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).

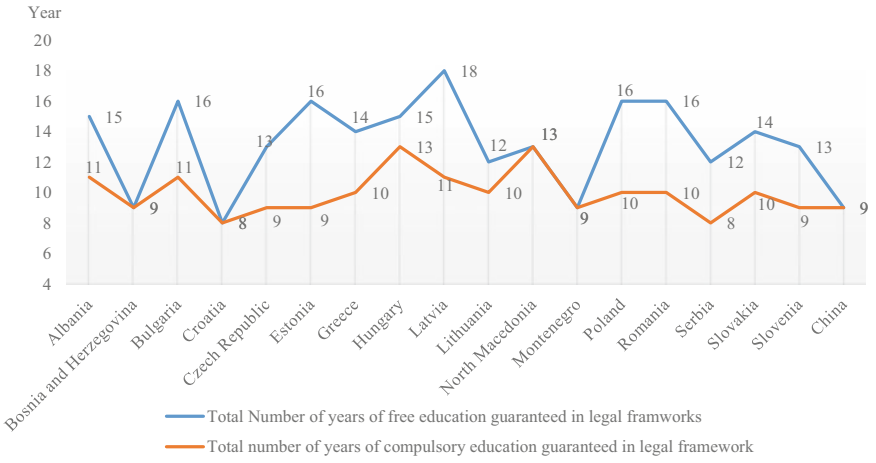

Fig. 19.1 Total Number of years of free education and compulsory education guaranteed in legal framework. *Source* UIS Stat

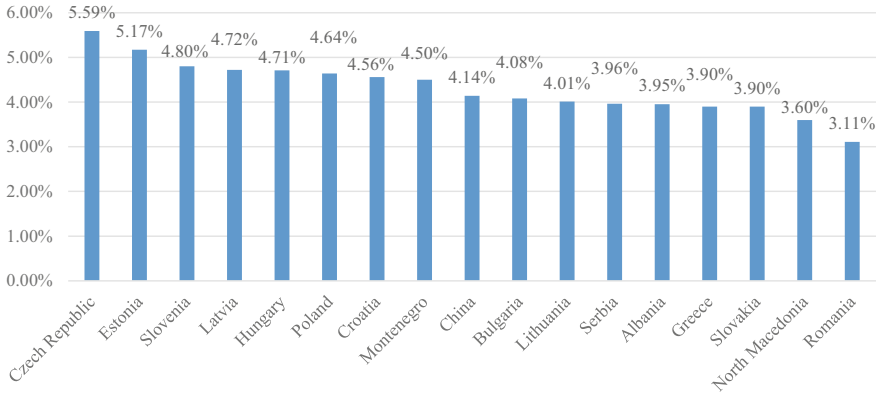

Fig. 19.2 Government expenditure on education as % of GDP. *Source* UIS. Stat, European Commission, National Bureau of Statistics of China (mainly based on the data of 2016)

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.

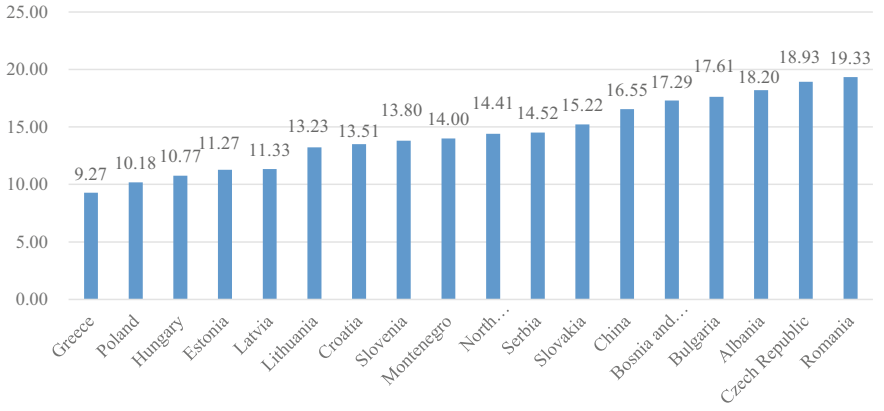

Fig. 19.3 Pupil-teacher ratio in primary education. *Source* UIS (mainly based on the data of 2016, except Poland (2017), North Macedonia (2015), Czech Republic (2013)); ICT in Education in Montenegro (Montenegro (2018))

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

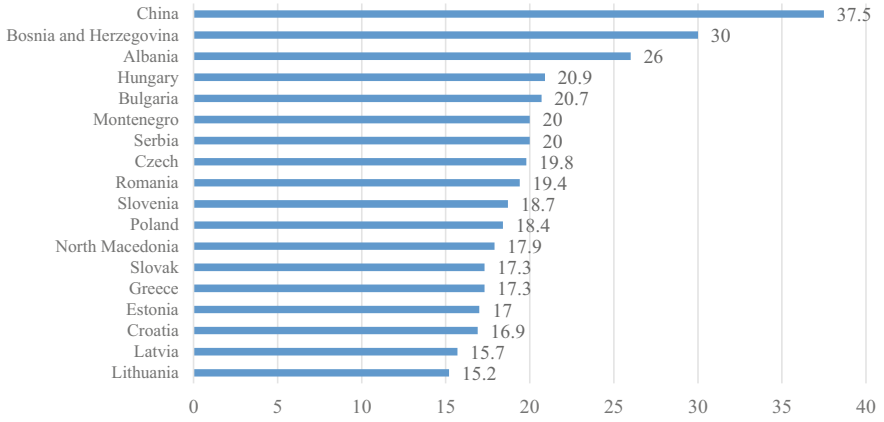

Fig. 19.4 Average class size *Sources* Eurostat (2012); OECD (2013); Edufile; *Albania: Albania Education Policy Review: Issues and Recommendations*

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

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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	Government success in ICT promotion
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).

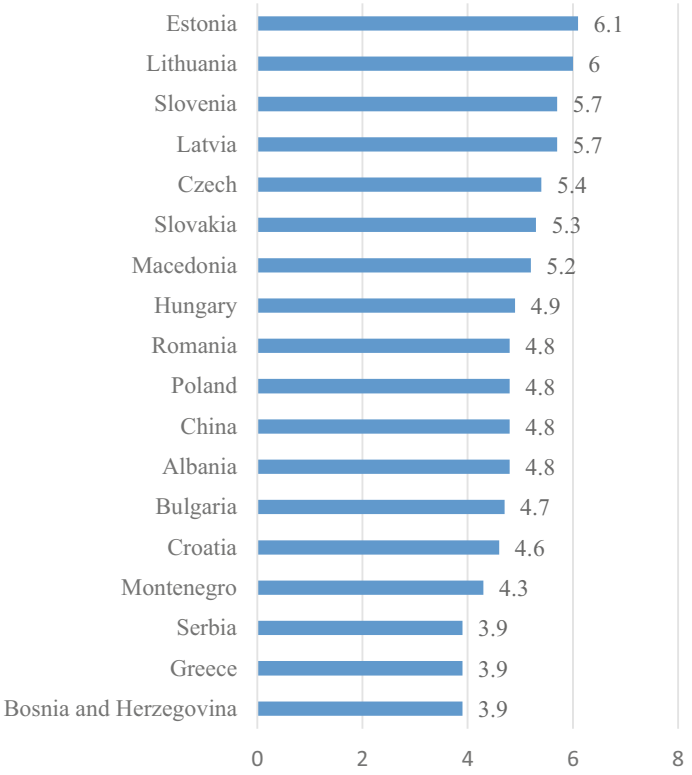

Fig. 19.6 Internet access in schools. *Note* In your country, to what extent is the Internet used in school for learning purpose?[1 = not at all; 7 = to a great extent] | 2014–15 weighted average.. *Source* The global information technology report (WEF, 2016)

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

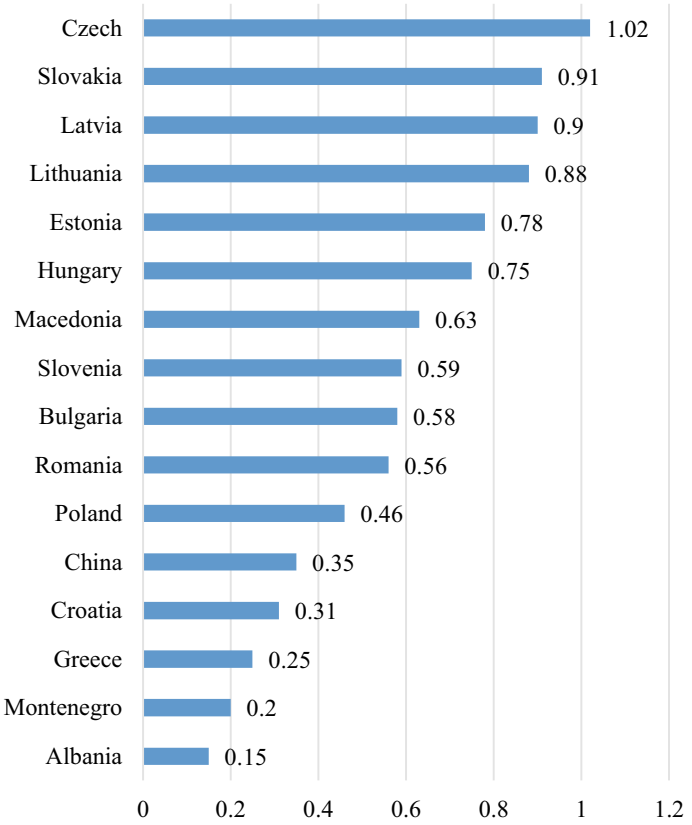

Fig. 19.7 Computer-student ratio *Note* China refers to the four PISA-participating China Provinces: Beijing, Shanghai, Jiangsu, and Guangdong. *Sources* PISA 2015 Results (Volume II): Policies and Practices for Successful Schools.©OECD 2016

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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