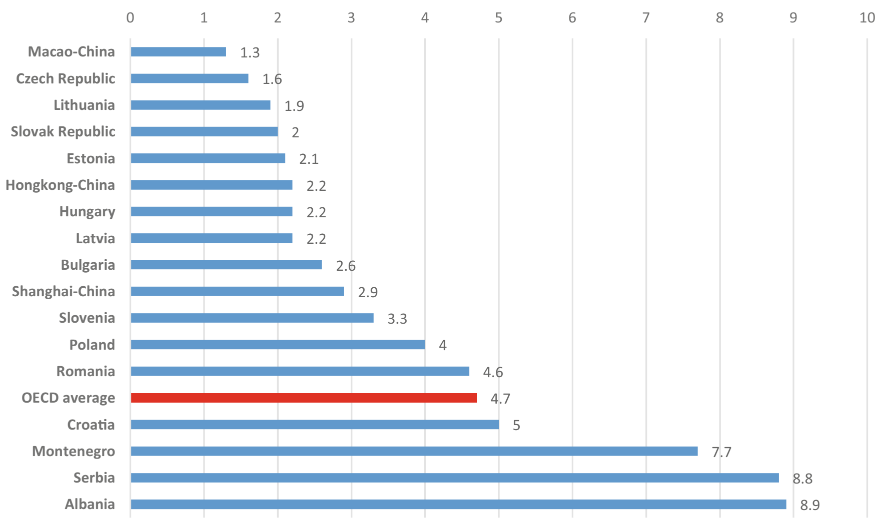

Fig. 16.3 Students per school computers (OECD, 2015)

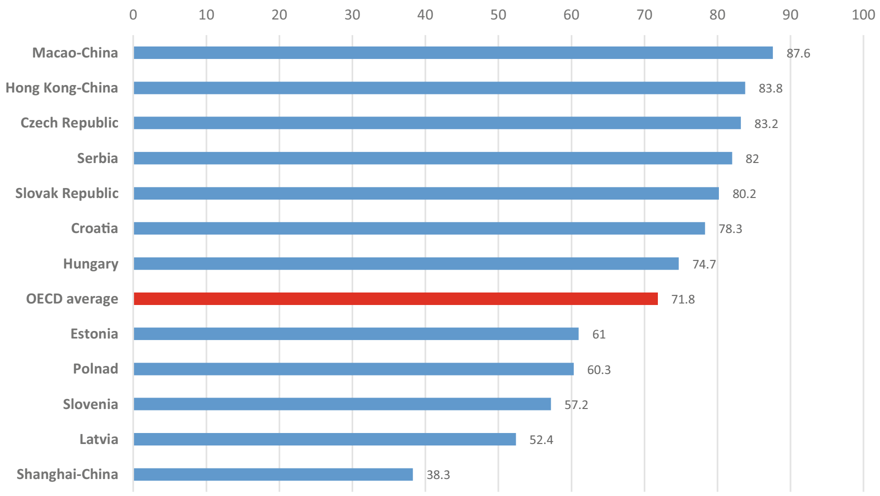

Fig. 16.4 Students using computers at school, % (OECD, 2015)

Based on results from the unpublished report (Ministry of Education Sciences and Technological Development, 2017b), only 21% of all primary schools have computers younger than 3 years old (Fig. 16.5). Most of the primary schools in Serbia have computers between 3 and 8 years old (68.08%). Around 95% of all primary schools have internet access, but only half (48.86%) of them have wireless network (Ministry of Education Sciences and Technological Development, 2017b).

The school equipment at the secondary education institutions is very different and varies. Research about ICT use in schools (Dzigurski, Simic, Markovic, &

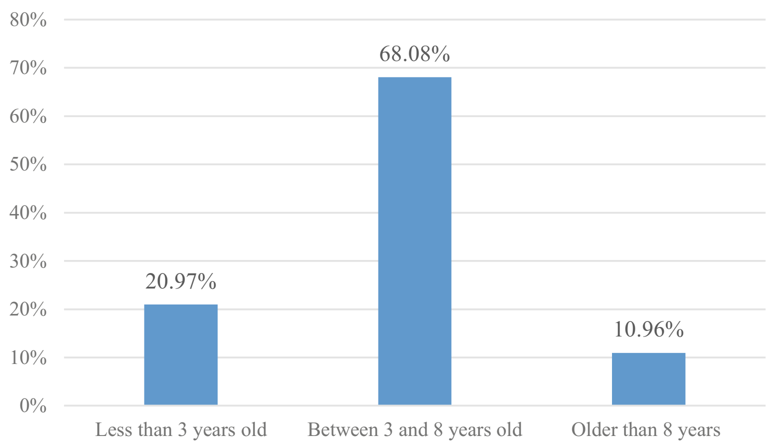

Fig. 16.5 Age of computers in primary schools in Serbia, % (Ministry of Education Sciences and Technological Development, 2017b)

Scepanovic, 2013) found that following factors influence the scope of ICT equipment in the secondary schools:

- the profile and size of the school;
- the level of economic development of the municipality in which it is located;
- participation in development projects;
- willingness of employees and parents to invest in equipment, etc.

Figures from the Ministry report (Ministry of Education Sciences and Technological Development, 2017b) show that age of computers in secondary schools are slightly better in comparison to the primary schools (Fig. 16.6). Around 40 and 30% of secondary vocational schools and grammar schools, respectively, have computers younger than 3 years old. On the other hand, 27.41% of all grammar schools have computers older than 8 years. Figure 16.6 depicts the age distribution of all computers in secondary schools in Serbia.

Almost all secondary schools in Serbia have access to the internet (Fig. 16.7). Wireless network exists in 60% of all secondary vocational schools and in 54% of all grammar schools in Serbia (Ministry of Education Sciences and Technological Development, 2017b).

Based on the ETF report (Brolpito et al., 2016), most of the secondary vocational schools are lacking a reliable and regular funding mechanism for the maintenance, renewal, and upgrading of the existing equipment for digital and online learning. Human resources (i.e. administrative personnel) is the major challenge for most of the schools (e.g. in most cases a single computer science teacher is responsible for maintenance and troubleshooting). The positive side is that 88% of secondary schools have their own website (Ministry of Education Sciences and Technological

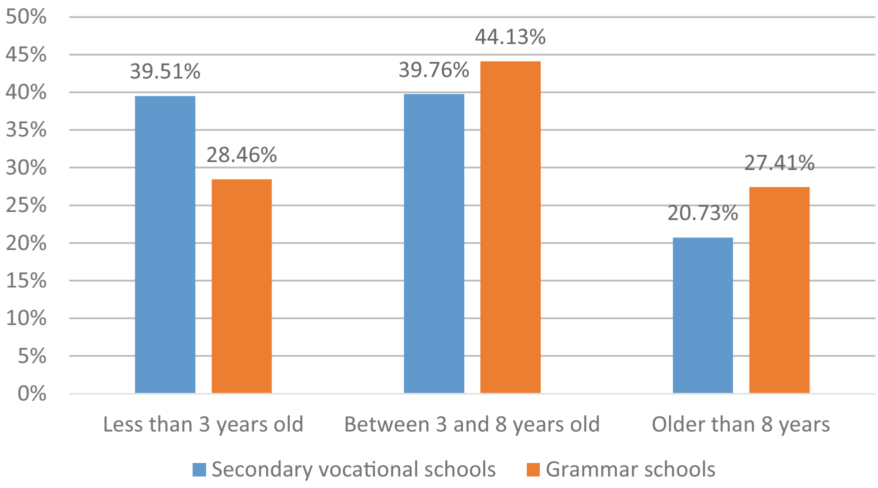

Fig. 16.6 Age of computers in secondary schools in Serbia, % (Ministry of Education Sciences and Technological Development, 2017b)

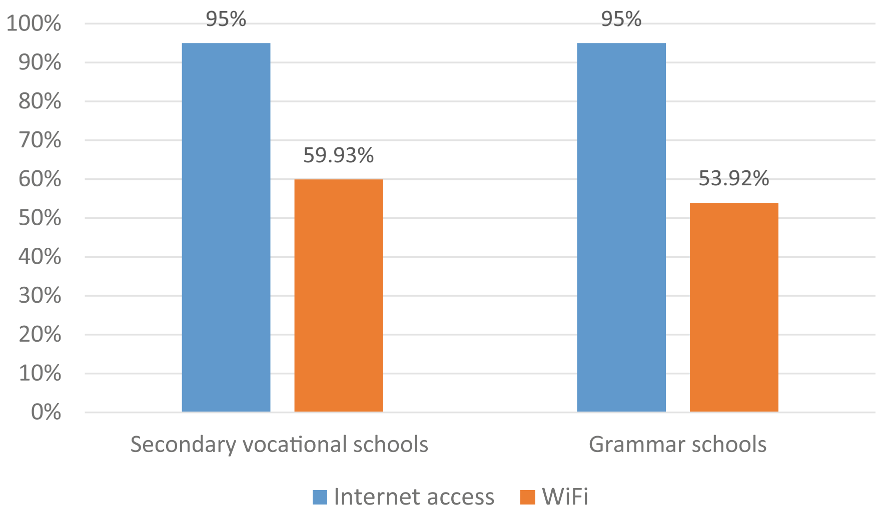

Fig. 16.7 Internet access in secondary schools in Serbia, % (Ministry of Education Sciences and Technological Development, 2017b)

Development, 2017b) and at least one computer classroom (Dzigurski et al., 2013). The format and functionalities of the website are not standardized. Only 6% of the schools are using online learning management platforms (Ministry of Education Sciences and Technological Development, 2017b).

16.3.2 ICT Integration into Practices

Maksimovic (2016) found that current CPD needs of teachers are in: new technologies in workplace (65% assess that there is a moderate or high level of need, with 37% stating moderate, and 28% high level of need), and ICT (56% in total, with 41% stating moderate, and 15% high level of need). In primary and secondary education, one third of teachers are proficient and continuously use DOL, about one third recognize the importance of DOL but have limited skills, while the remaining third are ambivalent or refuse to try out such practices (Dzigurski et al., 2013). Based on the report (Dzigurski et al., 2013), the average competencies of teachers in primary and secondary education are reflected through following ICT skills: text editing program, e-mail correspondence, and internet search. Internal training and individual accredited seminars for continuous professional development are highly ranked among opportunities for acquiring ICT competences. Special emphasis is placed on the need for competences necessary for the development of digital teaching materials, the use of equipment and use of specific computer software. Figure 16.8 depicts the

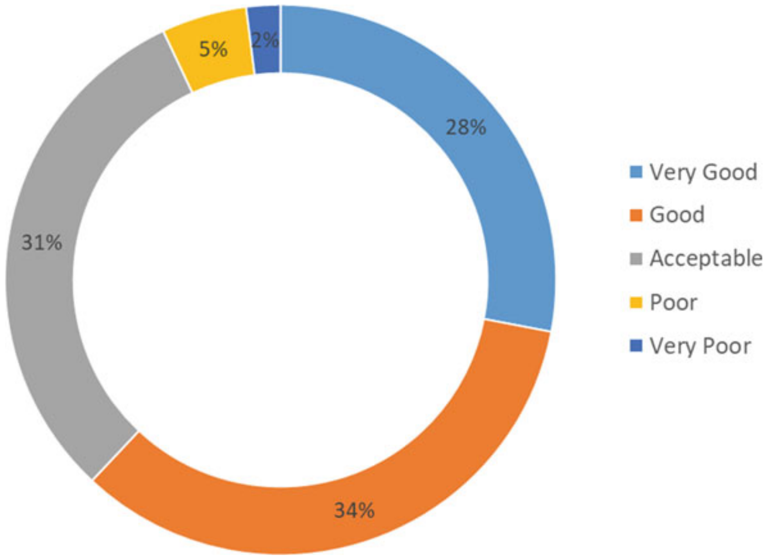

Fig. 16.8 Self-reported ICT skills of teachers (Dzigurski et al., 2013)

results of self-reported ICT skills of teachers in the primary and secondary education. Based on the results, the teachers on average perceived their ICT skills as good.

16.3.3 Educational Resources

Educational resources in Serbia are mainly presented through Virtual Networks to Support the Professional Development of Teachers in Serbia. Research conducted by European Training Foundation (Marjanovic, 2017) found that for primary and secondary education in Serbia, the most common sources for Open educational resources are following websites:

- kreativnaskola.rs
- klikdoznanja.edu.rs
- digitalnaskola.rs
- vebciklopedija.weebly.com
- rs.wikimedija.org
- obrazovanje.vojvodina.gov.rs
- arhiva.nara.ac.rs
- moodle.mpn.gov.rs.

16.3.4 Learning and Teaching

For example, Digital Class initiative is a part of the Digital School project. It presents the competition for teachers of primary schools who successfully use information and communication technologies in teaching and who are creative at work. The aim of the competition is to encourage the effective and diverse use of information technology in the teaching process. The scope of the competition is the project that contains the presentation of the teaching unit, which is realized in the curriculum of one to four school hours, which shows the use of information technologies as a teaching tool. Used information technologies must be applicable in teaching and in line with tasks and goals of curricula.

A study conducted in Serbian primary schools found that a student in the classroom enriched by the educational computer software is more responsible for his own learning, uses a variety of resources, has a constant feedback and strives for higher achievements (Jocic, Vasic, Andjelic, Tesic, & Vidojevic, 2017). Systematic and continuous training of teachers is a prerequisite for good teaching. Authors argued that the students have generally positive stance on the use of computers and tablets in the classroom and that a large number of teachers apply ICT devices in the classroom (Jocic et al., 2017).

Strategy for Education Development in Serbia 2020 was firstly introduced in 2012. Since then it had major impact on Educational informationalization. First key impact was achieved in 2013 with *The Guidelines for Advancing the Integration of Information-Communication Technologies in Education.* It is the second most important educational document in Serbia relevant for ICT use in education, after the Strategy. The given recommendations aim to direct and harmonize future activities to achieve efficient integration of ICT in the education system, seen broadly and particularly, in the teaching practice.

In 2016, Serbia joined EU Open Method of Coordination, a cooperation mechanism among the Member States of the EU, in education through thematic working groups focused on six topics including digital and online learning. In the same year, Serbia started to use the Self-assessment tool for digitally capable schools (SELFIE) (European Commission, 2017). SELFIE is a sound, reliable and validated self-assessment tool to help primary and secondary schools' progress toward digital age learning. It is based on the Digitally-Competent Educational Organizations (DigCompOrg) conceptual framework that offers a fine-grained description of what it takes to educational organizations of any kind to be digitally competent.

16.4 Policy and Strategy of ICT

16.4.1 Policies Related Educational Informationalization

In recent years, Serbia has developed different ICT-related policies to educational informationalization:

1. *The Education Development Strategy for Serbia until 2020* (Ministry of Education Sciences and Technological Development, 2012). This document is unyieldingly underlining the use of electronic and distance learning in all levels of education, from pre-school across higher up until lifelong learning.
2. *The Guidelines for Advancing the Integration of Information-Communication Technologies in Education*—document based on the result of research implemented in several stages and levels, during 2012 (National Education Council of the Republic of Serbia, 2013). The document presents abundance of quantitative and qualitative data that reflect the current level of development and the application of ICT within the system of elementary and secondary education system in Serbia.
3. *Digital Competence Framework—Teacher for a Digital Age*—policy instrument recognizing the importance and role of new technologies for improving the educational system and Guidelines for improving the role of ICT in education (Ministry of Education Sciences and Technological Development, 2017a).

Major impact of all the ICT-related polices flourished in 2017. Course of Informatics and Programming was introduced in primary education at the fifth grade. This presents a breakthrough for Serbian educational system from the perspective of informationalization.

16.4.2 ICT Financing Resource

The major financing resources for ICT in education come from the Ministry of education, science and technological development funds and European Union funds. Within the Sector for Digitalization in education and science at the Ministry of education, science and technological development, there are three groups responsible for program development and funding: (1) Group for e-Education, (2) Group for e-Science, and (3) Group for Digitalization in Education (Ministry of Education Sciences and Technological Development, 2019). The e-Education Group carries out tasks related to planning, organizing, programming, monitoring, achieving, and evaluating the digitization processes in the systems and portals of e-Education. This Group is responsible for proposing new programs and providing financial resources for the projects related to the improvement of overall e-Education ecosystem. The e-Science Group carries out tasks related to e-Science portals. e-Science portals are accountable for data collection and analytical process related to scientific research and innovation activity. In addition, this Group is proposing new programs and funding opportunities for scientist, researchers, and academics interested in digitalization of science and higher education. For instance, the Ministry of education, science and technological development is currently implementing program for development of higher education through increasing the use of information technology in teaching and learning process (Ministry of Education Sciences and Technological Development, 2019).

The Digitalization in Education Group performs following tasks:

- planning, monitoring, development, and implementation of digitization in the field of education;
- support for all categories of users and consulting services after the implementation of services, portals, information systems, registers, and other software solutions that are developed in the field of digitization in education;
- technical support to information technology users and planning, organization, and realization of regular IT courses, promotion of customer service and evaluation of ICT use in education;
- planning, monitoring, development of implementation of education in the field of ICT, and the application of ICT in education;
- analysis of national needs and strategies in the field of integration of information and communication technologies into the education system;
- preparation of expert bases in drafting laws and by-laws in the field of ICT application in education;
- participation in the preparation of legal acts in the field of ICT application in education;
- analysis, planning, development, and monitoring of training, and training of teachers and professional associates in the field of raising the level of digital competences and the application of ICT in education;
- development of electronic teaching materials bases;
- preparation of standards and norms of space, equipment, and teaching facilities in institutions in this field;
- checking the realization of the competition and looking for the student;
- development and reform of the education system in accordance with the adopted international conventions and obligations and national and interstate development programs and projects in the field of development of digital competences;
- preparation of analysis and data for contracts and solutions, preparation of reports, information, and other materials within the competence of the Group (Ministry of Education Sciences and Technological Development, 2019).

European Union funding opportunities are mainly implemented through European Commission programs related to the e-learning, such as Erasmus + programme (European Commission, 2019b). For instance, Electronic Platform for Adult Learning in Europe (EPALE) is a European, multilingual, open membership community of adult learning professionals, including adult educators and trainers, guidance and support staff, researchers and academics, and policymakers (European Commission, 2019a). EPALE is funded by the Erasmus + programme. It is part of the

European Union's strategy to promote more and better learning opportunities for all adults.

Another important opportunity from the European Union is the Horizon 2020 programme (European Commission, 2019c). For example, Horizon 2020 is currently financially supporting all the projects related to the use of Interactive technologies, such as Augmented and Virtual Reality, in education (European Commission, 2018). Interactive technologies are set to transform the ways in which people communicate, interact, and share information on the internet and beyond. This will directly impact a larger number of European industries ranging from the cultural and creative industries, manufacturing, robotic and healthcare to education, entertainment and media, enabling new business opportunities. The challenge is to forge a competitive and sustainable ecosystem of European technology providers in interactive technologies.

Finally, ICT readiness of all educational stakeholders in the Republic of Serbia plays the crucial role for the success of overall educational system. It represents the prerequisite for implementation of today's global educational paradigm based on digital and online learning. The "Belt and Road" Initiatives proposed by the government of China is a long term and comprehensive plan covering all areas including education. Hence, Serbia should use all opportunities of the potential cooperation with China and other Belt and Road countries in coming decades to overcome all the challenges of digital and online learning.

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Chapter 17
Report on ICT in Education in the Slovak Republic

Juraj Šebo and Dana Pal'ová

17.1 Overview of the Country

17.1.1 History and Geography

The Slovak Republic (Slovakia) is a small country (49,035 km^2) in Central Europe with Bratislava as its capital city. In terms of the total area, agricultural land makes up 49% of it, forest soil 41%, and other land 10% (Wikipedia 2018). The country has 2890 municipalities (of which there are 140 cities) (Bačík 2018).

Prior to 1993, Slovakia was part of Czechoslovakia. From 2004, it has been a member of the European Union (EU). From 2009, it has been a member of the Eurozone with the Euro as its currency. Slovakia is a part of the so-called Visegrad (V4) countries (Poland, Czech Republic, Hungary, and Slovakia).

17.1.2 Population

Slovakia's population comprises of 5.43 million people (2016) with an average annual growth rate of 0.2% (2013) (OECD 2018). The highest proportion is of Slovak nationality (80.7%) while around 8.5% are of Hungarian nationality (Government Office of the Slovak Republic 2018), and 7.4% are Roma people (estimated by (Mušinka et al. 2014)).

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17.1.3 Current Situation of Economic Development

The Gross Domestic Product (GDP) is equal to €80.958 billion (2016). The net national income is 22,321 USD/capita (2014) (OECD Total = 33,709 USD/capita (2014)). The household disposable income annual growth rate is 4.1% (2015) and labor compensation per hour worked annual growth rate is 3.72% (2015) (OECD 2018).

17.1.4 Political System

The political system is a parliamentary republic one. The constitutional system is as follows: the National Council of the Slovak Republic has the constitutional and legislative power, the President and the Government has the executive power, and the Constitutional Court and courts have the judicial power. The current government (from 2020) is led by the center-conservative movement OĽANO (Ordinary People and Independent Personalities) in coalition with Sme Rodina (We are Family), SaS (Freedom and Solidarity) and Za ľudí (For the People).

17.1.5 Language and Religion

The official language is Slovak which belongs to the Slavic group of languages (it includes Polish, Czech, Croatian, and others). Roman Catholicism is the dominant religion (62% of the population) followed by Evangelical (5.9%), and Greek-Catholics (3.8%) (Government Office of the Slovak Republic 2018).

17.1.6 The Relationship with China Under the "16 + 1" Cooperation Framework

In 2015, Slovakia was among the first countries to sign the memorandum with China on Belt and Road (BRI) initiative. In 2017, two documents related to the China strategy were put forward by Slovak government. Firstly, in April, the government approved the Concept of Development of Economic Relations between the Slovak Republic and the People's Republic of China for the Years 2017–2020. Later, it has been extended to the Action plan (Kironská and Turcsányi 2017). Recently, the 8th "16 + 1" summit in Dubrovnik has got the largest reaction in the press and on the websites of government and other relevant institutions. The reason for this was the signing of an agreement enabling the export of Slovak dairy products to China. Slovakia was one of the last EU countries that did not have such a deal with China in place, Prime minister outlined three areas where Slovakia envisages stronger cooperation with China in the immediate future. Apart from the dairy product certification agreement, the most important one was the development of cargo transit capacities, and the third was the construction of a center of excellence in modern technology in Slovakia (Ondriaš 2019).

17.2 Overview of the Educational Development

17.2.1 Enrollment Rate

According to the demographic development in Slovakia, the number of students in primary to post-secondary education in 2014 was 89.5% of the number of students in 2010 (100%) (Germany 93.8%) (based on data from (OECD 2018)). In Fig. 17.1, we can see the downward trend of the number of students studying at primary and secondary schools in Slovakia.

17.2.2 Years of Schooling

The Slovak education system is divided into four levels (pre-primary, primary (6–15 years), secondary (15–19 years), and higher education) based on the age of the student. In the Slovak education system there are 10 years of compulsory education (until the age of 16 with no exceptions). After leaving secondary school it is possible to enter the labor market or continue into further study.

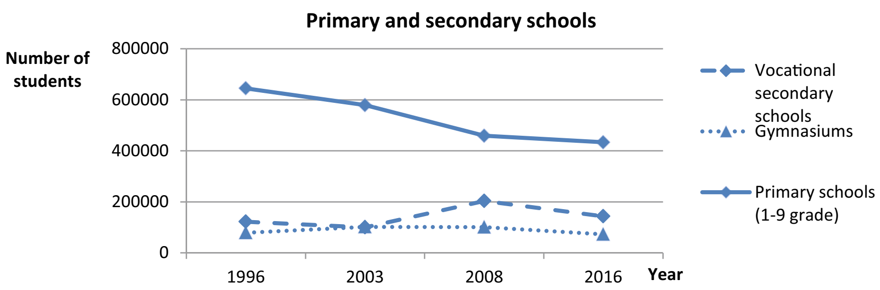

Fig. 17.1 Number of students in primary and secondary schools in Slovakia. *Source* Own, based on Statistical Office of the Slovak Republic (2017)

17.2.3 Academic Performance

In comparison with other OECD countries, Slovakia is at the bottom of academic performance as measured by PISA tests. In mathematics, Slovak students achieved 472 (girls) and 478 (boys) (2015) (OECD average 486 girls and 494 boys). In reading, 471 was achieved by girls and 435 by boys (2015) (OECD average 506 girls 479 boys) and in science, 461 by girls and 460 by boys (2015) (OECD average 491 girls 495 boys) (based on data from (OECD 2018)).

17.2.4 Development of Teaching Staff

The average age of teachers in primary education in Slovakia is 44.3 years (Germany 45.9 years). Teachers in primary education in Slovakia spent 832.1 teaching hours per year (2015) (Germany 799.3 h per year) (Note: teaching hours = preparatory time + statutory teaching time). In Slovakia there are 14,182 teachers which mean professional staffs are directly involved in teaching students. Women in primary education make up 89.7% of teachers (Germany 86.8% of teachers). The average teacher's salary in Slovakia is the second lowest from the OECD countries. In primary education, teachers with 15 years of experience have gross salaries of 17,930 USD/year (Germany 68,265 USD/year) (based on data from (OECD 2018)).

17.2.5 Policies for Educational Inclusiveness, Equity and Quality

These goals of the educational system in Slovakia are secured by the following main Acts (Šebo and Paľová 2020 (in publishing)):

- The School Act (approved in 2008) aims to increase the equity and quality in the education system and to prepare students for the future. It presents several funding schemes by the Slovak Government with support from the European Union. The new act encourages the learning of new languages and ICT and harmonizes the classification of education in schools with the international classification ISCED.
- The New Curriculum defines education areas, focuses on the development of logical thinking and working with texts as well as increasing the number of compulsory hours in mathematics and natural sciences.
- The New Act on VET (Vocational Education and Training) (approved in 2015) aims to link education and training better to the needs of the labor market. It introduces an option for providing VET in a dual system.
- The Act on Higher Education (last version approved in 2013) aims to improve the higher education accreditation process and introduces new criteria for assessing

a university's competence to award the academic titles of assistant professor and professor.

Besides general acts there are also other strategic documents such as the newly developed National Programme for Upbringing and Education Development in the Slovak Republic until 2027 (called "Learning Slovakia") published in September 2017. This document gives goals and guidelines for the improvement of the Slovak education system over a 10 year horizon.

In relation to policies, it is worth mentioning the spending on education per student in Slovakia. In 2014 it was 6234 USD (2014) for primary education (Germany 8546 USD/student), while in % of GDP (2014) it was 0.9% (Germany 0.6%). Public spending in Slovakia on primary to post-secondary education was 6.3% of public spending (Germany 6.5% of public spending). Private spending on primary to post-secondary education in Slovakia represents 2.8% of GDP (2014) (Germany 3.1% of GDP) (based on data from (OECD 2018)).

17.3 New Progress of ICT in Education

17.3.1 Infrastructure

In Slovakia in general, 87% of those in the fourth grade (75% EU average), 77% in the eighth grade (69% EU average), 55% of those in the eleventh grade (60% EU average), and 78% in the eleventh vocational grade (80% EU average) could use ICT during the lessons (Šebo and Paľová 2020 (in publishing)) based on data from (European Commission 2013). In Fig. 17.2, it can be seen that the number of students per computer and beamer and per whiteboard decreases with the age of students.

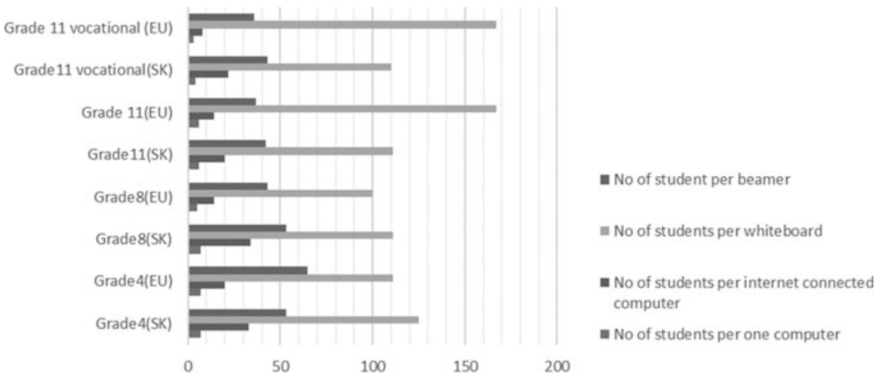

Fig. 17.2 Comparison of main ICT in education indicators in particular Grades of provided education; EU value presents an average value of EU27. *Source* Šebo and Paľová (2020) (in publishing) based on data from European Commission (2013)

The EACEA study (EACEA 2011) shows that at least 50% of students in Slovakia are in schools where one computer is available for every three students (in other European countries it is for every two students). Another study (Indícia n.o. 2012) has highlighted the significant differences in the availability of computers for pupils at primary and secondary schools (at an average primary school, one computer per 4.6 pupils; at an average secondary school, one computer per 2.8 pupils). Moreover, only 47% (EU average 56.6%) of students in the fourth grade have computers available during their mathematics lessons and almost half of the students (EU average: almost 30%) in the fourth grade is affected to some degree by a lack of computers in mathematics and science classes (EACEA 2011). The most commonly used operating system in schools was MS Windows XP and the most widely used office suite was MS Office 2007. The management of hardware and software in schools is usually done by teaching staff, beyond their teaching duties (Indícia n.o. 2012).

Based on the latest officially collected data (European Commission 2013), (Šiškovič and Toman 2015), all primary and secondary schools in Slovakia have access to the internet at present. The national program "Infovek" (2003–2017) has made significant improvement in terms of school access to the Internet. While in 2007, two-thirds had Internet connection with speeds slower than 2 Mbit/s, this number has decreased in 2013 to 38% for primary and secondary schools. These days, the speed of Internet connection is comparable to the speed provided to the business sector, i.e. approx. 13 Mbit/s, however, only every fifth school from all primary and secondary schools has this speed currently guaranteed.

17.3.2 Educational Resources

At the national level (Slovakia), a general initiative by a non-profit organization in the internet called Open Education[1] has simple structured general information and is a gateway to national and international OER. The key public educational portal, the "Planet of Knowledge," has been provided by the Ministry of Education, Science, Research and Sport in the Slovak Republic since 2011. The primary objective of this portal is to provide pupils and teachers with quality and attractive teaching materials for the modernization and streamlining of the learning process. In 2014 it provided up-to-date training materials for some subjects, especially for ISCED2-3 levels. Since 2014, the digital educational content has not covered the full range and levels from pre-primary to secondary education (ISCED0-3). The coverage of ISCED0-1 was also a priority for the near future (The Ministry of Education, Science, Research and Sport of the Slovak Republic 2014). These days, the portal contains more than 30,000 educational materials from various fields such as mathematics, physics, biology, etc. The educational materials are in the form of videos, presentations, simulations, animations, 3D models, pictures, photos, illustrations, interactive exercises, and lessons (Ministry of Education, Science, Research and Sport

[1] Open Education, otvorené vzdelávanie. www.otvorenevzdelavanie.sk. Accessed 12 Apr 2019.

of Slovek Republic 2017). Despite its undoubted advantages there have been some criticisms. Some of the disadvantages have been addressed by Ján Žabka (creator of schoolbooks). He points out that the portal is not a digital schoolbook but rather an encyclopedia which contains the completed facts which it presents to the pupil. The second problem is that the “Planet of Knowledge” does not know, what takes place at school. The explanatory videos mainly present the knowledge and there is no development of creative thinking. Teachers, on the other hand, claim that the “Planet of Knowledge” is a positively recognized teaching resource (Dobrá škola 2017). Another thematic portal,[2] with more than 120 titles (2014) has solved the shortage of printed textbooks through the temporal availability of the digital format of textbooks and teaching materials (The Ministry of Education, Science, Research and Sport of the Slovak Republic 2014).

17.3.3 Learning and Teaching

In connection with some European ICT-related strategies, Slovakia has implemented ICT as a part of the school curriculum in the form of a mandatory subject at all levels of compulsory education for a number of years. At first, it was introduced in 1985 at upper secondary level, in 2005 at lower secondary level, and finally in 2008 at primary education level.

In Slovakia a teacher’s use of ICT is recommended for a variety of subjects (Languages, Mathematics, Natural Sciences, etc.). ICT as a subject is taught at primary level by generalist teachers and at secondary level by specialist ICT teachers or other specialist teachers (EACEA 2011).

In Slovakia at most grades percentages of students taught by teachers for whom ICT training is compulsory are among the lowest in the EU, by teachers participating in training provided by school staff is but close the mean at all grades and by teachers who have not spent any time on ICT-related professional development are close to those in most other countries (European SchoolNet and University of Liège 2012).

17.3.4 The Ability for Faculty to Use ICT to Teach

All specialist teachers for general secondary education have ICT-related skills included in the core curriculum for the initial education for teachers: internet use, subject-specific training, multimedia operations, creating websites, and pedagogical issues. The generalist teachers have first 3 from above mentioned skills in the core curriculum (EACEA 2011). As for ICT skills for teaching, 18.6% of Slovak teachers (19.7% of OECD) have highlighted the need for further professional development in this area (OECD 2014). In order to improve their ICT skills, Slovak teachers

[2] eAktovka. www.eaktovka.sk. Accessed 12 Apr 2019.

in primary and general secondary education can use websites and platforms for teacher collaboration, and there is also staff available to help teachers with using ICT (60.4% of Slovak students in the 4th grade go to a school with staff available to help teachers use ICT (EU average: 73.1%)) (EACEA 2011). In Slovakia also project "IT Academy" targets schools and universities, pupils and students and aims at training teachers so they can use digital technology and innovative pedagogies.

In Slovakia, use of ICT by teachers is higher at all grades with considerably more teachers using ICT in more than 25% of lessons than the EU average, while use of ICT in more than 75% of lessons is similar for Grade 8 and 11 general, but considerably higher for Grade 4 and Grade 11 vocational. Slovakia is also in the group of leading countries as regards teachers who have been using ICT in lessons for more than six years (European SchoolNet and University of Liège 2012).

17.3.5 The Ability for Students to Use ICT to Solve Problems

Figure 17.3 presents the primary and secondary school pupils' experience with ICT in the learning process. There is also one initiative worth mentioning—eSkills Week. Since 2010, it has provided tools and know-how to help young people better understand the opportunities related to careers in ICT and the relevance of digital skills for their prospects in the labor market more generally.

In Slovakia, student use of ICT equipment in class (reported by students) is in general higher than the EU mean. In more detailed view, use of school desktop/laptop

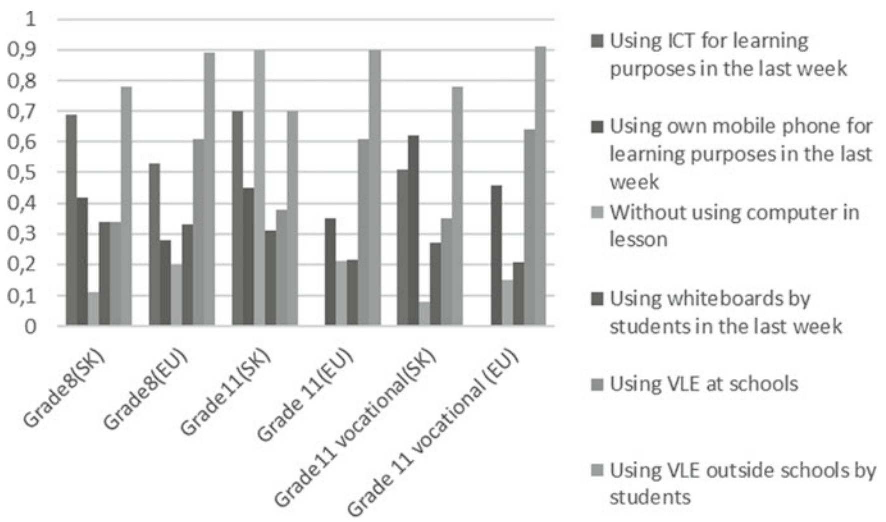

Fig. 17.3 Using ICT for learning purposes by students (according to age).
Source Šebo and Paľová, 2020 (in publishing) based on data from European Commission (2013)

is considerably higher at all grades, use of own laptop is close to EU means at all grades, and use of mobile phone is also considerably higher than the EU mean at all grades. Use of interactive whiteboards is at around the same frequency as other countries at all grades. Only at grade 11 there is more intensive use (European SchoolNet and University of Liège 2012).

17.4 Policy and Strategy of ICT

17.4.1 Policies Related Educational Informationalization

In Slovakia, as almost all EU countries, using of ICT for all EU key competences (mother tongue, mathematical competence, social competences, etc.) is suggested in central steering documents for primary and general secondary education. Central recommendations on the inclusion of cross-curricular skills and using ICT as a tool for skills teaching in primary and general secondary education in Slovakia includes skills as creativity, critical thinking, problem solving, communication, collaboration, and initiative and self direction. Slovakia belongs to EU countries which have most of the ICT learning objectives (knowledge of computer hardware, computer using, office applications, using multimedia, etc.) in central steering documents for primary and general secondary education. Despite there are no official recommendations or suggestions of the use of ITC tools in the classroom in Slovakia, support is nevertheless provided to schools and teachers for using a range of ICT tools (EACEA 2011).

In newly developed above mentioned National Programme (called "Learning Slovakia") in the first chapter the "use of ICT" is defined as a sub-goal from 11 basic goals of Slovak education system. In the part related to learning resources, materials and equipment, there is identified problem of missing textbooks and its partial solution is in the form of an "e-Aktovka" (e-Briefcase) electronic portal. It also mentions the need to provide the necessary material and technical equipment for schools, including the technical conditions for the use of modern technologies, digital content, and resources and that schools do not currently have enough financial resources to provide the necessary equipment, or teaching materials to enrich education. In the part related to measurement, testing, examinations the trouble-free provision of building of an electronic/digital test system by NICEM is outlined. In the part related to school environment and school facilities (interiors and exteriors) the sub-goal of having a learning environment with integrated modern information and communication technologies (Integrating information and communication technologies directly into the learning environment) is discussed. In the part related to informal education and learning the sub-goal of "providing informal education and training financial support" is looked at where financial support of the Ministry of Education is recommended e.g. Slovak Wikipedia pages, Khan Academy education video subtitling, creation of e-learning courses (MOOC) for Coursera, Udacity, etc.

(Šebo and Paľová 2020 (in publishing)). In the second chapter related to teachers, measures with a focus on ICT are outlined: financing technical staff for ICT cares. In the third chapter related to vocational education and training, measures with a focus on ICT are mentioned: promote the dissemination of digital teaching materials. In the fourth chapter related to the financing of regional education in relation to ICT there are recommendations to increase the normative (payment "per student") also according to ICT equipment and in specific financial resources to take into account all the statutory obligations that were added to the schools without raising the funds (including network administrator, ICT administrator).

17.4.2 ICT Financing Resource

In 2014, the Ministry of Education prepared the "Concept of Informationalization and Digitization of the Education Sector with a view to 2020," which analyzes, among other things, the current situation. As stated, in past years in the education sector things have begun to be implemented such as a portfolio of national and demand-side projects focused on material and technical equipment and ICT equipment of schools, the initiation phase of education sector digitization, co-financed from EU funds, as well as other projects financed from the state budget. According to surveys in 2011 and 2012 (UIPŠ 2013), the number of computers (an average of 59 computers per school, 91% of which were connected to the Internet) and ICT equipment of primary and secondary schools in Slovakia was on the rise. Despite the implementation of projects and improving ICT equipment of schools, Slovak pupils under-perform in the PISA (2012) and TIMSS tests, pointing to the lag of Slovak education in comparison to the OECD countries. When looking for ICT deficiencies in schooling, PC learning equipment (57%) was among the identified material deficiencies reported by teachers in the earlier TALIS (OECD 2009) survey. According to the new TALIS (OECD 2014) study, up to 73% of teachers reported a need to develop competences for teaching through ICT. Other issues, such as unprofessional teaching of informatics, poorly utilized improved ICT equipment of schools, and problems with the development of pupils' key competences for lifelong learning and digital skills have been identified on the basis of inspections (The Ministry of Education, Science, Research and Sport of the Slovak Republic 2014).

Slovak Republic, through 9 national programs, benefits from ESIF (5 European structural and investment funds) funding of EUR 15.3 billion. This represents an average of 2830 euro per person from the EU budget over the period 2014–2020 (European Commission 2019a, b). The total budget for 2014–2020 in Integrated Infrastructure program of Slovakia is €8,128,441,573 and the finances that have been planned specifically for ICT represent € 866,988,591 (European Commission 2019a).

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Chapter 18
Report on ICT in Education in the Republic of Slovenia

Borut Čampelj and Eva Jereb

18.1 Overview of the Country

18.1.1 History and Geography

In the past, the Slovenia lands have varied through history in various empires or states, although a first Slovenian book was released out in 1551. Before First World War, Slovenia had been a part of the Austro-Hungarian Empire. After the war in 1918, State of Slovenes, Croats, and Serbs were established and later in the same year also Kingdom of Serbs, Croats, and Slovenes, which was renamed to Yugoslavia in 1929. In 1945, after Second World War, Socialist Federal Republic of Yugoslavia has been established, where the Socialist Republic of Slovenia and the other five republics have been equal. Finally, in 1991 after a short 10-day war, an independent Republic Slovenia was established. Slovenia became a member of NATO and EU in 2004 and joined the euro zone and the Schengen zone in 2007.

Slovenia is located in Southern Central Europe and is boarded by Italy (west), Austria (north), Hungary (northeast), and Croatia (south and east). Slovenia has mainly continental climate. However, Alps and Adriatic Sea are also part of Slovenia, and there is Alpine as well as Mediterranean climate. Slovenian has in total 20,273 km^2, of which land: 20,151 and water: 1223 km^2. The highest mountain is Triglav 2864 m. Forests cover 62.3% Slovenia, agricultural 22.8%.

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18.1.2 Population

Population of around 2.1 million (July 2018) is distributed throughout most of the country, and the capital city is Ljubljana with around 280,000 habitants. Median age is 44.2 years (male 42.7 and female 46 years) and life expectancy at birth is 81.2 years (Central Intelligence Agency 2019). Population in Slovenian consists of Slovene 83.1%, Serb 2%, Croat 1.8%, Bosnian 1.1%, other or unspecified 12% (2002).

18.1.3 Political System

Slovenia is a democratic republic based on the principle of separating powers into legislative (National Assembly and the National Council), executive (Government that consists of the Prime Minister and Ministers), and judicial (as independent third part of power by the Constitution and the law). The President of the Republic (current Borut Pahor) represents the Republic of Slovenia and is the supreme commander of armed forces. Slovenia is divided into twelve statistical regions and 212 municipalities. As local matters that only affect the residents of a municipality and can thus be dealt with independently, fall under the jurisdiction of municipalities. At international level, Slovenia has been a member of the European Union since 2004, as mentioned (Taštanoska 2017).

18.1.4 Current Situation of Economic Development

Slovenia has one of the highest per capita GDPs in region (between the Balkans and Western Europe) as well as in Central Europe ($34,500; 2017) and adopted the Euro in 2007 as Slovenians had managed to provide a stable political and economic transition. Slovenia has also become a member of international organizations or associations such as World Bank in 2004 or OECD in 2007. It boasts excellent infrastructure, well-educated work force, and has a strategic location. Although Slovenia is a small country, it controls some of Europe's major transit routes. After the economic crisis in 2008, an economic development and growth has been sustainable as export-led has grown especially in larger European market. In 2017, the annual GDP reached 5.0% as well as unemployment fell below 5.5% in early 2018. Slovenian economy has been driven by strong exports and increasing consumption that boosted labor demand. Continued fiscal consolidation through increased tax collection and social security contributions results in a balanced government budget in 2018 and 2019 as public spending has been rationalized and the banking sector stabilized (Central Intelligence Agency 2019).

In Slovenia, the share of innovation active enterprises in the industry and selected services was 39.8% in period 2014–2016. In 2017, share of gross domestic expenditure on R&D in GDP was 1.90%. More detailed (2016): 0.27% share of R&D expenditure in GDP in the public sector; 0.22% share of R&D expenditure in GDP in the higher education sector. Slovenia is a well-developed information society, as it has 87% share of households with access to the Internet and 71% people are using the Internet every day or almost every day (2018).[1]

18.1.5 Social and Cultural Development

Throughout the centuries, culture and Slovenian language as well as science have been the major drivers of the development of the Slovene nation. Slovenia has a powerful spread network of cultural associations and institutions. Investments in research and development are important at state level as well as in enterprises and especially cooperation of all stakeholders.

The official language is Slovenian as well as Italian (only in municipalities where Italian national communities reside) and Hungarian (only in municipalities where Hungarian national communities reside). However, residents of Slovenia (2002) speak Slovenian (91.1%), Serbo-Croatian (4.5%), other or unspecified (4.4%). Religions in Slovenia (2002) are Catholic (57.8%), Muslim (2.4%), Orthodox (2.3%), other Christian (0.9%), unaffiliated (3.5%), other or unspecified (23%), none (10.1%) [1].

18.1.6 The Relationship with China Under the "16+1" Cooperation Framework

China is the largest foreign trade partner of Slovenia in Asia. Due to the deepened cooperation with China, also because of cooperation in the "16+1" initiative, bilateral trade between Slovenia and China has grown by more than 15% since 2013. Slovenia officially coordinates cooperation in the field of forestry, which has also proved to be an excellent platform for promoting trade, expertise, and technological cooperation, and thus contributing to sustainable forest management. The important characteristics of joint projects between Slovene and Chinese partners are their focus on high technology and the fact that the activities are present in the markets of both countries.

At the eight annual gathering of the "16+1" Cooperation platform in Dubrovnik, 2019, Slovenian Prime Minister was determined to assume an important role in building the infrastructure within the Belt and Road Initiative (the shortest connection to the markets of Central and Eastern Europe through the Port of Koper). The Prime

[1] Statistical Office of Republic Slovenia (2019a, b).

Minister highlighted the opportunities for cooperation in various fields, such as the production of parts for electric vehicles, high IT technology, aviation technology, and the pharmaceutical industry. The Prime Minister added that he is pleased with the organization of the Chinese-Slovenian Winter Sports Forum in Beijing in November 2018 with the participation of academics, companies, sports organizations, and the Olympic Committees of both countries. The Slovenian interest is in infrastructure facilities for summer and winter sports and with a large number of experts, Slovenian wants to contribute to the participation of “16+1” in the field of sports (LMŠ 2019). At Dubrovnik summit (2019), a series of agreements between China and the “16+1” was signed: framework agreement on cooperation between the Engineering Academy of Slovenia and the industrial development zone of Nanjing Jiangning High-tech in the establishment of an international scientific research and transformation center; the representatives of Slovenian Export and Development Bank signed the initiative for cooperation between the interbank consortium of China and the countries of Central and Eastern Europe in support of the development of small and medium-sized enterprises (Politikis 2019).

In 2018, an agreement on scientific and academic cooperation between the Capital University of Physical Education and Sports from Beijing and the Faculty of Sport from Ljubljana was signed. The cooperation is a part of Beijing’s preparation for the 2022 Winter Olympics.[2]

18.2 Overview of the Educational Development

18.2.1 Education System and Policy

Slovenian education system is organized mainly as a public service, with most schools are public, though there are some private institutions at all levels (kindergarten, schools, higher and adult education institutions). The public school space is autonomous and political and confessional activities are prohibited.

The primary goal of education is to provide optimal development of the individual, irrespective of gender, social and cultural background, religion, racial, ethnic or national origin, and regardless of their physical and mental constitution or physical and mental disability. Right to free education is enshrined in Constitution of the Republic of Slovenia. Basic education is compulsory and is financed from public funds.

All levels of education in the domain of the Ministry of Education, Science and Sport (Curent minister is Prof. Simona Kustec Lipicer, Ph.D): pre-school education, basic education (integrated primary and lower secondary education), basic music education, upper secondary, short-cycle higher education, higher education and adult education (Taštanoska 2017).

[2]The Slovenia Times (2018).

Pre-school education is not compulsory. The provision of pre-school education entails two age brackets: for children who are one to three years old and for children who are three to six years old. Public kindergartens (108; some of them in more locations of 211) and private kindergartens (97) are founded by municipalities in line with the needs of the local population. Nine years basic school education (6–15 years old pupils; primary and lower secondary level) is compulsory by Constitution and funded by the public revenues. In school year 2018/19, Slovenia has 455 independent schools (only 6 private) and 318 (non-independent) branch schools in smaller places in Slovenia. Regular kindergartens and schools provide education for children with special educational needs in an inclusive form or in separate classes. However, 16 specialized schools and institutions provide education only for children with special educational needs. The public network of basic schools gives all residents of Slovenia an access to education. After completion of basic education, pupils aged 15 could attend two to five years in upper secondary education (non-entail tuition fees) at general schools as well as vocational-technical schools. Some upper secondary schools (out of 182) could have limit of number of students or competence's limit (e.g. design, music). Tertiary education includes short-cycle higher vocational education (public or private colleges prepare students for working in the industry) and higher education studies, which is provided in three cycles: first cycle consists of academic and professional study program; students after finishing the first cycle may proceed to the second cycle study program; the third cycle program leads to a doctoral degree. An exception is integrated Master's program that entails at least 300 CPT and students can after graduation also enroll in third cycle programs. Slovenia has 7 universities (3 public, 2 private and 4 international), arc academies and some other higher education institutions. Adults can acquire basic education as well as upper secondary education qualification in special organization for adults. In Slovenia, basic music and ballet schools are publicly funded, which provide an opportunity to develop musical and dancing talents alongside regular formal education (EURYDICE 2019).

18.2.2 Students and Teachers' Profile

At the beginning of school year 2018/19, around 184,000 students were enrolled in basic schools (almost 22,000 in first class), and around 4,000 in special need institutions. 73,200 students were enrolled in upper secondary schools (around 35% in general schools), among them 19,600 in first class and in addition 320 in special need institutions.[3] In the academic year 2017/18 there were 76,534 students in faculties and colleges in Slovenia, 3420 (4.5%) students were from abroad. In the same academic year, the share of students of the population aged 19–24 years was 46.5% as well as 46.4% of people aged 30–34 have completed some form of higher education and is already higher than benchmarking at European level by 2020 (40%) (Statistical Office of Republic Slovenia 2018a, b, c).

[3]Ministry of Education, Science and Sport of the Republic of Slovenia (2018).

In the school year 2017/18, 45,434 professional employees were employed in formal education: 12,199 in kindergartens, 20,371 in basic schools, 7454 in upper-secondary schools, and 5410 at higher education institutions (Statistical Office of Republic Slovenia 2018a, b, c). There is significantly higher share of women teachers at all education levels (more than 95% in primary, 78% in lower secondary and 66% in upper secondary education, 2010). Percentage of female school heads in primary and secondary education is also above 50% (European Commission/EACEA/Eurydice 2013).

18.2.3 Enrolment Rate and Retention Rate

As mentioned, basic education in Slovenia is compulsory, the enrollment rate from age 5–14 is 97% at public and private schools (other kids are abroad, at SEN or other). The enrollment rate from age 15 to 19 (upper secondary education) is 93% and from age 20 to 24 (mostly higher education or other) is 61% (OECD 2018). In Slovenia, share of early leavers from education and training (18–24 year olds with ISCED 2 at most lower secondary educational attainment ISCED 2 and who are no longer in formal or non-formal education and training) fall from 4.8 to 4.3% in period 2011–2017. In the other hand, tertiary educational attainment (adults aged 30–34 having successfully completed tertiary education ISCED 5–8) has grown from 38 to 46% in period 2011–2017 (European Union 2019). Basic school for adults and project learning for young adults are designed for younger or other adults who did not finish basic or upper secondary education. However, there are systematical activities at basic and upper secondary school to prevent drop out, for example: early detection of the problems and providing appropriate solutions at class level (class teachers) or school level (psychologists, pedagogues, social workers, social pedagogues or SEN teachers) to provide counseling service at a public kindergarten and schools to counsel children, pupils, apprentices, students, teachers, and parents; plan, monitor, and evaluate. The Center for information and career (vocational) guidance within the Employment Service of Slovenia is designed for young people and all others who are planning their educational or employment career and need the right information for their decision-making.[4] Also pupils, students and young adults—early school leavers are entitled to counseling services in the Centre. A network of 14 regional guidance centers for lifelong learning is active in Slovenia.[5] This is where adults (also young adults) can obtain information on educational possibilities (formal and informal education, financing, examinations, acquiring another vocational qualification and similar) as well as on employment possibilities; they are given individual educational plans and directed to educational programs (European Commission/EACEA/Eurydice/Cedefop 2014).

[4]Employment service of Slovenia (2019).

[5]Slovenian Institute for Adult Education (2019).

18.2.4 Teachers' Professional Development

In Slovenia, admission to initial teacher education is regulated at national level takes 5-year higher education. Selection criteria for access to initial teacher is based on certificate of final examination of upper secondary education mostly (European Commission/EACEA/Eurydice 2013). To become a teacher in Slovenia, confirmation of professional competency is required after completion of initial teacher education. An induction programs as well as personalized help and advice, the duration of the induction phase is 10 months and can be extended or shortened. In Slovenia, to pass the state professional examination, applicants must have at least 840 h (approximately 10 months) of teaching practice, and they must have completed at least five assessed teaching presentations either as part of induction (not compulsory) or independently. The professional examination is oral. The specific topics are determined by the Minister of Education. There are no alternative pathways to a teaching qualification in Slovenia. The transition from initial teacher education (ITE) to professional life in Slovenia and other EU countries is a crucial phase both for teachers and from an education system perspective. The method of recruiting fully qualified teachers is open recruitment where teachers apply to schools directly, therefore the employer is the school. Most teachers have contract of indefinite duration, only a minor of them have fixed-term contract. The main challenge in Slovenia is the oversupply of teachers and the demand for teachers has fallen in recent years due to a population decrease (European Commission/EACEA/Eurydice 2018). Employed teachers have a civil servant status. The basic condition for a teacher to advance to the position of school head is teaching experience and special training for headship at National School for Leadership in Education. Slovenia considers continuing professional development (CPD) a professional duty for teachers. The participation in CPD is a necessary component for teachers to obtain a promotion in terms of career advancement and salary increase. Schools are obliged to have a CPD development plan for the whole school staff. The basic condition for a teacher to advance to the position of school head is teaching experience and special training for headship at National School for Leadership in Education (European Commission/EACEA/Eurydice 2013).

18.2.5 Public Expenditure on Education

Public expenditure on formal education in 2017, as in 2016, accounted for 4.8% of GDP. Basic schools are founded by municipalities, but upper secondary schools are founded by state (Statistical Office of Republic Slovenia 2018a, b, c). Share of public expenditure for formal education in GDP (2017) basic, upper secondary and higher education is 4.8% (43, billions EUR 2017) of BDP (Statistical Office of Republic Slovenia 2019, b). Share of public expenditure for formal education in GDP is calculated as the ratio between the amount of public expenditure for formal education and the observed GDP. Minimum basic gross teacher salaries in basic and lower secondary education are lower than a country's per capita GDP. Allowances that are added to the basic salary can considerably increase the basic salary of a teacher (European Commission/EACEA/Eurydice 2013).

18.2.6 Education Research Institutions

Most well-known education research institutions in Slovenia are: universities and their various research departments or sectors and National Research Institutes.[6]

The University of Ljubljana, with its rich tradition is the oldest and largest educational and scientific research institution in Slovenia. It has 5600 higher education teachers, researchers, assistants, and administrative staff (30 percent of all registered researchers) in 23 faculties and 3 arts academies. The University of Maribor has about 1050 pedagogical and research employees as well as 700 administration and technical support in 17 faculties and University libraries. The University of Primorska has 700 teaching, research, and technical staff at 7 faculties and several research institutions. The University of Nova Gorica has 7 faculties, 6 research centers, and 6 laboratories as well as Primorska Technology Park (vital link between higher education and the economy).

National Research Institutes: more than 50 research organizations operate independently of the universities. They differ in size, legal status, and field of research. Altogether, 15 institutes acquired the status of National Research or Public Institutes, some of them carrying out scientific and technological research in education also. For example, in education are active: Educational Research Institute, IJS—Jozef Stefan Institute, National Institute of Chemistry, National Institute of Biology, ZRC SAZU—Scientific Research Centre of the Slovenian Academy of Sciences and Arts. The following organizations provide information infrastructural and network service for Slovenian science, culture, and education: ARNES—Academic and Research Network of Slovenia, IZUM—Institute of Information Science as well as Slovenian Academy of Sciences and Arts.

18.3 New Progress of ICT in Education

18.3.1 Infrastructure

In the 2nd Survey of Schools: ICT in Education (2017/18), Slovenian school reported that around 45% of basic schools and only 11% of upper secondary schools have a high provision of digital equipment (laptops, computers, cameras, whiteboards) per number of students and a high broadband speed. All schools have safe internet

[6] InvestSlovenia (2019).

access. More than 27% of basic schools have internet speed faster that 100 mbps and at least 41% internet speed form 30–100 mbps. More than 70% of upper secondary schools have internet speed faster that 100 mbps. However, only 32% of pupils in basic schools use a computer at school on a weekly basis and 52% students in upper secondary schools (European Commission 2018a, b).

The Ministry of Education, Science and Sport Slovenia has co-financed ICT infrastructure from 1994. In Slovenian Education Project (2016–2022; 25 million EUR) are provided clients (notebook, tablets, computers, projectors) as well as wireless and secure high speed connection to the internet.

18.3.2 Digital Education Resources

Digital education in Slovenia started in 1993, after National Assembly assured a special budget for ICT in education [Computer Literacy Programme (Batagelj and Rajkovič 1996)]; especially to ensure infrastructure at schools (hardware, software, internet access), enhance teacher's pedagogical digital competences through teacher training and encourage development project at all level (new pedagogy, Slovenian educational network, survey on trends). The digital strategy and budget (national, EU) and especially activities to enhance teaching and learning supported by ICT have been updated several times in the last 25 years. However, the most significant period on development digital education in Slovenia was 2006–2015. At that period, national e-education project has been run at all levels (policy, school as well as classroom level). There are many evidence-based results, nevertheless Slovenia had a good result in large scale assessment ICILS 2013(Fraillon et al. 2014) After 2015, e-education project has not been a priority any more, but more comprehensive development of innovative learning environments. Even though ICT should be one of the main drivers of innovative learning environments, the level of comprehensive digital education hasn't developed further as before. At some areas the results have dropped and some evidence-based data showed that very clearly, for example school digital strategies, support for schools, teacher training (European Commission 2018a, b; IEA 2017). However, in 2019, the intervention of the minister and policy makers was quick as they start to upgrade the Digital Strategy in Slovenian Education (2021–2027) as well as started new development projects and start activities to upgrade existing e-materials and digital competences. In this chapter only most visible project and activities on digital education are presented.

18.3.3 Teacher Training and New Approaches of Learning and Teaching with ICT

At the pre-university level (kindergarten, general and VET education), one of the successful drivers of digital education projects and activities have been the development and implementation of teacher's pedagogical digital competences since 1994.

During e-education project (2006–2015), teacher pedagogical e-competence framework has been developed.[7] It consists of 6 key teacher's competences: 1—knowledge and ability of critical use of ICT; 2—ability of search, gathering, treatments, critical judgement of information and concepts; 3—ability of communication and distance cooperation; 4—ability of planning, implementation, and evaluation of use ICT in teaching and learning; 5—safe use, legal, and ethical principles of use and uploading e-content; 6—making, creating, updating, and publishing e-content on the internet. In the period 2009–2014, the framework was implemented and most of the teachers and headmasters participated in various training. The type of training was both, top-down approach (at seminars and conferences 38,000 participations out of 30,000 teachers) as well as bottom-up approach (at consultations, workshops, pedagogical and technical support 37,000 participations). Top-down approach mostly included 16–24 h seminars (at least 50% online; skills assessment included) with 12–15 participants.[8] Bottom-up approach included workshops and consultations (up to 4 h; at schools; up to 5 participants; including examples of good practices).[9] In average, more than 10,000 teachers and students have participated daily in online communities (Moodle) for school education purposes.

From 2015–2018, in Mentep project (EU-Erasmus Plus project, Action 3: Policy Experimentation), the portal E-ecosystem has been developed, which intended is to support the professional development of educators, teachers, and principals in the field of pedagogical digital competences (National Education Institute 2016). By using self-assessment toll TET-SAT (European Schoolnet 2017), teachers and other educators may assess their own pedagogical digital competences and find various possibilities to upgrade them, e.g., various training and support (face-to-face as well as on-line), learning scenarios, guidelines in introduction of ICT in different subjects (National Education Institute 2017), links to webinars, MOOCs in different languages and portals. Safe use of internet has been provided since 1998, and especially from 2006, when national contact point has been established (Centre for Safer Internet 2019).

As mentioned, from 2015–2018, the level of introduction of ICT in lessons has dropped down, as seminars, consultations and pedagogical support teachers, and schools almost vanished. Teachers' confidence in their digital competence has dropped down. It was reported in 2nd EU survey ICT in Education. On the scale up to

[7] Slovenian Educational Network (2012a).

[8] Slovenian Educational Network (2012b).

[9] Slovenian Educational Network (2012c).

4 teachers reported the level of their digital competences: 2.8 Information and Data Literacy; 2.5 Communication and Collaboration, 2.5 Digital Content Creation, 2.7 Internet Safety, 2.5 Problem Solving (European Commission 2018a, b).

In the period 2020–2022, the plan is to further develop and implement the Self-assessment of Pedagogical Digital Competencies of Educators (budget provided: 2.4 million EUR). The goal is to upgrade the i-ecosystem and extend its usability for identifying and assessment of pedagogical digital competencies of teachers and other educators through providing consultations, shorter forms of training and support and other bottom-up approaches as well as evidence of assessment.

Teachers, researchers, students, and others have participated also in EU funded project since 2012. For example: EU folio project—development portfolio, ATS2020 project—assessment of transversal skills based on e-portfolio approach; YouthStart project—development of entrepreneurial competences, ATS STEM project—assessment of transversal skills in STEM.

From 2018, for VET school, development work on pedagogical digital competence of teachers has being carried out. Project POKIT includes 12 vocational and professional schools in Slovenia and has been coordinated by National Education Institute (NEI) and Centre for Vocational Training and Education (CVTE). NEI and CVTE have provided consultations and professional support for teachers to design and use digital technology in teaching and to develop digital competences of students. The participating teachers have developed a set of different tools for assessing student progress in the development of digital competences.

In higher education, several projects started from 2016. Within the framework of the projects "Innovative and Flexible Forms of Teaching and Learning in Pedagogical Study Programs" (2017 and 2018, 1.3 million EUR, 14 faculties from 3 universities), activities were carried out in the field of the implementation of pedagogical study programs, which were used to train students—future primary and secondary teachers for the didactic use of ICT in the learning and teaching. Students (future teachers, nearly 2800) acquired basic knowledge of the didactic use of ICT, and were able to recognize the possibilities offered by the use of ICT also in order to achieve higher reading literacy among pupils and students. In another project "Integrating the Use of Information and Communication Technology in Higher Education" (2017-2020, EUR 2 million, 49 higher education institutions from three universities), integration of didactic use of ICT is introduced in the higher education pedagogical processes at all areas of study through up-to-date, and flexible forms of teaching and learning to enhance digital skills and digital literacy of students. The goal is modernization of higher education didactics with the prudent use of ICT and the transition to digital education to promote the quality of the own operation of higher education institutions and the enhancement of the transfer of skills and knowledge to students for faster and more visible contribution to the success of the economy and the wider society is encouraged. Innovative learning environments have been provided and methods and pedagogical practices has been introduced by integrating new technologies (e.g. the development of innovative teaching materials, interdisciplinary subjects, new pedagogical models, new forms of learning), which increase the overall competence of students (including digital skills). Third important national project in higher education has been “Establishing a System for Monitoring the Employability of Higher Education Graduates in Slovenia and Modernizing eVS” (2017 to estimate 2022; 0.5 m EUR). A system for monitoring employability of graduates has been established at the national level, which will serve as a basis for forecasting the needs in the labor market career advising (e.g. acquaintance with the profession, individual support for identifying interests and competences) and is available to both higher education policy makers (ministries) and higher education institutions, which support self-evaluation and monitoring the quality of teaching (preparation and implementation of study programs). Also, users at various levels are able to inspect the already prepared analyzes and produce reports by selected categories. The fort significant project is “Innovative and Flexible Forms of Teaching and Learning” (2018–2022; EUR 3.3 million; consortium of public higher education institutions: UL, UM, UP, FIŠ). The goal is interconnection point, where carried out top-level training (presumably 6183) of higher education professors and professional staff, constant updating of knowledge and skills and exchange of good practices, carried out research in this field and trained (estimated 110) teacher trainers. By linking and participating in higher education institutions, higher education institutions are opening up for new teaching methods, which are also provided by modern ICT and the associated new ways of teamwork; integration between higher education teachers and professional associates is possible, thus connecting and sharing knowledge and experiences, different practices, policies, and systems in the field of education and training from all over Slovenia as well as from abroad, through foreign experts. The project provides opportunities for professional development and higher quality of work of higher education teachers and professional staff and activities for the benefit of students. As a result of the project, the share of higher education teachers (full professors, associate professors, docents and proofreaders and lecturers and senior lecturers) and professional associates (assistant, librarian, expert councilor, senior expert, expert associate and teacher of skills) who perform flexible forms of learning to improve the competences of young people. Through upgraded, innovative and flexible forms of teaching and learning, training is provided to raise general competences (e.g. ability to plan and solve problematic tasks, independent work, analytical thinking, creativity, entrepreneurship), key competences for lifelong learning and professional competencies of students, and the development and use new didactic methods and innovative work with students. Teacher trainers are in charge of transferring knowledge and examples of good practices from abroad.

18.3.4 Pedagogical Multimedia and Interactive E-Materials as Well as Repositories

In the period 2006 till 2015, more than 120 interactive pedagogical e-materials have been developed and 43 interactive e-textbooks.

Multimedia and interactive e-material has been developed since 1998. Since 2006, public tenders have been published to encourage various development teams of experts from schools, universities, companies, and NGE to provide new multimedia and interactive pedagogical e-materials and support new approaches of learning in teachers. From 2006 more than 130 projects have been supported (10 million EUR) for different subject in basic and upper secondary education. All e-materials have been approved by counselors of different subjects at National Education Institute and are available under Creative Commons License. After 2011, 43 interactive e-textbooks for various general subjects (math, languages, chemistry, physics, biology, geography etc.) in basic in upper secondary education have been developed[10] and approved by special body—committee, which approve curriculum and other documents at national level. An evaluation study of the pilot projects of the use of e-textbooks in basic and upper secondary education among teachers, pupils, and parents has been done (Rutar Leban and Milekšič 2016).

In 2019, activities started which focus in upgrade of existing e-materials and e-textbooks. The plan is also to upgrade editor to producing interactive e-materials and access to all materials through repositories in Slovenian Educational Network.

As mentioned, Open Education Resources have been developed, promoted at national level as well as in EU an international arena as Slovenia has taken one of the major role in UNESCO OER movements. In 2017, 2nd world OER congress have been organized by Slovenian Government and UNESCO and supported by generous support of The William and Flora Hewlett Foundation.

18.3.5 Student's Digital Competences and Computational Thinking

As expected, students' confidence in their digital competence has been reported (on the scale up to 4) with 2.9 Information and data literacy; 3.2 Communication and Collaboration, 2.7 Digital Content Creation, 2.8 Internet Safety, 2.7 Problem solving. More than 70% students reported about none coding/programming activities at school (European Commission 2018a, b).

In the period 2016–2022, new development projects have been established to enhance and empower learners with global competences/skills (key, transversal, twenty-first century, interdisciplinary) to become active citizens and can actively participate in competitive trade market. One of the common goal of the project is comprehensive development of open and innovative learning environments with special emphasis to introduce ICT (2017–2022, 18 million EUR) and most of the schools participated with whole-school approach. However, the level of current digital education in Slovenia is lower than in the period 2008–2015, which has been visible in various large scale assessment and other survey. From 2016, an expert

[10]National Education Institute & Academic Research Network of Slovenia (2015).
Stanković Elesini and Tomažin (2018).

group on introduction of basic knowledge of computer science and computational thinking in general education has been active. Next task is to prepare, implement and monitor the implementation of action plan.

18.3.6 Digital Strategy at Particular School

In period 2009–2014 (E-education project), most of the Slovenian schools have upgraded and implemented school digital strategies as the Ministry of Education, Science and Sport though public tenders ensured a comprehensive counseling and support for schools. This was again visible in large scale assessment as Slovenian schools have been at the top on the scale in the 1st Survey of Schools: ICT in Education (European Commission 2018a, b) and ICILS 2013 (Fraillon et al. 2014). A development project to support for schools to develop and implement school digital strategy have been established (Čampelj et al. 2017).

In 2018 at EU level, self-assessment tool of use of ICT at school level (SELFIE) have been released. Another project is planned by the Ministry of Education in the period 2020–2022 (budget provide: 0.8 million EUR) to encourage the comprehensive use of SELFIE tool and to develop and implement school digital strategies at more than 220 schools.

18.4 Policy and Strategy of ICT

18.4.1 Digital Education Policy

Current policy in based on *Strategic Guidelines for Further Implementation of ICT in the Slovenian Education until 2020* was been released by the Minister of Education, Science and Sport in 2016, proposed and drafted by the program board for ICT in education (Programme Committee for Digital Education, 2016). The Strategic guidelines updates and complement a more detailed action plan of ICT in education from 2006, which describes detailed objectives and measures. Additional document about OER (as supportive document to UNESCO 2nd world OER congress, Sept 2017)—a roadmap of OER in Slovenia has been published by the Minister of Education, Science and Sport "Open education and OER—From Commitment to Action" (Ministry of Education, Science and Sport of the Republic of Slovenia 2017).

The Vision in Strategic Guidelines for Further Implementation of ICT in the Slovenian Education until 2020 (2016) is to "open up possibilities of education in an open, innovative and sustainable learning environment facilitated by innovative use of information-communication technology that will enable individuals to gain knowledge and develop skills, key competences, as well as competences of the twenty-first century that are essential for a successful integration in a society." Goals are:

GOAL 1—Didactics and e-material Develop and test innovative pedagogical approaches, models and strategies of student-centered learning and teaching that rationalize the use of ICT at all stages of learning (including critical evaluation of the didactical importance of ICT, necessary changes in teaching and learning, virtual environments of communication and cooperation, application of various sources, progress monitoring, assessment and (self)evaluation of competences, special needs, etc.). Develop didactical aids or tools (e.g. multimedia and interactive learning e-material, mobile and web-based applications, e-portfolio), and accordingly, adapt the existing educational approaches.

GOAL 2—Platforms and cooperation Set up an open platform of information technology, e-content, (e-) services, pedagogical concepts and approaches, added-value models, as well as motivation mechanisms (e.g. positive legislation) in an open education. In this way, upgrade the Slovenian education network—SIO (including efficient use of technology, e.g. cloud technology), establish synergy environment for (interdisciplinary) partner cooperation of all stakeholders in development and research of efficient use of ICT in the process of education, including economically effective business models of IT implementation.

GOAL 3—E-competences Raise the level of digital competence and enhance the use of ICT within the overall educational system, and contribute significantly to improvement of key competences and twenty-first century skills of students at all levels of education, as well as participants in adult education, namely on a premise of comprehensive development of competences of teachers, ICT coordinators, head teachers, higher education teachers, and other education staff (formal education and continuous education and training) through effective forms of training (face to face and online), by strengthening the professional (e-)communities, active exchange of good practice, peer learning, as well as and providing quality (e-)services (counselling, support).

GOAL 4—Informatization of institutions Set up open learning environments in educational institutions that shall enable innovative approaches. It includes higher level of collaborative leadership (planning, managing, evaluation) and improved flexibility, as well as e-operations, upgrade of activities pursued by the school e-development teams (curriculum, e-content, e-services, etc.) and enable an efficient and secure infrastructure: clients (mobile devices, computers, etc.), interactive devices, cloud services, standardization, and portability among various platforms, broadband and safe internet access, as well as efficient spatial and ergonomic planning.

GOAL 5—E-education (higher education, adult education) Promote e-education in higher education as a way of formal education (accreditation of subjects, modules or the overall study program); promote a form of transmitting the current higher education knowledge and skills, as well as new (scientific) knowledge or findings as part of the lifelong learning; increase the use of e-learning in terms of improving the deficit in the knowledge of students when they transfer from upper secondary to higher education or between study programs and graduates who strive to refresh or improve their knowledge with the knowledge of new (scientific) findings; preparation courses for foreigners who come to study or exchange students in Slovenia (mobility), as well as to promote e-education (e-learning) in adult education (formal as well as non-formal).

GOAL 6—Evaluation Provide sustainable and quality implementation of the strategy by measuring and evaluation of the current situation, by analyzing the indicators (including the indicators of the strategic guidelines); by benchmarking in the Republic of Slovenia, EU and beyond, namely the condition, use, efficiency and effectiveness of ICT in education; by data collecting at the national as well as international level, whereby it is practical to retrieve proper data and indicators of the international program for research in education (large-scale international assessment, as well) that will provide international standards of quality and the comparability of indicators of ICT in education.

As mentioned, program board for digital education will prepare new action plan 2021—2027 this year.

18.4.2 Financing Resource

At basic education, municipalities are responsible for equipment. However, in 1993, Slovenian parliament released a special budget for school digitalization (Computer Literacy Programme; 1994–2005) to encourage develop new teacher training programs to introduce ICT in learning, to co-finance ICT equipment (software and hardware as well as internet broadband access) and to ensure research and development projects (Slovenian Educational Network etc.). From 2000, Slovenia also started to use EU budget (6th and 7th Development European Framework for Research Projects) and especially from 2004, European Social Funds (75% or 85% co-financing from EU) has been used for new learning interactive and multimedia e-materials, teacher training (on-line and face-to-face), pedagogical and technical support for schools, etc., To further develop new methods of learning and teaching with ICT, other EU funds have been used (Long-life learning; ERASMUS + etc.). Slovenia have developed also international co-operation in the field of digital education (for example UNESCO OER movements) as well as bi-lateral cooperation at EU and other countries (Dubai etc.).

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Chapter 19
Comparative Analysis of ICT in Education Between China and CEECs

Ting-Wen Chang and Man Wan

19.1 Overview of the Country

19.1.1 Area, Population, and Official Language

China is located in the east of Asia and the west coast of the Pacific Ocean. Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Czech, Estonia, Greece, Hungary, Latvia, Lithuania, Montenegro, North Macedonia, Poland, Romania, Serbia, Slovak, Slovenia are located in central and eastern Europe (hereinafter referred to as CEECs). According to the latest data showed in National Statistical Office of each country and National Statistical Office of each country and Ministry of Foreign Affairs of the People's Republic of China, the general situation of China and 17 CEECs, such as area, population, and official language are listed as follows (Table 19.1).

19.1.2 Economic Development Level and Rates of Growth of Real GDP

For analytical purposes, World Economic Situation and Prospects 2019 (WESP), published by United Nation, classifies all countries of the world into one of three broad categories: developed economies, economies in transition, and developing economies. According to this classification, Bulgaria, Croatia, Czech, Estonia, Greece, Hungary, Latvia, Lithuania, Poland, Romania, Slovak, Slovenia belong to developed economics; Albania, Bosnia and Herzegovina, Montenegro, Serbia, North

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Table 19.1 Area, population, and official language of China and CEECs

Country	Area (thousand·km^2)	Population (million)	Official language
China	9634.1	1395.38	Standard Mandarin
Albania	28.8	2.87	Albanian
Bosnia and Herzegovina	51.2	3.32	Bosnian, Serbian, Croatian
Bulgaria	111.0	7.00	Bulgarian
Croatia	56.6	4.17	Croatian
Czech Republic	78.9	10.65	Czech
Estonia	45.3	1.32	Estonian
Greece	132.0	10.74	Greek
Hungary	93.0	9.78	Hungarian
Latvia	64.6	1.91	Latvian, Russian in common use
Lithuania	65.3	2.79	Lithuanian
Montenegro	13.8	0.62	Montenegrin
North Macedonia	25.7	2.08	Macedonian
Poland	322.6	38.40	Polish
Romania	238.4	19.52	Romanian
Serbia	88.4	7.18	Serbian
Slovakia	49.0	5.45	Slovak
Slovenia	20.3	2.08	Slovenian

Source National Statistical Office of each country and Ministry of Foreign Affairs of the People's Republic of China

Macedonia belong to economies in transition; and China belongs to developing economic.

During the decade from 2010 to 2020, China, Estonia, Lithuania, Poland, Slovakia, Albania are the six countries who always achieve the positive rate of growth of real GDP. Among all the China and CEE countries, China is the only country in which rate of growth of GDP keeps more than 6. Compared with the growth rate of 2010 and 2020, Latvia is the country in which rate of GDP grows most, increasing 7.9 from −3.9 to 4.0 (Table 19.2).

Table 19.2 Economic development level and rates of growth of real GDP

Country	Rates of Growth of Real GDP											Economic development level
	2010	2011	2012	2013	2014	2015	2016	2017	2018[a]	2019[b]	2020[b]	
China[c]	10.6	9.5	7.9	7.8	7.3	6.9	6.7	6.9[c]	6.6[c]	6.3[c]	6.2[c]	Developing economies
Bulgaria	1.3	1.9	0.0	0.9	1.3	3.5	3.9	3.8	3.4	3.5	3.5	Developed economies
Croatia	−1.5	−0.3	−2.3	−0.5	−0.1	2.4	3.5	2.9	2.7	2.8	2.7	
Czech Republic	2.3	1.8	−0.8	−0.5	2.7	5.3	2.5	4.3	2.5	3.1	3.3	
Estonia	2.3	7.6	4.3	1.9	2.9	1.9	3.5	4.9	3.8	3.5	3.0	
Greece	−5.5	−9.1	−7.3	−3.2	0.7	−0.3	−0.2	1.4	1.8	1.9	1.5	
Hungary	0.7	1.7	−1.6	2.1	4.2	3.4	2.2	4.0	4.8	3.2	3.0	
Latvia	−3.9	6.4	4.0	2.4	1.9	3.0	2.2	4.5	4.6	3.8	4.0	
Lithuania	1.6	6.0	3.8	3.5	3.5	2.0	2.3	3.9	3.2	3.5	3.5	
Poland	3.6	5.0	1.6	1.4	3.3	3.8	3.0	4.6	5.0	3.8	3.8	
Romania	−2.8	2.0	1.2	3.5	3.1	3.9	4.8	6.8	4.2	3.8	3.6	
Slovakia	5.0	2.8	1.7	1.5	2.8	3.9	3.3	3.4	4.2	4.0	3.6	
Slovenia	1.2	0.6	−2.7	−1.1	3.0	2.3	3.1	4.9	4.2	3.8	3.2	

(continued)

Table 19.2 (continued)

Country	Rates of Growth of Real GDP											Economic development level
	2010	2011	2012	2013	2014	2015	2016	2017	2018[a]	2019[b]	2020[b]	
Albania	3.7	2.5	1.4	1.0	1.8	2.2	3.4	3.8	4.2	4.0	3.8	Economies in transition
Bosnia and Herzegovina	0.9	1.0	−0.8	2.4	1.1	3.8	3.3	1.3	2.7	3.0	3.0	
Montenegro	2.7	3.3	−2.7	3.5	1.8	3.4	3.8	4.3	4.8	3.7	4.2	
Serbia	0.6	1.4	−1.0	2.6	−1.8	0.8	2.8	1.9	4.5	4.0	4.0	
North Macedonia	3.4	2.3	−0.5	2.9	3.6	3.8	2.9	0.0	2.5	3.0	3.0	

Source World Economic Situation and Prospects 2019

[a]Partly estimated

[b]Baseline scenario forecasts, based in part on Project LINK and the UN/DESA World Economic Forecasting Model

[c]Data in 2017: Partly estimated; Data in 2018,2019,2020: baseline scenario forecasts, based in part on Project LINK and the UN/DESA World Economic Forecasting Model

19.2 Overview of the Educational Development

19.2.1 Education System

In China and CEECs, Education system generally consists of kindergarten/pre-primary education, primary education, lower secondary education, upper secondary education, post-secondary non-tertiary education, higher education, special education, and adult education. Compulsory education generally includes primary education and secondary education, with specific years ranging from 8 to 13 years, and the average compulsory education period is about 10 years. In China and CEE countries, Hungary and North of Macedonia have the longest compulsory education period of 13 years. Croatia and Serbia have the shortest compulsory education period of 8 years. Compulsory education in half of these countries includes pre-school education, such as Bosnia and Herzegovina, Bulgaria, Czech Republic, Greece, Hungary, Latvia, Poland, and Romania, which has led to earlier compulsory schooling ages in these countries. For example, in Hungary, its compulsory education includes three years of pre-school education, so its official schooling age is much earlier than most countries, which is 4 years old.

In terms of free education, more than 2/3 China and CEECs have longer free education years than their compulsory education years. Among them, Latvia is the longest, which is 18 years, and Croatia is the lowest, 8 years. The average period of free education in these countries is about 13.2 years (Fig. 19.1).

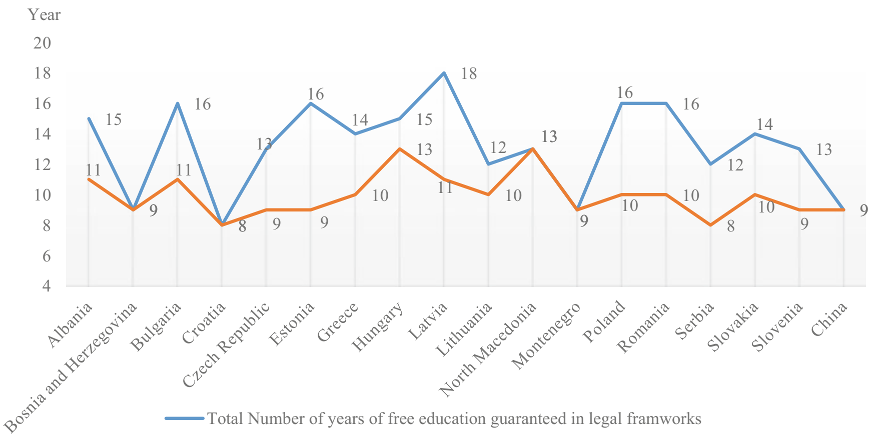


Fig. 19.1 Total Number of years of free education and compulsory education guaranteed in legal framework. *Source* UIS Stat

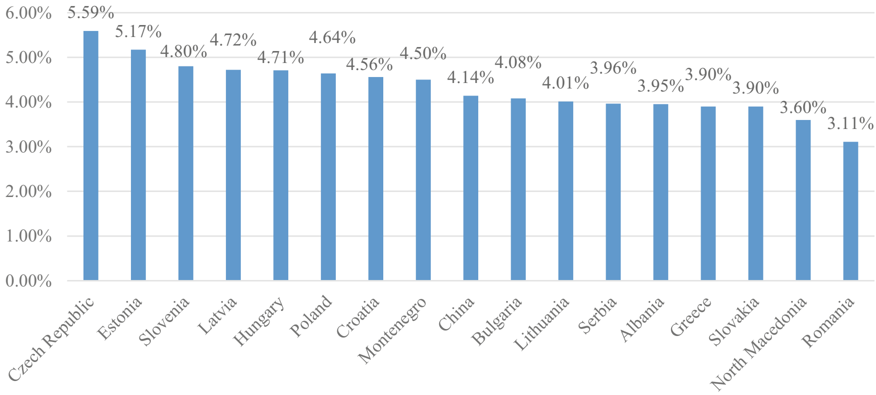


Fig. 19.2 Government expenditure on education as % of GDP. *Source* UIS. Stat, European Commission, National Bureau of Statistics of China (mainly based on the data of 2016)

19.2.2 Government Expenditure on Education

The proportion of government expenditure on education to gross domestic product (GDP) can reflect to a certain extent the importance that a country's government attaches to education as well as the efforts of the whole society to develop education. According to the data collected (Fig. 19.2), the average value of public education expenditure in GDP in China and CEECs was 4.31%. In terms of the minimum standard of 4% of government expenditure on education in GDP advocated by UNESCO (Education 2030, UNESCO), about 2/3 of countries are above this level.

In Bosnia and Herzegovina (BiH), its education system is financed from entity, cantonal, and municipal budgets. The share of education in financing from the state budget is very small. Republika Srpska allocates about 4% of its GDP for education, Federation of BiH issues about 6% of GDP while Brčko District for education allocates 11.2% of the total budget of the District.

19.2.3 Students and Teachers' Profiles

19.2.3.1 Student–Teacher Ratio

According to the data shown in Fig. 19.3, the average level of student–teacher ratio in regular primary schools of China and CEECs is around 14.41. Among the 18 countries, 10 countries' student–teacher ratio is below average. The student–teacher ratio in Greece is the lowest, being around 9.27; while Romania is the highest—over 19. The student–teacher ratio in China is about 16.55, being just lower than Bosnia and Herzegovina, Bulgaria, Albania, Czech and Romania.

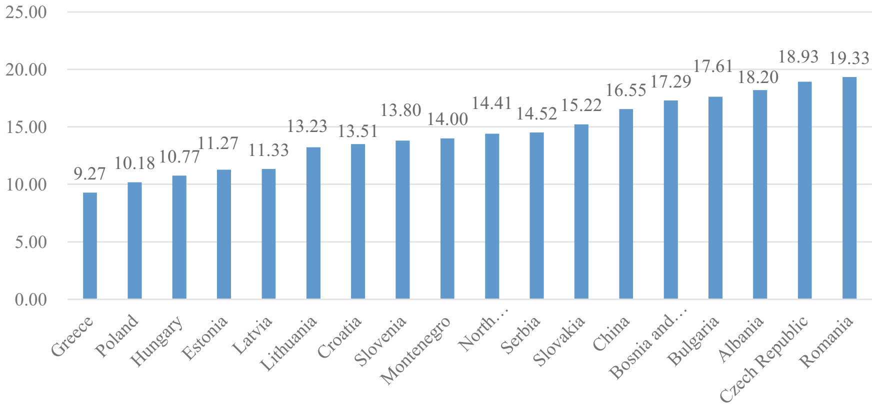


Fig. 19.3 Pupil-teacher ratio in primary education. *Source* UIS (mainly based on the data of 2016, except Poland (2017), North Macedonia (2015), Czech Republic (2013)); ICT in Education in Montenegro (Montenegro (2018))

There is a main challenge that most China and CEECs encounter with teachers aging and a lack of novice teachers. However, the main challenge in Slovenia is the oversupply of teachers and the demand for teachers has fallen in recent years due to a population decrease.

19.2.3.2 Average Class Size

As shown in the following Fig. 19.4, the average class size in the primary school of these 18 countries is around 20.48, of which 13 countries are below the average

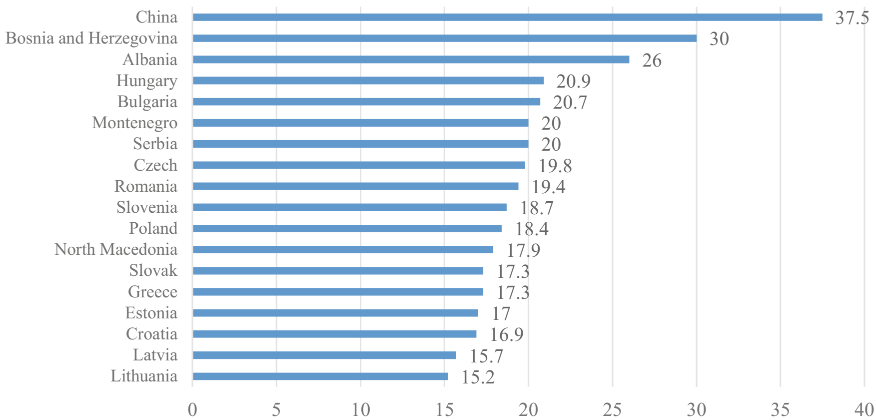


Fig. 19.4 Average class size *Sources* Eurostat (2012); OECD (2013); Edufile; *Albania: Albania Education Policy Review: Issues and Recommendations*

level. Lithuania and Latvia have the smallest class size, with 15 students in each class while the class size in China and Bosnia and Herzegovina is relatively high—with at least 30 students in the same class. Generally speaking, the reasonable class size is closely related to the teaching quality, taking the overall situation of average class size in China and CEECs into account, it can be seen that reducing class sizes is still the urgent requirement for China's educational reform.

19.2.4 Teachers' Professional Development

19.2.4.1 Teachers' Profile

In CEECs, from the perspective of numbers of male and female teachers in all education levels (pre-primary, primary education, lower secondary, upper secondary and post-secondary non-tertiary education) there is a clear dominance of female over male teachers. For example, in the stage of pre-primary education, in some countries, such as Bulgaria, Czech, Latvia, Lithuania, Hungary, Romania, and Slovakia, the proportion of male teachers is even less than 1%. According to the statistics collected in the following Table 19.3, in 2017, CEECs' average proportion of male and female teachers in primary education stage is about 1:5.9, in lower secondary stage 1:2.8, and in upper secondary stage 1:1.9. Therefore, it is noticeable that with the increase of education levels, the proportion of male teachers is gradually increasing. Especially in tertiary education, most of the CEECs have more male teachers than female teachers, with the ratio of 1.2:1.

As for China, the problem of gender imbalance among teachers also exits. According to the latest statistics collected by the Ministry of Education of China, in 2017, there were in total 2378.3 thousand full-time female teachers in pre-primary schools, accounting for up to 97.79%, and in primary, junior, senior schools and universities, the female teachers account for, respectively, 67.15%, 55.64%, 53.07%, and 49.83%.

19.2.4.2 Minimum Qualification to Enter the Teaching Profession

Referring to relevant conditions and requirements on teachers' educational level or their academic qualification, the qualification for a teaching job is an important part for choosing teacher candidates, which has been constantly established and perfected in the world's teacher professionalization movement. In China and CEECs, the minimum academic requirements for a teaching job are different in different education stages, except Bosnia and Herzegovina, Bulgaria, Greece, Lithuania, North Macedonia, and Romania, in which countries, the minimum academic qualification standards for pre-primary, primary, general lower secondary, and general upper secondary teachers are all the same. Besides, there are 13 CEECs, that is, Albania, Bulgaria, Croatia, Estonia, Greece, Hungary, Latvia, Lithuania, North Macedonia,

Table 19.3 Number of teachers in China and CEECs, 2017 (thousands)

	Pre-primary education			Primary education			Lower secondary			Upper secondary			Post-secondary non-tertiary			Tertiary education		
	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female
China	2432.1	53.8	2378.3	5955.7	1956.6	3999.1	3500.1	1575.0	1975.1	1776.4	833.6	942.8	839.2	-	-	1633.2	819.4	813.8
Albania	-	-	-	24.8[a]	-	-	-	-	-	8.9	-	-	-	-	-	4.7	-	-
Bosnia and Herzegovina	1.9[b]	0.1[b]	1.8[b]	24[b]	6.7[b]	17.3[b]	-	-	-	12.6[b]	4.9[b]	7.7[b]	-	-	-	10.2[b]	5.6[b]	4.6[b]
Bulgaria	18.3	0.1	18.2	17.4	1.0	16.4	17.6	3.5	14.1	20.6	4.8	15.8	0.3	0.1	0.1	22.2	11.3	10.9
Croatia	9.2	0.1	9.1	12.2	0.8	11.4	23.5	6.1	17.4	19.9	6.5	13.4	-	-	-	16.6	8.5	8.1
Czech	27.9	0.1	27.8	30.1	1.7	28.4	31.7	7.0	24.7	34.7	14.0	20.7	0.6	0.4	0.2	18.7	11.5	7.2
Estonia	8.5[c]	0.1[c]	8.4[c]	7.6	0.7	6.8	4.4	0.8	3.7	4.6	1.4	3.2	-	-	-	4.2	2.1	2.1
Latvia	7.7	0.03	7.7	10.5	0.8	9.7	7.5	1.2	6.4	6.7	1.3	5.4	0.3	0.1	0.2	7.0	3.1	4.0
Lithuania	10.7	0.1	10.6	8.4	0.3	8.2	22.7	4.0	18.7	8.4	1.7	6.6	1.4	0.5	0.9	12.1	5.3	6.9
Greece	14.6	0.2	14.4	69.2	19.8	49.5	41.5	13.8	27.7	36.5	16.8	19.7	9.9	4.5	5.4	19	12.5	6.5
Hungary	26.2	0.1	26.1	36.7	1.3	35.5	39.4	9.2	30.2	40.0	14.8	25.2	8.7	3.5	5.2	24.1	14.4	9.7
Montenegro	2.5	0.1	2.4	4.9	1.1	3.8	2.0[d]	0.7[d]	1.3[d]							1.6	0.8	0.8
North Macedonia	4.7	0.4	4.3	7.3	1.2	6.1	10.9	4.4	6.5	7.5	3.1	4.5	-	-	-	4.1	2.2	1.9
Poland	100.2	2.0	98.0	225.6	33.2	192.4	125.3	33.3	92.0	139.4	48.9	91.5	21.0	6.6	14.4	95.7	52.6	43.1
Romania	34.3	0.1	34.2	48.0	4.9	43.1	68.7	18.8	49.9	55.7	16.2	39.5	1.9	0.4	1.5	26.6	13.1	13.5
Serbia	13.5	0.3	13.2	18.9	2.6	16.4	36.7	12.5	24.2	30.7	10.8	19.9	0.9	0.5	0.3	11.5	6.1	5.4
Slovenia	6.8	0.2	6.6	8.8	1.1	7.7	9.1	1.1	8.0	6.1	2.0	4.1	-	-	-	7.2	4.1	3.1
Slovakia	13.8	0.1	13.7	14.5	1.4	13.1	23.1	5.4	17.7	16.8	4.8	12.0	0.8	0.3	0.6	12.2	6.6	5.6

[a]Primary education: include lower secondary education
[b]Bosnia and Herzegovina: 2018; Primary education: basic education, includes lower secondary education
[c]Pre-primary education: 2015; includes early childhood education development
[d]Lower secondary education: include upper secondary education
Sources Eurostat, National Statistic Office of each country

Poland, Romania, Serbia, Slovenia, in which pre-school teachers need minimum higher education degree or Bachelor's.

Compared with the minimum entry qualifications for primary and secondary school teachers in CEECs, China does not set high requirements on academic qualifications for teachers. Therefore, on January 20th, 2018, the Central Committee of the Communist Party of China and the State Council issued *"Suggestions for Deepening the Reform of Teachers' Team Construction in the New Era,"* which has mentioned that the entry standards for primary and secondary school teachers should be gradually improved. Integrated with the reality, academic qualifications for kindergarten teachers will be upgraded to non-university higher education sector; primary school teachers' qualifications will be improved to teacher education graduates from non-university higher education sector or non-teacher education undergraduates; secondary school teachers' qualifications will be changed into undergraduates, and upper secondary teachers' will be promoted to postgraduates where the conditions permit (Table 19.4).

19.2.4.3 Teachers' Professional Development

Programs on teachers' professional development are set to help teachers maintain a high standard of teaching. In China and CEECs, types of professional development are mainly divided into training courses, qualification programs, individual or collaborative research, mentoring or peer observation and coaching, etc. The requirements for initial teachers and in-service teachers are varied. Teachers with higher qualifications receive longer periods of professional development, and they are required more highly to complete these programs. As the important part of teacher's professional development, ICT-related training programs are not covered in all the 18 countries. Therefore, training projects focusing on more effective use of ICT in teaching need to be enhanced (Table 19.5).

19.3 New Progress of ICT in Education

19.3.1 ICT Development Index

ICT Development Index (IDI) is a comprehensive evaluation index to measure the development level of ICT in countries and regions, which bases on 11 ICT indicators, grouped in three clusters: ICT access, ICT use, and ICT skills. ICT access includes five indicators: fixed-telephone subscription rate, mobile-cellular telephone subscription rate, international internet bandwidth (bit/s) per internet user, percentage of households with a computer, and percentage of households with Internet access. ICT use includes three indicators: percentage of individuals using the internet, fixed-broadband subscription rate, and active mobile-broadband subscription rate. ICT

Table 19.4 Minimum qualifications to enter the teaching profession

China	02: Kindergarten teacher qualification and graduate from kindergarten teacher's school 1: Primary teacher qualification and graduate from non-university higher education sector 24: Lower secondary teacher qualification and graduate from higher teacher training college or non-university higher education sector 34: Upper secondary teacher qualification and graduate from higher teacher training college or other university
Albania	02: Bachelor's degree on teaching or its equivalent (ISCED 5) plus state exam 1: Bachelor's degree in education or its equivalent (ISCED 6) plus state exam 24: Bachelor's degree in education or its equivalent (ISCED 6) plus state exam 34: Bachelor's degree in education or its equivalent (ISCED 6) plus state exam
Bosnia and Herzegovina	02: Bachelor's degree in education (ISCED 6), internship and competitive examination 1: Bachelor's degree in education (ISCED 6), internship and competitive examination 24: Bachelor's degree in education (ISCED 6), internship and competitive examination 34: Bachelor's degree in education (ISCED 6), internship and competitive examination
Bulgaria	02: Bachelor's degree in education (ISCED 5) or Bachelor's degree on specific field plus further formal teaching qualifications (at least one year long) 1: Bachelor's degree in education (ISCED 5) or Bachelor's degree on specific field plus further formal teaching qualifications (at least one year long) 24: Bachelor's degree in education (ISCED 5) or Bachelor's degree on specific field plus further formal teaching qualifications (at least one year long) 34: Bachelor's degree in education (ISCED 5) or Bachelor's degree on specific field plus further formal teaching qualifications (at least one year long)
Croatia	02: Bachelor or equivalent level (ISCED 6), 1-year induction program, a competitive examination and additional pedagogical psychological education if necessary 1: Bachelor or equivalent level (ISCED 6), 1-year induction program, a competitive examination and additional pedagogical psychological education if necessary 24: Bachelor or equivalent level (ISCED 6), 1-year induction program, a competitive examination and additional pedagogical psychological education if necessary 34: Master or equivalent level(ISCED 7), 1-year induction program, a competitive examination and additional pedagogical psychological education if necessary

(continued)

Table 19.4 (continued)

Czech Republic	02: Certificate on completing upper secondary education with maturita examination (ISCED 344 or 354) in a field aimed specially at pre-primary school teacher training 1: Master's degree (ISCED 746 or 747) and pedagogical qualification 24: Master's degree (ISCED 746 or 747) and pedagogical qualification 34: Master's degree (ISCED 746 or 747) and pedagogical qualification
Estonia	02: Higher education and pedagogical competences 1: Master degree (ISCED 7) or qualification corresponding to it and teacher qualification according to the qualification frame 24: Master degree (ISCED 7) or qualification corresponding to it and teacher qualification according to the qualification frame 34: Master degree (ISCED 7) or qualification corresponding to it and teacher qualification according to the qualification frame
Greece	02: Relevant Bachelor's degree (ISCED 6)—plus examination (Supreme Council for Civil Personnel Selection (ASEP)) for permanent positions 1: Relevant Bachelor's degree (ISCED 6) (or bachelor's degree plus further qualifications on teaching and pedagogy)—plus ASEP examination for permanent positions 24: Relevant Bachelor's degree (ISCED 6) (or bachelor's degree plus further qualifications on teaching and pedagogy)—plus ASEP examination for permanent positions 34: Relevant Bachelor's degree (ISCED 6) (or bachelor's degree plus further qualifications on teaching and pedagogy)—plus ASEP examination for permanent positions
Hungary	02: BA(ISCED6) óvodapedagus/kindergarten teacher 1: BA (ISCED6) tanító/primary teacher 24: MA(ISCED7) tanár/teacher 34: MA (ISCED7) tanár/teacher
Latvia	02: Higher education (Bachelor or Master level (ISCED 6 or 7) or college level (ISCED 5)) in pedagogy and professional teacher's qualification, which include completion of in-school placement, final examinations and diploma thesis. For foreign language teacher, music teacher and sports teacher a respective qualification is necessary 1: Higher education (Bachelor or Master level, ISCED 6 or 7) in pedagogy or in a field of teaching subject and professional teacher's qualification in respective teaching subject area, including completion of in-school placement, final examinations and diploma thesis 24: Higher education (Bachelor or Master level, ISCED 6 or 7) in pedagogy or in a field of teaching subject and professional teacher's qualification in respective teaching subjects' area, including completion of in-school placement, final examinations and diploma thesis 34: Higher education (Bachelor or Master level, ISCED 6 or 7) in pedagogy or in a field of teaching subject and professional teacher's qualification in respective field of teaching subject, including completion of in-school placement, final examinations and diploma thesis

(continued)

Table 19.4 (continued)

Lithuania	02: Bachelor´s degree in education (ISCED 6), no qualification category 1: Bachelor´s degree in education (ISCED 6), no qualification category 24: Bachelor´s degree in education (ISCED 6), no qualification category 34: Bachelor´s degree in education (ISCED 6), no qualification category
North Macedonia	02: Bachelor or equivalent level (ISCED 6), faculty of pedagogy 1: Bachelor or equivalent level (ISCED 6), faculty of pedagogy, probation period and pass a state exam 24: Bachelor or equivalent level (ISCED 6), faculty of pedagogy, probation period and pass a state exam 34: Bachelor or equivalent level (ISCED 6), faculty of pedagogy, probation period and pass a state exam
Montenegro	02: Post-secondary non-tertiary education (ISCED 4) + induction phase(12 months) + professional exam 1: Bachelor or equivalent level (ISCED 6) + induction phase(12 months) + professional exam 24: Bachelor or equivalent level (ISCED 6) + induction phase(12 months) + professional exam 34: Bachelor or equivalent level (ISCED 6) + induction phase(12 months) + professional exam
Poland	02: Teacher training college diploma or foreign language teacher training college diploma (ISCED-A 550) 1: Teacher training college diploma or foreign language teacher training college diploma (ISCED-A 550) 24: Bachelor's degree or Bachelor of Applied Science degree with pedagogical training (ISCED-A 660) 34: Master's degree with pedagogical training (ISCED-A 760)
Romania	02: Bachelor's degree (ISCED 5), including module on psycho-pedagogy 1: Bachelor's degree (ISCED 5), including module on psycho-pedagogy 24: Bachelor's degree (ISCED 5), including module on psycho-pedagogy 34: Bachelor's degree (ISCED 5), including module on psycho-pedagogy
Serbia	02: Bachelor's degree (ISCED 6) 1: Master's degree (ISCED 7) 24: Master's degree (ISCED 7) 34: Master's degree (ISCED7)
Slovenia	02: Bachelor's degree (ISCED 6) in pre-school education, at least 5 months experience, and the state professional examination 1: Relevant master's degree (ISCED 7), at least 5 months experience, and the state professional examination 24: Relevant master's degree (ISCED 7), at least 5 months experience, and the state professional examination 34: Relevant master's degree (ISCED 7), at least 5 months experience, and the state professional examination

(continued)

Table 19.4 (continued)

Slovakia	02: Upper secondary vocational education (ISCED 354) 1: Master's degree in pedagogy(ISCED 7) 24: Master's degree in pedagogy(ISCED 7) 34: Master's degree in pedagogy or a bachelor plus complementary qualification on teaching(ISCED 7)

Sources Teacher's and School Heads' Salaries and Allowances in Europe 2017/2018(European Commission, 2019)
ISCED Levels (Classifications of ISCED refers to 2011 International Standard Classification of Education (ISCED) https://en.wikipedia.org/wiki/International_Standard_Classification_of_Education) =>02: Pre-primary ed. (ISCED 02); 1: Primary ed. (ISCED 1); 24: General lower secondary ed. (ISCED 24); 34: General upper secondary ed. (ISCED 34)

skills include three indicators: mean years of schooling, gross enrollment ratio, and tertiary gross enrolment ratio. The higher the score, the higher the level of development is in this area.

According to Measuring the Information Society Report Volume 1 (ITU, 2017), Estonia was the country which had the highest level of ICT development with the highest IDI value of 8.14 among China and CEECs and ranked 17th among the estimated 176 countries, and Albania was the lowest, with the lowest IDI value of 5.14 and ranked 89th. Bulgaria, Croatia, Czech, Greece, Hungary, Latvia, Lithuania, Poland, Slovak, and Slovenia were all among the Top 50 of 176 countries. As to China, with the IDI value of 5.6, ranked the 16th among the 18 countries and 80th among 176 countries (Table 19.6).

19.3.2 The Networked Readiness Index

Networked Readiness Index (NRI) is a set of indicators system launched by World Economic Forum in 2001 and significantly extended in 2012. The NRI is a composite of three components: the environment for ICT offered by a given country or community, the readiness of the community's key stakeholders (individuals, businesses, and governments) to use ICT, and finally the usage of ICT amongst these stakeholders.[1] Through scoring and ranking the effectiveness of ICT in promoting economic development and competitiveness of major economies in the world, NRI seeks to better comprehend the impact of ICT on the competitiveness of nations.

According to "The Networked Readiness Index (2016)," Estonia ranks first among China and CEECs, with the value of 5.4 and ranking 22nd among the estimated 139 countries, while Bosnia and Herzegovina ranks last with the value of 3.6. The Top 5 Networked Readiness Index countries are Estonia, Lithuania, Latvia, Czech, and Slovenia, all belonging to the high income and advanced economies. Among the upper-middle-income economies, North Macedonia achieved the best performance

[1] IGI Global. https://www.igi-global.com/dictionary/government-barriers-opportunities-greece/20227. Retrieved May 29, 2019.

Table 19.5 Teachers' professional development

Country	Participator	Organizer/programs	Subjects	Minimal time (hour)/credits
Albania	Initial teacher	Ministry of education	Subject: pedagogical, methodological, key skills, ICT, the English language, research and teaching practices in schools	
	In-service teacher		Teachers and directors should be trained at least 3 (three) days per year (compulsory)	
Bosnia and Herzegovina	In-service teacher	the Ministry of Education	Only teachers who regularly attend professional development programmes may be promoted into mentors and advisors	
			Subject includes assessment methods training	
Bulgaria	Initial teacher	National agency for evaluation and accreditation	Pedagogy	60
			Psychology	60
			Educational methodology	90
			Inclusive education	15
			ICT in education and working in a digital environment	30
			Practical training	180
	In-service teacher (primary teachers)		**Aim of Training** include: Periodically upgrading of teacher's knowledge; Acquiring new methods of teaching; Learning how to use Information and Communication Technologies in education	
Croatia	In-service teacher	Ministry of education Science and sports and relevant agencies, school	Teachers are required to take part in professional development at the national level at least once every two years, and at the county level at least three times per year	
			ICT Training courses: generic software and internet usage, ICT use in education, multimedia equipment use	

(continued)

Table 19.5 (continued)

Country	Participator	Organizer/programs	Subjects	Minimal time (hour)/credits
Czech	Initial teacher	Universities	There is no unified compulsory curriculum for teacher training but **components usually include**: general subject education, psychology, pedagogy, didactics and pedagogical practical training	
	In-service teacher	School	not compulsory	
			Training program: formal teacher qualification training, other qualification training, professional development courses	
Estonia	Initial teacher	Tallinn University and University of Tartu	**Subject**: teacher training courses, subject-specific didactics, placement and master's thesis A minimum of 50 days spent at a school acquiring some teaching experience	
	In-service teacher	Universities, foundations and non-governmental organizations	Teachers can apply for certification at any of the levels twice a year (April and November) Upon entrance into teaching, a 12-month induction program is mandatory	
Greece	Elementary school teachers	Pedagogical Departments across Greece	All teacher candidates follow the same strict national curriculum and go through the same process in achieving their accreditation	
	Secondary school teachers	Higher Education University or Technological sector	In addition to core courses in the disciplines sought to teach, teacher candidates also complete courses in teacher instruction or teaching methods courses	
Hungary	Kindergarten and primary grades teacher	four-year BA programs	Four-year BA programs; practical training	
	Lower and upper secondary grades teacher		Two school subject areas	100–130 credits/each
			education and psychology, supervised, practice-based learning	100 credits
			constitute an internship at a school	40 credits
Latvia	Initial teacher	Universities	**Subjects**: pedagogy, psychology and teaching methods, teaching practice	

(continued)

Table 19.5 (continued)

Country	Participator	Organizer/programs	Subjects	Minimal time (hour)/credits
	In-service teacher	education institutions, teachers' professional NGOs, institutions subordinated to the ministries	at least 36 h' in-service training in three years period (compulsory)	
Lithuania	Initial teacher (Primary school (Grades 1–4) teachers)	higher education institutions, teachers education centers	Courses of study include education in the subjects taught at the primary level as well as general courses in pedagogy and psychology	
	In-service		Information management, communication, content creation, security, solving digital literacy problems.	
North Macedonia	Pre-service	Ministry of Education	focusing initial preparation on pedagogy skills and use of various teaching tools	
	In-service		**ICT training**: Including structured, face-to-face and distance learning opportunities, building upon pre-service training and directly relevant to teacher needs On-going formal and informal pedagogical and technical support enabled for teachers by ICTs	
Montenegro	Initial teacher	Higher education	**Focus**: improvement of the quality of teachers' education; improvement of research work; development of mobility and European dimension and development of evaluation procedure	
	In -service teacher	the ministry of education, the university of Montenegro, VET centre, BES		
Poland	Initial teacher	university and polytechnic	**Course:** subject-specific courses for the teaching of a first subject or type of classes; psychology and pedagogy courses; teaching courses; training for the teaching of an additional subject or type of classes; a special education course; and Internships	
	In -service teacher	Higher education institutions (HEIs) Teacher training colleges in-service teacher training institutions	The government is preparing new standards for teacher education. A strong emphasis is to be placed on practical training and the adaptation of the education process by teachers to special education needs of their students	

(continued)

Table 19.5 (continued)

Country	Participator	Organizer/programs	Subjects	Minimal time (hour)/credits
Romania	Initial teacher	the Ministry of Education, higher education institutions	Fundamental issues of pedagogy	4 credits
			Theory and methodology of instruction	4 credits
			Psychology of education	5 credits
			Didactics of the subject to be taught	4 credits
			Computer-assisted Instruction	unknown
			Practical work	8 credits
	In -service teacher		in-service training is compulsory once every five years; **Training Module**: Designing, organizing and assessing teaching/learning activities; Management and communication; Computer-assisted Instruction	
Serbia	In-service teacher	Minister of education, science and technological development	Teachers should apply ICT in teaching: Knowledge, Planning, Realization and Improvement	
Slovakia	All specialist teachers	The methodological and pedagogical centre	ICT-related skills included in the core curriculum for the initial education for teachers	
Slovenia	Initial teacher	nation	Teaching practice	840 h
			Teaching presentations	5 times
	In-service teacher	schools	The participation in CPD is a necessary component for teachers to obtain a promotion in terms of career advancement and salary increase. (compulsory)	
China	Initial teacher	The ministry of education, university	**Subject**: Psychology, pedagogic, Mandarin, Teacher professional ethics and Education policy	
	In-service teacher	The ministry of education, the department of education, the bureau of education and universities	**Training Focus**: curriculum teaching, professional construction and teacher development (compulsory)	

Table 19.6 ICT Development Index

Country	IDI	IDI access sub-index	IDI use sub-index	IDI skills sub-index
	Value/Rank	Value/Rank	Value/Rank	Value/Rank
Albania	5.14/89	4.8/106	4.42/84	7.26/59
Bosnia and Herzegovina	5.39/83	5.84/86	4.52/79	6.23/82
Bulgaria	6.86/50	6.83/65	6.23/45	8.17/35
Croatia	7.24/36	7.60/39	6.45/41	8.11/38
Czech Republic	7.16/43	7.14/55	6.62/39	8.27/28
Estonia	8.14/17	8.16/20	7.97/15	8.43/23
Greece	7.23/38	7.76/38	5.82/53	9.00/4
Hungary	6.93/48	7.78/37	5.71/56	7.70/46
Latvia	7.26/35	7.41/45	6.65/37	8.17/34
Lithuania	7.19/41	7.11/57	6.63/38	8.44/22
Montenegro	6.44/61	7.03/59	5.38/66	7.37/57
North Macedonia	6.01/69	6.66/69	5.36/67	6.03/91
Poland	6.89/49	7.58/40	5.47/64	8.35/25
Romania	6.48/58	6.98/60	5.59/61	7.25/60
Serbia	6.61/55	7.20/53	5.54/63	7.57/49
Slovakia	7.06/46	7.22/51	6.67/36	7.54/50
Slovenia	7.38/33	7.91/32	6.16/49	8.79/8
China	5.60/80	5.58/89	5.27/69	6.28/81

Sources Measuring the Information Society Report Volume 1 (ITU, 2017)

with the value of 4.4 and the ranking of 46. As the upper middle level among emerging and developing Asian countries, China ranks 12th among the 18 countries with the value of 4.2 and 59th out of 139 countries (Table 19.7).

19.3.3 Government Success in ICT Promotion

The indicator of "Government Success in ICT Promotion" is measured on a 1–7 (best) score among 139 countries. According to the scores, the level of government success in ICT promotion in China and CEECs are mostly lower medium. Only the score of Estonia, North Macedonia, Lithuania, and China exceed the average value of 4.1 among the 139 countries. Estonia, with the value being 5.6, was placed in the 7th position among the 139 countries, ranking first among the 18 countries, which means this country still takes the lead in government's promotion in ICT. China, with the value being 4.5, ranked the 4th among the 18 countries; while Bosnia and

Table 19.7 Networked readiness index

2016 rank (out of 139)	Country	Value	2015 rank (out of 143)	Income level[a]
22	Estonia	5.4	22	HI-OECD
29	Lithuania	4.9	31	HI
32	Latvia	4.8	33	HI
36	Czech Republic	4.7	43	HI-OECD
37	Slovenia	4.7	37	HI-OECD
42	Poland	4.5	50	HI-OECD
46	North Macedonia	4.4	47	UM
47	Slovakia	4.4	59	HI-OECD
50	Hungary	4.4	53	HI-OECD
51	Montenegro	4.3	56	UM
54	Croatia	4.3	54	HI
59	China	4.2	62	UM
66	Romania	4.1	63	UM
69	Bulgaria	4.1	73	UM
70	Greece	4.1	66	HI-OECD
75	Serbia	4.0	77	UM
84	Albania	3.9	92	UM
97	Bosnia and Herzegovina	3.6	N/A	UM

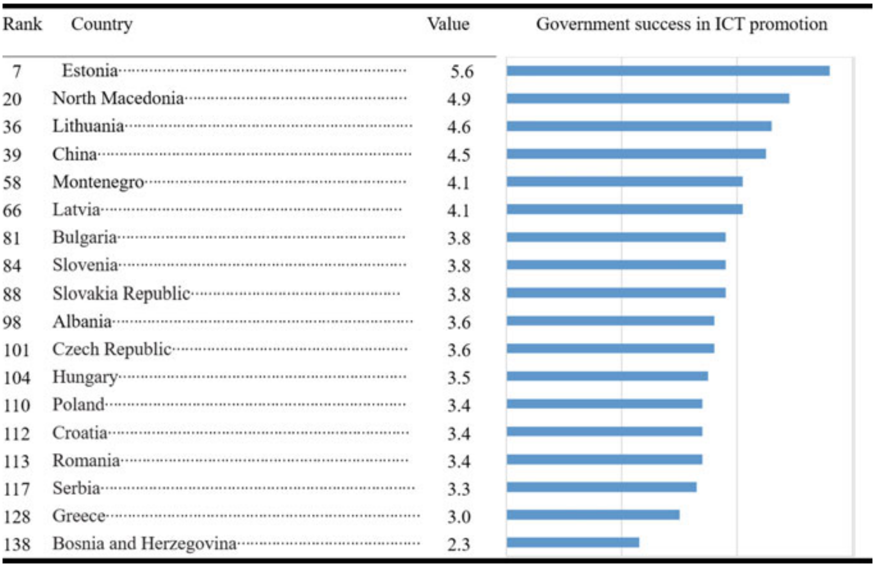
Note Income level classification follows the World Bank classification by income (situation as of July 2015)
[a]Income groups: *HI* high-income economies that are not members of the OECD, *HI-OECD* high-income OECD members, *UM* upper-middle-income economies, *LM* lower-middle-income economies, *LI* low-income economies
Sources The Global Information Technology Report (WEF, 2016)

Herzegovina was ranking last for its government to promote ICT, with the lowest score of 2.3 (Fig. 19.5).

19.3.4 Infrastructure

19.3.4.1 Internet Access in Schools

According to *the Global Information Technology Report* (WEF, 2016), the average value of internet access in schools in these 18 countries was 4.93. Among them, Estonia and Lithuania achieved the largest scale of popularizing the internet in schools



Rank	Country	Value
7	Estonia	5.6
20	North Macedonia	4.9
36	Lithuania	4.6
39	China	4.5
58	Montenegro	4.1
66	Latvia	4.1
81	Bulgaria	3.8
84	Slovenia	3.8
88	Slovakia Republic	3.8
98	Albania	3.6
101	Czech Republic	3.6
104	Hungary	3.5
110	Poland	3.4
112	Croatia	3.4
113	Romania	3.4
117	Serbia	3.3
128	Greece	3.0
138	Bosnia and Herzegovina	2.3

Fig. 19.5 Government Success in ICT Promotion. *Note* In your country, how successful is the government in promoting the use of ICTs? [1 = not successful at all; 7 = extremely successful]. *Sources* The Global Information Technology Report (WEF, 2016)

for learning purposes, indicating that ICT-based learning environment was excellent in these two countries. Slovenia, Slovak, Latvia, Czech, and North Macedonia also achieved remarkable performance in applying internet in schools for learning purposes. In Slovak, all primary and secondary schools have access to the internet at present. While in Serbia, Greece, and Bosnia and Herzegovina, the value of the internet access in schools was the worst, with the lowest value of 3.9. With the value of 4.8, internet access in school in China was also a bit below than the average (Fig. 19.6).

19.3.4.2 Computer-Student Ratio

According to the collected statistics of 16 China and CEECs except Bosnia and Herzegovina and Serbia, the average computer–student ratio in these 16 countries is around 0.58. With the ratio of 1.02, almost each student in Czech has his or her own computer for learning. In Slovak, Lithuania, and Latvia, computers have also been widely used learning tools for students. However, in Greece, Romania, Poland, Montenegro, Croatia, and Albania, the computer–student ratio is considerably lower than the regional average. China, with the ratio of 0.46, also belongs to the lower middle level (Fig. 19.7).

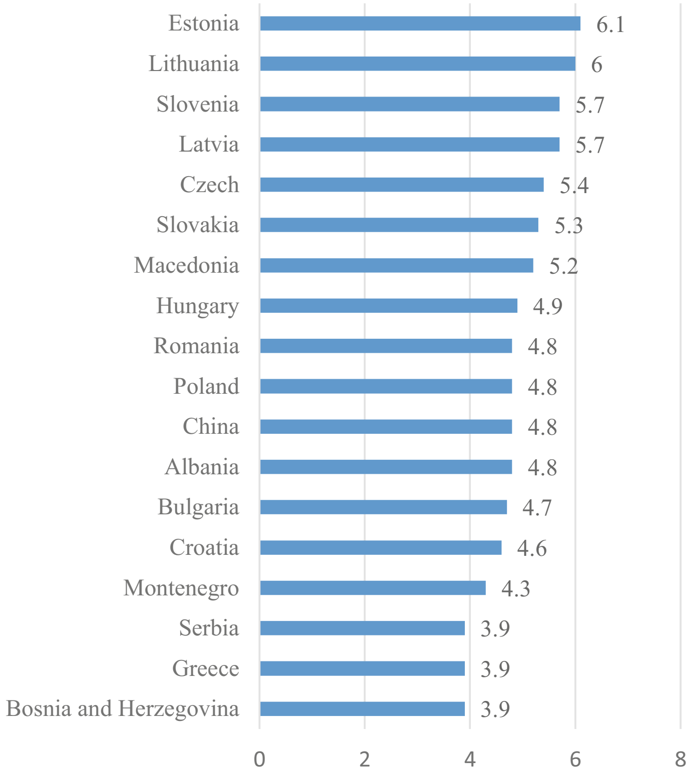


Fig. 19.6 Internet access in schools. *Note* In your country, to what extent is the Internet used in school for learning purpose?[1 = not at all; 7 = to a great extent] | 2014–15 weighted average.. *Source* The global information technology report (WEF, 2016)

19.3.5 Internet Users Ratio and Digital Skills Among Population (1–7)

According to *the Global Competitiveness Report 2018*, Estonia had the largest Internet users' population and digital skills population among the 18 countries. 87.2% of population in Estonia would use Internet, which led this country to achieve the 21st position among 140 countries. In Slovak, Latvia, Hungary, and Czech, Internet were used wildly, with respectively 80.5%, 79.8%, 79.3%, and 76.5% of population in these countries being Internet users. However, in 18 countries, internet users' population in China was the small percentage, only taking 53.2%, ranking 82nd out of 140 countries.

As to digital skills among population, the difference of the ranking of 18 countries among the 140 countries was very huge. With the ranking of 10th, Estonia still took the lead in the 18 countries. While digital skills among population in Hungary were

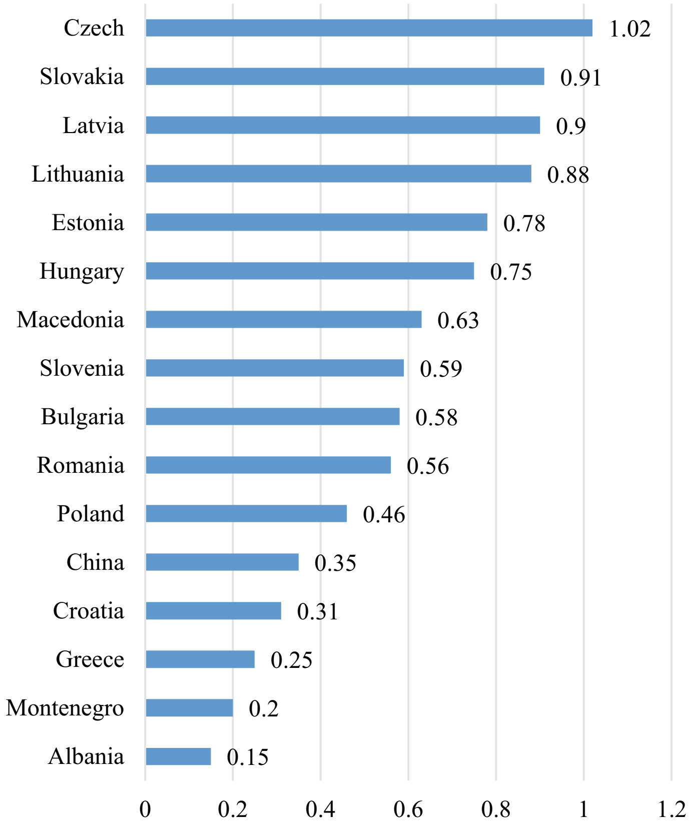


Fig. 19.7 Computer-student ratio *Note* China refers to the four PISA-participating China Provinces: Beijing, Shanghai, Jiangsu, and Guangdong. *Sources* PISA 2015 Results (Volume II): Policies and Practices for Successful Schools.©OECD 2016

the weakest, with the lowest score of 41.1 and the ranking of 115th out of 140 countries (Table 19.8).

19.3.6 Information Technology Courses

According to the data in the following table, all the China and CEECs have IT courses, mostly taught in primary and secondary schools. The focuses of IT courses in these countries are on students' practical use of computers and their development of logical and abstract thinking. Although in Montenegro, ICT courses have a profusion of varieties, covering algorithms, computer audio and graphic programs, business informatics, web graphics, etc., the amount of courses in most China and CEECs is

Table 19.8 Internet users ratio and digital skills among population

Country	Internet users % population			Digital skills among population 1–7 (best)		
	Value	Score	Rank/140	Value	Score	Rank/140
China	53.2	53.2↑	82	4.7	61.0=	45
Bosnia and Herzegovina	60.3	60.3↑	66	3.8	47.1↑	88
Bulgaria	59.8	59.8↑	68	4.2	54.0↑	66
Croatia	72.7	72.7↑	50	3.6	43.5↑	108
Czech Republic	76.5	76.5↑	39	5.0	66.9↓	27
Estonia	87.2	87.2↓	21	5.4	73.6↑	10
Greece	69.1	69.1↑	56	4.2	53.3↓	72
Hungary	79.3	79.3↑	33	3.5	41.1↑	115
Latvia	79.8	79.8↑	29	4.7	62.0↑	41
Lithuania	74.4	74.4↑	46	4.8	64.0↓	33
Montenegro	69.9	69.9↑	55	4.1	52.3↑	74
North Macedonia	72.2	72.2↑	51	3.6	43.6	106
Poland	73.3	73.3↑	47	4.2	53.8↓	68
Romania	59.5	59.5↑	70	4.4	57.2↑	56
Serbia	67.1	67.1↑	57	4.2	52.7↓	73
Slovakia	80.5	80.5↑	28	4.7	61.9↑	42
Slovenia	75.5	75.5↑	43	4.8	63.9	34

Source The Global Competitiveness Report 2018 (World Economic Forum, 2018)
Note Scores are on a 0–100 scale, where 100 represents the optimal situation or 'frontier'. Arrows indicate the direction of the change in score from the previous edition, if available
Value Indicator value for the economy under review

generally monotonous, which is mainly divided into Informatics and Programming (Table 19.9).

19.3.7 ICT Integration into Practice

19.3.7.1 Application of ICT in Teaching and Learning

With the rapid development of ICT in education, computer technology, telecommunication as well as network technology have been wildly used in teaching and learning process. The ways and means of applying ICT in education mainly include introducing novel tools to support teaching, learning, and management. For example, in Slovenia, teachers and other educators may assess their own pedagogical digital competences and find various possibilities to upgrade them by using self-assessment tool TET-SAT. In Poland, computers and the Internet can be used in the learning

Table 19.9 Information technology courses

States	Courses	Levels	Courses' requirements and focuses
China	Computer operations, information technology (compulsory)	In high schools and primary schools where the conditions permit	Practical use of computers Scientific understanding of information Attitudes of participation in the information society
Albania	ICT curriculum	Primary schools High schools (starts in III grade and extends up to XII grade)	The acquisition of ICT learning methodology Preparation of the students for employment in real life, for example, secretarial work, basic programs, creating web pages, etc.
Bulgaria	ICT as a subject (optional)	Primary schools High schools	The curriculum is synchronized with the EU framework of *Key Competences for Lifelong Learning*
Bosnia and Herzegovina	Technology and ICT Basics of computer science	Primary schools Secondary schools	Unknown
Croatia	Informatics (compulsory)	Primary(grade 5–6) and secondary schools	Use of ICT in education, programming language, computational thinking, abstraction, logic, data analysis, digital tools use, creating digital artifacts and algorithms, digital communication and digital citizenship
Czech	The subject of informatics—computer science or computing (compulsory)	Primary, lower and upper secondary schools	This subject focuses primarily on user skills to work with computers and the Internet (digital literacy)
Estonia	Informatics (optional)	Basic schools	Teaching digital competences through other subjects

(continued)

Table 19.9 (continued)

States	Courses	Levels	Courses' requirements and focuses
Greece	Informatics	Primary schools High schools	In general education: acquiring all the knowledge needed for a proper understanding of the work done with the help of a computer In high school: students should master the technologies of information and communication and be able to utilize rationally solving simple problems or making information processing
Hungary	Informatics	Primary schools High schools	Supporting digital learning and digital competence development
Latvia	Course of digital skills; Programming (compulsory)	From first grade In grades 7–9	Providing technological and informative accessibility of learning and methodological materials and an interactive learning environment for students
Lithuania	Information Technology	In lower secondary schools (compulsory)	Oriented to computer use, including modeling with logo
		At the upper secondary level (optional)	ICT integrated into other disciplines Basic and advanced modes
Montenegro	Computer science with technical education	Elementary schools Comprehensive schools Vocational schools (compulsory)	Incorporating digital literacy education in the curriculum would mean supporting every child to gain the basic skills needed for digital citizenship in the twenty-first century
North Macedonia	Informatics, Programming (compulsory) Work with computer (optional)	Primary schools Secondary schools	Office applications, Internet, programming, multimedia and computer graphics

(continued)

Table 19.9 (continued)

States	Courses	Levels	Courses' requirements and focuses
Poland	IT, Computer activities (compulsory) Programming (optional)	Primary schools Secondary schools	Low secondary schools—contain a section on algorithm, algorithmic thinking and solving problems with computers High schools—focus on informatics (computer science)
Romania	Computer Science and ICT School Curriculum (compulsory)	Grade 5–8	Reinforcing the commitment to help prepare children and adolescents for living in the IT world
Serbia	Course of Informatics and Programming	From primary education at the fifth grade	In higher education: constantly following developments in computer science, ITS professors harmonize the curriculum with the highest global standards and newest achievements in the information technology sphere and they work according to advanced programs that teach students IT skills using latest-technology software solutions
Slovakia	ICT as a subject (compulsory)	At all levels of compulsory education	5 principles for the informatics education in all levels Information around us; Communication through digital technologies; Procedures, problem solving, algorithmic thinking Principles of the functioning of digital Technologies; The information society

(continued)

Table 19.9 (continued)

States	Courses	Levels	Courses' requirements and focuses
Slovenia	E-education Project (compulsory)	In most of the Slovenian schools	Grade 7: Editing Text Grade 8: Computer Network Grade 9: Multimedia High school and gimnazium Processing the data, computer networks and programming, plus algorithmic thinking and problem solving

process in the informatics labs, libraries with public access to computers and the Internet, classrooms, and lecture halls. In Hungary, an online diagnostic assessment system was introduced to primary school to assess the mastery of curricular materials, measure the skills of applying knowledge in new contexts, and monitor students' psychological (domain-specific and general thinking skills) development. In Serbia, 88% of secondary schools have their own website, 6% of the schools are using online learning management platforms. Among these online systems, Moodle is the most popular and widely applied online learning community in many countries, through which better mastery of learning materials in class and better communication with teachers after class can be achieved.

Besides, some states have made great progress in renewing teaching model in classrooms and exploring the technology associated with using new tools in classroom teaching. In Czech, mobile classrooms have penetrated in its major primary schools, middle schools, and universities. In Estonia, every fifth classroom has an interactive whiteboard, and video projectors are installed in 65% of the classrooms.

As to China, the development of new technologies such as educational robots, educational data, artificial intelligence, internet of things, learning analysis technology, and block chain technology has brought new opportunities for the development of educational informatization. In the future, the development of ICT in education will focus on promoting the deep integration of information technology and education, creating a wise learning environment, building large educational resources, improving the information literacy of teachers and students, transforming the mode of talent cultivation, educational service, and educational governance from the integrated application to the innovative development.

Despite all of these development and achievements, the process of applying ICT in education has also met some obstacles in some areas—either the lack of ICT skills or the lack of willingness to apply ICT in education has bothered some states. As for ICT skills for teaching, 18.6% of Slovakia teachers have highlighted the need for further professional development in this area; in Czech, though a compulsory subject has been a compulsory part of the curriculum for schools, it is still not enough since users' skills to use a computer are not sufficient for study and work. As for the willingness to apply ICT, in Croatia, over 60% of teachers believe that ICT negatively impacts writing or social skills, with 51% believing that ICT only stimulates copy-pasting information from other sources.

19.3.7.2 Capacities of Teachers and Students to Use ICT

In the Information Age, many countries have put forward new demands on teachers and students' abilities to apply ICT to solve related problems. In China and CEECs, teachers and students' professional development abilities vary greatly.

According to related studies, in some CEECs, excellent performances of using ICT have already been achieved, which is characterized by that teachers hold a quite positive attitude towards adopting ICT in teaching and ICT skills are better commanded by teachers and students. Romania is the leader in Europe, and sixth in the world, in terms of the number of certified IT specialists. According to Microsoft (who acquired since 2003 Romanian Antivirus Technology), Romania has a clear potential in IT, an area in which Romanian students, researchers, and entrepreneurs excel. In Poland, more than half of teachers have expressed their willingness of introducing ICT tools to their classes and they have had the experiences of e-learning in the form of online courses, educational projects, post-graduate studies, training courses, IT courses, or language courses. Lithuanian teachers are reported to be very active in ICT training—the majority (68%) of teachers have learnt to apply ICT during the lessons and 43% of them have improved their digital qualification. In Estonia, teaching ICT competences of mathematics and natural sciences teachers is considered the best. In total, 78% of teachers use computers and 70% of teachers use presentation tools regularly in their teaching. In Bulgaria, teachers universally hold a curious attitude towards ICT and their participation in ICT pedagogical use courses is also above the EU average level, and this country is said to have enough confidence that it could easily measure with the best European practices. In Latvia, ICT in educational establishments are used very widely for developing database for teachers, preparing documents and organizing and managing study process (e-class). In Slovakia, the use of ICT by teachers is higher at all grades with considerably more teachers using ICT.

However, in some other CEECs, teachers and students' abilities of using ICT are limited. Croatian teachers' attitudes towards the use of ICT in education are less positive, with only 54% of them believing in ICT's role of creating better learning results for students. Bosnia and Herzegovina has already admitted that in their country, there are no specially designed training courses for teachers or their preparation for the use of ICT in the educational process. In Hungary, the situation has not so many differences, in which ICT skills are not automatically part of the teacher training courses, because they are only available in a few higher education institutions.

In accordance with the teachers' ability of applying ICT in teaching process, students in some countries own excellent abilities to command digital learning resources—the abilities of students in North Macedonia to use ICT tools to solve problems at all education level are reported to be on very good level. Lithuanian pupils' information and computer literacy (CIL) is similar to their peers abroad and is around the basic level, with over 60.2% of students in grade 8 are using their own computers and mobile phones for learning. In Romania, digital tools are provided to improve quality assessment in pre-university system, while in Montenegro, all schools provide e-mail addresses and 57% of students are using smartphones at least weekly for learning in courses.

In some other countries, the situation with students' ability of applying ICT is not so much remarkable. In Slovenia, the level of digital education is lower than that in the period 2010–2016. Students' confidence in their digital competence has been reported (on the scale up to 4) with 2.9 Information and data literacy, 3.2 Communication and Collaboration, 2.7 Digital Content Creation, 2.8 Internet Safety, 2.7 Problem solving. More than 70% students reported about none coding or programming activities at school. In Serbia, though email addresses and websites have been universal for primary and secondary schools, learning management systems and other ICT tools are still rare in this state. According to The ICILS 2013, among 21 countries, Croatia ranks 14th on the list, with very few Croatian students (1%) in the highest literacy level. Besides, Hungarian students' ICT literacy and skills of working in technology-rich environments are below the international norms.

As to China, in the past 40 years of economic reform and opening up, this country has made remarkable achievements in the development of ICT in education. Teachers have significantly improved their ability to use digital tools and software for teaching and informationization-supported teaching has gradually become the norm. Universities, primary, and secondary school principals have generally promoted the leadership of informationization, and a number of specialist principals have emerged, playing an important role in promoting the process of informationization in school education.

With the popularization of ICT in primary and secondary education, Chinese students' information literacy has also improved significantly. More and more students have mobile terminals such as smartphones, tablets, notebooks, and so on. Blended learning is gradually becoming the main learning mode in universities, primary, and secondary schools. Students improve their ability of using information to carry out collaborative learning, inquiry learning, research learning, and so on. With the implementation of STEAM and Creator Education, innovation guided learning is gradually favored by students.

19.4 ICT in Education Projects

According to case studies of China and CEECs, their projects of ICT in Education are collected as follows (Table 19.10).

19.5 ICT in Education Related Policies and Strategies

In China and CEECs, there are huge differences in the understanding of the importance and urgency of implementing the strategies and policies of ICT in education. Most countries have realized the significance of ICT in education and have launched a series of strategies for ICT in education. In China, Slovenia, Serbia, Poland, Hungary, Czech, and Bulgaria, strategies of ICT in education are placed in a crucial position, while some countries have not yet realized the importance of these strategies. In Bosnia and Herzegovina, there is still no strategy for the development of information communication technologies in society as well as in education.

As for the content of strategies for ICT in education, the emphasis of each country varies. For example, Czech, Hungary, Estonia, Poland, and Slovakia emphasize

Table 19.10 ICT in education projects

Country	Projects of ICT in education	Key word
Albania	1. "Education and leadership—develop ICT in pre-higher education" (2017): an up-to-date modern ICT curriculum, a teacher's learning platform (TLP) for ICT teachers	ICT curriculum, teacher's learning platform
Bosnia and Herzegovina	1. The program of computerization of primary and secondary schools 2. "Dositej" project 3. "School for the twenty-first Century in the Western Balkans" program 4. Improving the Key Competencies of Teachers in the Tuzla Canton area 5. E-diary: allows parents to see the grades and absences of students 6. "Video Conference" project	ICT infrastructure, teacher training, home-campus service
Bulgaria	1. Training for IT Career 2. Information and Communication Technologies (ICT) in the System of Pre-school and School Education for 2017	Teacher training, ICT infrastructure

(continued)

Table 19.10 (continued)

Country	Projects of ICT in education	Key word
Croatia	1. e-Schools project—support primary and secondary schools in the process of growing their institutional digital maturity	e-Schools
Czech Republic	1. Nine-year project «Supporting the development of informatics thinking (PRIM)» 2. Three-year project «DG: Support for the development of digital literacy»	Informatics thinking, digital literacy
Estonia	1. Modernizing the ICT infrastructure of general schools in 2016–2020 (Renovate network cabling and replace network equipment) 2. ProgeTiger programme (2012)-enhance learners' technological literacy and digital competence 3. The digital focus programme: the main development strategy and funding instrument for ICT in education 4. IT Academy programme: focuses specifically on improving the quality of ICT education in higher education	Network equipment, digital competence, ICT education
Greece	1. The Survey of Schools: ICT in Education (2011–2012): to benchmark countries' performance in terms of access, use and attitudes to ICT at grades 4, 8 and 11 2. "ICT in Schools": research focused, e-learning	ICT in education, ICT in schools
Hungary	1. "Development of textbooks, equipment, digital content and National Public Education Portal in line with the National curriculum" (2015) 2. The digital Themeweek (2016)	The use of digital technologies in the classroom

(continued)

Table 19.10 (continued)

Country	Projects of ICT in education	Key word
Latvia	1. ERDF project "Training of small and micro enterprises for the development of innovations and digital technologies in Latvia"	Enterprises training
Lithuania	1. Information technologies for higher education and science (2001–2006)" (ITMiS)	Information technologies
North Macedonia	1. Computer for every child 2. Macedonia country of computer experts 3. Technology integration Program 4. Free internet for all citizens 5. Twenty-first century schools program in Western Balkans	ICT infrastructure, digital skills
Montenegro	1. European computer driving licence for digital Montenegro—employee training 2. Montenegrin Educational Information System project—providing all educational institutions with computer equipment, the provision of broadband, training for school-based ICT coordinators and administrative and staff, and computer training, the selection of regional ICT coordinator, and finally, the implementation of the MEIS application 3. Win the internet, Surf Smart—to educate and improve the Internet skills of Montenegrin children, for safe use of internet 4. Schools for the twenty-first century—offer training and support for teachers in the field of critical thinking and problem solving, digital skills and using the microbit computers	Employee training, ICT infrastructure, children's internet skill

(continued)

Table 19.10 (continued)

Country	Projects of ICT in education	Key word
Poland	1. "Digital school" project (Equip schools with computer equipment, raising teachers' competences, create OER) 2. "Our ABC-book" (development and release of state-funded textbooks for grades 1–3 in primary school) 3. Open monuments project (manages open information website about monuments) 4. Masters of coding program (make open educational materials about teaching programming in primary schools)	Computer equipment, open educational materials
Romania	1. "CRED: relevant curriculum, open education for all" project (curricular reform) 2. 200 Euro programme (help students from low-income families purchase computers) 3. System educational informatization programme (equipped Romanian schools with computers, latest technologies and internet connection, trained teachers and developed digital contents) 4. Knowledge Economy Project (KEP)—Expanded access to information and communication technologies and improved digital literacy; development and promotion of government e-services; Promotion of e-commerce and innovation support for SMEs 5. The Educated Romania (2016–2019)—conducting a broad public debate on education and research for a set of policies 6. Relevant curriculum and open education for all (http://www.ise.ro/cred) (2017–2021)—train teachers and produce OERs	Curricular reform, equip computer, internet connection, teacher training, digital literacy

(continued)

Table 19.10 (continued)

Country	Projects of ICT in education	Key word
Serbia	1. Digital School(equip computer room for primary schools)	Computer room
Slovakia	1. "Infovek" 2003–2017 (national program, has made improvement in terms of school access to the Internet) 2. eSkills week	Internet access, eSkills
Slovenia	1. Computer Literacy Programme (special budget for ICT in education) 2. Development and implementation of an effective assessment of pedagogical digital competencies of educators 3. Project POKIT (provided consultations and professional support for teachers to design and use digital technology in teaching and to develop digital competences of students) 4. Innovative and flexible forms of teaching and learning in pedagogical study programs (train future teachers) 5. Integrating the use of information and communication technology in higher education (integration of didactic use of ICT in pedagogical processes to enhance digital skills and digital literacy of students) 6. Establishing a system for monitoring the employability of higher education graduates in Slovenia and Modernizing eVS 7. Innovative and flexible forms of teaching and learning	Computer literacy, future teacher training, ICT integration, teaching and learning innovation

the improvement of digital competence, while in Bulgaria, Lithuania, Macedonia, and Montenegro, more attention is paid to the construction of ICT infrastructure (Table 19.11).

Table 19.11 ICT in education related policies and strategies

Country	ICT related policy and strategy	Key words
China	1. Ten-year development plan of education informatization (2011–2020) 2. Open education and OER—from commitment to action 3. The thirteenth five-year plan of education informatization 4. The action plan of education informatization 2.0 5. National information development strategy (2006–2020)	Education informatization
Albania	1. Albanian digital agenda 2015–2020; 2. The 2014–2020 pre-university education development strategy	Digital agenda, pre-university education
Bosnia and Herzegovina	1. Internal policy for the development of the information society of the Brčko District of BiH 2. Strategy for education development 2016–2021 in Republika Srpska (RS)	Information society, education development
Bulgaria	1. Strategy for effective implementation of information and communication technologies in education and science in the Republic of Bulgaria (2014–2020) 2. Information and Communication Technologies (ICT) in the System of Pre-school and School Education for 2017	ICT development indicators, ICT environment
Croatia	1. The strategy of education, science and technology (2014) 2. Strategy for broadband development in the republic of croatia for 2016–2020	Comprehensive curricular reform, lifelong learning
Czech Republic	1. Digital education strategy 2. Estonian lifelong learning strategy 2020 (2014)	Education equalities, quality teaching and teaching, education system, digital competence

(continued)

Table 19.11 (continued)

Country	ICT related policy and strategy	Key words
Estonia	1. The Estonian research and development and innovation strategy 2014–2020 (2014) 2. Estonian lifelong learning strategy 2020	ICT, health technologies and services, effective use of resources
Greece	1. National digital policy 2016–2021	Digital skills
Hungary	1. National Info-communication strategy 2014–2020 2. Digital Success Programme (DSP) 3. Hungary's Digital Education Strategy(DES) 4. Hungary's public education development strategy 5. The Degrees of Change in Higher Education strategic document	Strategic goal, digital competences, higher education transform, use of ICT in education
Latvia	1. Sustainable development strategy of Latvia until 2030 2. Guidelines for the development of education 201–2020 3. National development plan 2014–2020 4. Guidelines for the development of science, technology and Innovation for 2014–2020 5. Adult education governance model implementation plan 2016–2020	Digital learning environment, e-teaching materials
Lithuania	1. Next generation internet access development plan for 2014–2020 2. Digital agenda for the Republic of Lithuania 3. Action plan for ICT implementation in general and vocational education for 2014–2016 4. Higher education infrastructure program LITNET 2017–2021	Internet access, learning and teaching conditions, higher education, computer networks

(continued)

Table 19.11 (continued)

Country	ICT related policy and strategy	Key words
NorthMacedonia	1. National strategy for information society development of Republic of Macedonia: action plan (2005–2015) 2. National policy on information society and the national strategy on information society development (2005–2015) 3. National strategy for ICT (2015–2018) 4. National cyber security strategy	Computerization and digitalization of education, national strategy, information society, cyber security
Montenegro	1. Strategy for the information society development of Montenegro 2020	Broadband access, digital skills
Poland	1. The development of school infrastructure and students' and teachers' ICT competences in the years 2017–2019—"Interactive Whiteboard" 2. The amendment to the Act on education information system (SIO) 3. School education priorities for the school year 2018/19	School infrastructure, ICT competences, education information system
Romania	1. National strategy on digital agenda for Romania (2014–2020)	ICT integration, digital infrastructure
Serbia	1. The education development strategy for Serbia until 2020 2. The guidelines for advancing the integration of information-communication technologies in education 3. Digital competence framework—teacher for a digital age	ICT integration, policy instrument
Slovakia	1. Learning Slovakia	Use of ICT, technical equipment, ICT training
Slovenia	1. Strategic guidelines for further implementation of ICT in the Slovenian education until 2020 2. Upgrade of digital strategy in Slovenian education (2021–2027) 3. Upgrade of existing E-materials in the period 2019–2022	Digital strategy, E-materials

19.6 ICT Financing Resource

For some European Union (EU) member states, such as Estonia, Hungary, Serbia, and Poland, financial assistance from EU is the most important and largest funding resource for the development of ICT. Over half of EU funding for the construction of ICT is issued through European Structural and Investment Funds (ESIF), since network is a priority area in structured finance. Besides, European Social Fund (ESF), European Regional Development Fund (ERDF), as well as European Investment Bank (EIB), also have played a crucial role in investing in education infrastructure in Croatia, Latvia, Lithuania, and Slovak.

Additionally, Ministry of Education and the National Budgets of each country are the main resources for the application of ICT in education. In Czech, ICT projects are generally supported by public budgets and Ministry of Education, Youth and Sports. While in certain countries, there are some special sources of funding. For example, in Bosnia and Herzegovina, its ICT in education is mostly financed by public funds of the entities, cantonal, district of Brčko, and the municipal budgets, partly financed by local ministries or private institutions. In Bulgaria, financing support from America for Bulgaria Foundation (ABF) has largely promoted the development of ICT. In Montenegro, World Bank is of great significance in investing projects for higher education, research and competitiveness.

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Appendix1: Joint Virtual Laboratory for Future Education

Background

In response to the "16 + 1" cooperation mechanism, established by China and Central and Eastern European countries in 2012, and the Belt and Road Initiative proposed by President Xi Jinping in 2013, and also acknowledging the importance of long-term cooperation between China and China and Central Eastern European Countries (thereafter short for China and CEECs), the importance of collaboration between university and industry, the importance of information and communication technologies (ICT) in building knowledge-based societies, and the importance of building worldwide capacities in the field of ICT, University of Novi Sad, Beijing Normal University, and NetDragon Websoft Inc. signed a cooperation agreement (MoU) on May 29th, 2018 during the 5th Meeting of China-CEEC Higher Education Institutions Consortium held in Shenzhen, China.

The purpose of this MoU is to promote multilateral cooperation in the area of research, innovation, and technology between China and CEEC through establishing a Joint Virtual Laboratory for Future Education as the foundation of the Education Informatization Partnership Program, beginning with Serbia and later extending to the other 15 countries involved in 16 + 1 Cooperation Mechanism.

Three Initiative Parties

1. **Beijing Normal University**

Beijing Normal University, a key university under the administration of the Ministry of Education, is a renowned institution of higher education known for teacher education, education science, and basic learning in both the arts and the sciences. The comprehensive disciplinary strength of Beijing Normal University puts the school at the forefront of the nation's advanced teaching institutions, and therefore, it has been listed on the nation's "211 Project" and "985 Project" Construction Program. The University has 22,000 full-time students, including 8,900 undergraduates, 11,300 graduates and 1,800 long-term international students.

Beijing Normal University always attaches importance to international exchange and cooperation. At present, the university has established cooperative ties with

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about 300 universities and international organizations from more than 40 countries and regions.

Smart Learning Institute (SLI) is affiliated to Beijing Normal University, and serves as an experimental platform comprising scientific research, technology development, and education. It is also a joint venture between BNU and Elernity. SLI aspires to promote the advantages of BNU in education, psychology, educational technology, and other disciplines. It also aims to utilize the capital, knowledge, and experiences of Elernity, and its parent firm NetDragon Websoft Inc., in internet technologies, cloud computing, and product development. Now, SLI is focusing on researching learning patterns under ICT environments, designing smart learning environments, and building platforms that enable life-long learning and support the various, personalized, and differentiated learning styles of digital learners.

2. **University of Novi Sad**

The University of Novi Sad (UNS) was founded in 1960. It is the only state university in the Autonomous Province of Vojvodina, comprising 14 faculties and 2 research and developmental institutes, with more than 50,000 students, 5,000 teaching and non-teaching staff. As a comprehensive and reputable educational and scientific institution, UNS covers nearly all major fields of study and research. The activities of UNS are realized through fundamental, applied, and developmental research and teaching in the field of natural, technical, social, humanistic, and medical sciences as well as arts. It is recognized as a reform-oriented university in the region and on the map of universities in Europe. UNS is rather active in the international collaboration field participating in both educational and research projects (ERASMUS+, TEMPUS, HORIZON 2020, FP7, EUREKA, COST, IPA, etc.), and is taken as an example of how one university in a transition country, which was lacking tradition in entrepreneurial practices, is striving to become an entrepreneurial university and leading many projects dedicated to innovation and technology transfer and ideas commercialization.

The Faculty of Technical Sciences (FTN) is the largest faculty at the UNS offering a very prominent educational profile for prospective engineers, which ranks it among the most developed institutions in the field of technology in Serbia. It was founded in 1960 and until now it has developed 13 departments and 33 research centres. The activities of the FTN have been divided into education, research and development and applied research in cooperation with Industry. There are more than 300 cooperation agreements signed with companies. FTN has been issued the certificates EN ISO 9001:2008, ISO 14001:2009, OHSAS 18001:2007 and is accredited as a research and scientific institution. Department of Industrial Engineering and Management has a great tradition in the field of IEM. their researchers promoted inseparable three dimensions of development path by combining RESEARCH-EDUCATION-INDUSTRY TRANSFER. From its establishment, department of IEM has a strong support from the most important research institutions like Fraunhofer IAO Stuttgart, Germany, Cranfield University, UK, and industry FESTO, SMC, Cisco Systems, USA, ABB and from companies like Norma Group, Dreaxlmeier, Siemens, Robert Bosch, IG Bauerhin, ATB Sever, etc.

Department of Industrial Engineering and Management has established **E-Learning laboratory (eLLab)** at the University of Novi Sad based on successful cooperation with Cisco Systems (from 2007, establishing first regional Cisco Entrepreneur Institute TC Serbia), and today has more than 7000 students enrolled on different courses (about 300 courses) and more than 400,000 page views per month. Beyond further development of e-learning and transferring good practices to other consortium members, special emphasis in this e-learning environment will be given on the development of student internship program.

3. **NetDragon Websoft Holdings Limited**

NetDragon Websoft Holdings Limited (Stock Code: 777.HK), established in 1999 and headquartered in Fuzhou, Capital of Fujian Province of China, is a world's leading creator of the online community. As the first Chinese game maker that successfully expanded outside of its home market, NetDragon has localized its products in over 10 different languages, including English, French, Spanish, and Arabic, and has reached over 65 million users covering 180 markets. Its' brunch Elernity was founded in 2010, Elernity's mission is to leverage the power of the Internet to improve education, by combining superior educational resources with advanced information technologies. The company employs over 1,500 personnel, including over 1,000 research personnel. The vision of Elernity is to build a global lifelong learning community.

Five Mission

The Lab aims to promote multilateral cooperation in the area of research, innovation, and technology between China and CEECs, beginning with Serbia and later extending to the other 15 countries involved in 16 + 1 Cooperation Mechanism, focusing on, but not limited to the following:

1. **Teacher training**: To provide professional and continuing training to teachers who are at the heart of education system in using ICT to improve their teaching practices;
2. **Educational Resources**: To promote access to resources and encourage sharing of information and knowledge to create inclusive knowledge societies;
3. **Models of ICT-Based Teaching**: To explore and develop innovative models of ICT-based teaching for implementation in schools in diverse contexts;
4. **ICT Infrastructure**: To advance the development of ICT infrastructure to improve the quality of education and increase equity in education;
5. **Policy Analysis and Planning**: To encourage policy analysis and planning that prepares the next generation for the demands of knowledge societies.

Call for Both Domestic and International Partners

We sincerely invite partners from China and CEECs to join the Joint Virtual Lab for Future Education. The scope of invitation includes but is not limited to:

1. Government bodies and institutions who can conduct and provide funding for the Lab;
2. Primary schools, high schools, and universities who are interested in future education with new educational technologies and teacher training;
3. Enterprises and organizations who are outstanding and representative in the fields of education and education technologies and can provide funding;
4. Individuals who are famous and have rich experience in education and education technology researches.