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UNDP Project:

"Digital skills and opportunities for youth employment towards digital economy in the Kyrgyz Republic"

ANALYTICAL REPORT ON CURRENT AND FUTURE NEEDS AND GOALS IN THE DIGITAL SKILLS

To form the digital skills and competences development strategy of the Kyrgyz Republic

Aziz Soltobaev

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Content

About UNDP Project

In 2017, the Government of Kyrgyzstan announced the launch of the “Taza Koom” (Clean Society) national digital transformation program aimed to build an open and transparent state, a knowledge-based economy, improve the living standards of Kyrgyz citizens, and improve the business climate. The “Taza Koom” is a key component of the long-term Vision of National Sustainable Development until 2040 aimed at improving the quality of human capital and striving for innovation in harmony with the environment. The goal of the Project is to assist the Government of Kyrgyzstan in creating a favourable climate and ecosystems that would contribute to the creation of opportunities for young people and especially young women in the digital economy, support their successful integration into the global development community and create sustainable employment.

The gradual actions envisaged by the Project should lay the groundwork for the following key objective: strengthening the capacity of the formal education system and applying new educational standards to build digital skills and introduce demand-driven curricula to better preparation of youth for the digital economy. This objective will be achieved by creating new standards for digital skills and strengthening the institutional capacity of the formal education system (technical universities and vocational schools in the cities of Bishkek and Osh) in order to provide young people with ready-to-use digital skills including basic, intermediate and advanced digital entrepreneurial as well as personal and social skills and to enhance the digital competencies of teachers in order to ensure better integration of digital skills into education. Under this component of the Project, activities will be carried out with the Government of Kyrgyzstan to prepare a National Digital Skills Development Strategy and a related Action Plan.

The Project will be implemented by the UNDP office in Kyrgyzstan in close cooperation with the Government Office, the Ministry of Education and Science, the State Committee for Information Technologies and Communications, the Ministry of Economy, the private sector and the academic community.

Introduction

This analytical report was prepared to show what global trends in the field of digital skills and competencies exist, how they are applied in different countries and what lessons would be important for Kyrgyzstan to take into account when forming an education development strategy for the period from 2020 to 2030. The report contains key documents in this sector worldwide, as well as in Kyrgyzstan, and also provides practical recommendations for achieving the UN Sustainable Development Goals 2030 and the objectives of the National Sustainable Development Strategy for 2018-2040.

The author of this report hopes that this document will serve as a starting point for the formation of National Digital Skills and Competencies Development Strategy designed to contribute to the achievement of the target indicators of the national five-year plan “Sanarip Kyrgyzstan” and the relevant National Sustainable Development Strategy for 2018-2040 component.

Global trends forming the environment for the development of digital skills and competencies

The last decade of human development has been described by a significant increase in the role and importance of information technology in socio-cultural life and economy. The widespread introduction of technological innovations, the democratization of the cost of Internet access, and the growing consumption of digital content have strengthened the connection and dependence of the virtual and physical dimensions of life featuring the beginning of the fourth industrial revolution. All this together determine the environment of life and the necessary skills and abilities. The growing importance of the digital dimension in society has generated the demand for new types of competencies such as digital skills and competencies. This section presents the key trends and issues forming the demand for digital life skills, ways of development and measurement.

Technological trends

One of the main factors identifying the demand for digital skills is the development growth of infrastructure technologies that exists today. While one of the UN's goals is the first coverage of the next three billion of the world's population with the Internet, the world's leading countries are setting targets for the transition to a gigabit society by 2025. A gigabit society is an environment where the average Internet connection speed is 1Gbps with all new products and services emerging. For example, Germany, in the mid-phase of the fourth industrial revolution, is committing up to 12 billion euros to connect every household to gigabit broadband Internet speeds by 2025.

Within the next five years, the infrastructure gap between countries that are close to gigabit speeds and those countries where the average speed is less than 100 Mbps will increase creating a gap in the type of new professions that create maximum added value, the type of skills and competencies demanded in these countries. For example, in Kyrgyzstan now the average download speed of broadband Internet is 40 Mbps. However, in the Top 30 countries, the average speeds exceed the 100Mbps with Singapore's best indicator of 208.16Mbps[1].

Over the past twenty years, the cellular and mobile data technologies have been developed rapidly. It was especially fast and widespread in developing countries including Kyrgyzstan. In 2020, 94% of the population in Kyrgyzstan is covered by 4G data networks and the cost of mobile Internet is among the ten cheapest worldwide. The development of 4G technology has given a strong boost to the growth in the use of mobile applications, streaming video, and services that were impossible to use with 2G / 3G technology. For example, in Kyrgyzstan there are online taxi and food delivery services with the ability to track cars online, systems of interaction and training in real time.

[1] https://www.speedtest.net/global-index Entry date August 1, 2020.

The next step in the development of mobile communications in the next ten years is the development of 5G technology envisaging an increase in the maximum data download speed by 20 times up to 1Gbps, mainly by accelerating the server response speed by 50 times up to 1 millisecond compared to 4G networks. This infrastructural data transmission technology opens up opportunities for remote surgical operations for patients, remote configuration and management of fully robotic factories, widespread use of autonomous unmanned vehicles, as well as the widespread development of augmented and virtual reality services, instant video transmission with a resolution of 4-8K and a frequency of 120 frames per second.

In terms of national policy, the development of digital competencies related to 5G in scientific laboratories and the academic environment would create the potential for employment in high-income professions, creation of new professions and jobs, and the creation of highly profitable export-oriented services. But in the absence of a clear developed internal policy, these technologies will be installed and maintained by specialists from other countries, though the other countries will be the beneficiaries. The opposite long-term effect of the spread of technology may be a reduction in employment in the provision of transport services due to the introduction of unmanned trucks and passenger vehicles within the next 10-15 years.

The next technology that will rapidly grow is additive manufacturing (3D printing). Over the past five years, it has shown an annual cumulative growth rate of 25% and in five years the cumulative size of all related markets could be up to $40 billion. To date, there are some examples when due to the Covid-19 coronavirus pandemic Californian start-up Relativity Space using 3D printing and with the engagement of only one engineer prints a fully functional space rocket in 60 days.

Additive manufacturing along with automation of work processes, robotization of production and the introduction of unmanned systems is accelerating the modernization growth of traditional sectors of the economy and changing the global supply chains of goods and services. Export-oriented companies require planning for the integration of Industry 4.0 components to ensure the competitiveness of their products, and the government is faced with the task of training qualified personnel to support existing technologies and create new solutions in this field. In Kyrgyzstan, where the share of industry has just begun to grow over the past decades, these trends require the development of sectoral programs for the development of Industry 4.0 technologies, the digital transformation of industrial enterprises and the training of the necessary personnel for them.

Another boosting technology is the development of the concept of artificial intelligence (AI), a complex of machine learning systems that allows automatic execution of specified functions with minimal participation of human personnel. The emergence of the concept of machine learning (AI) algorithms has accelerated the process of cutting jobs with routine types of tasks, but at the same time it has created new in-demand positions. McKinsey estimates that by 2030, about 70% of companies will use one type of AI and the first companies adapted AI will

get the most benefit. Leading countries in AI adaptation can obtain an additional 20-25% of net economic benefits, while follower countries, mainly from developing countries, only 5-15%. Leaders in AI adoption are projected to double their revenues by 2030, and companies that refused to adapt AI will experience a 20% drop in revenues from today's levels[2].

The biggest impact of AI development is expected in the labour market. Job demand can shift from repetitive tasks to jobs that are more socially and cognitively driven and require more digital skills. Job profiles with repetitive activities or requiring low levels of digital skills can experience the largest decline as a share of total employment. At the same time, jobs with non-routine activities and requiring a high level of digital skills will receive the greatest benefits. For example, in Kyrgyzstan in recent years, specialists in the field of web and layout design have been actively trained which can be classified as professions with initial advanced skills. However, international start-ups such as b12.io with a developer's team in Kyrgyzstan automate such workflows using artificial intelligence and pushing web designers and layout designers out of the international labour market.

This factor creates not only the need for the formation of a national policy on the implementation and training of working with machine learning algorithms in Kyrgyzstan, but also for a multi-stage stage of a general increase in the level of digital competencies of the working-age population to an advanced level in the medium and long term.

Economic trends

Following the results of the second quarter of 2020, the top 10 global enterprises with the largest capitalization include technology companies that took the first six places of the rating and the leader of the rating is Apple that was valued at $2 trillion, the highest indicator in the entire history of the stock market.

In terms of global economic perspective, tectonic technological shifts have led to the growth and dominance in the digital area of interaction platforms created and supported in the United States and China. The digital economy is rapidly changing the structure of employment in all sectors of the economy including services, financial services, telecommunications, agriculture, and healthcare. Leading companies are trying to carry out digital transformations in companies by placing at the head the possession of digital competencies of all employees of the company as a key factor in maintaining the competitiveness of companies. At the enterprise level, there is a shift in emphasis in favour of automating work processes, a focus from line employees to creative specialists, a shift in the paradigm of one baggage of knowledge for life to constant self-training, retraining on new professions.

In the labour market, there is a growing share of open vacancies requiring at least basic digital skills. Moreover, there is an acute shortage of specialists with advanced digital skills in the world. It is expected that with the growing share of digitalization of countries, the need for

[2] https://www.mckinsey.com/featured-insights/artificial-intelligence/notes-from-the-ai-frontier-modeling-the-impact-of-ai-on-the-world-economy#

such specialists will continue to grow. According to OECD research, having digital skills is associated with higher earnings than without them. Despite the fact that young people are considered to be more technology-native, most still do not have the necessary digital skills needed to work.

Political trends

Regarding the political aspect, the spread of technology has changed the speed of information dissemination, greater population's involvement in political processes, and increased requirements from states in terms of accountability and fulfilment of election promises, as well as in terms of the speed of communication with population through digital communication channels. At the same time, there is a growing number of sources of mass misinformation using technologies that mislead the population. On the other hand, the need from the state side has grown for a general digital transformation, the creation of new sources of income generation and jobs in the country with an emphasis on the latest innovative technologies. However, there has also been an increase in attempts by some countries to strengthen total control over citizens' data.

In the technological environment, there are trade wars are observed between countries for technological innovation leading to destructive balkanization of technologies and fragmentation of ecosystems. In the short term, this leads to a shortage of materials in the global market for the implementation of technologies such as 5G. This, in turn, reduces the possibility of receiving economic dividends by importers of this technology, especially by developing countries like Kyrgyzstan. The economic wars of countries for innovation and control over big data can lead to problems in the availability of certain devices, software solutions, and services in the world. This factor creates challenges in the development of national policies in the field of digitalization processes in countries, as well as in the development of strategies for the formation of future personnel.

Demographic trends

According to UN estimates, for the period from 2013 to 2025, the total world population will grow by one billion and reach eight billion people. In Kyrgyzstan, by this period the maximum population growth is expected over 75 years. By 2025, the country will have about 4.6 million working population that is almost 180% higher than the indicators of the economically active population as of 2019.

Population growth leads to an overall increase in demand for consumption that leads to economic growth and employment in certain sectors. Demographic trends have a multifactorial effect on various areas of society and the economy. Taking into account global trends, digital skills will be an integral necessary part for overall competitiveness in the labour market, the possibility of obtaining higher incomes, overcoming poverty, and increasing the export of services through digital technologies.

Epidemiological factor - Covid-19

The spread of the COVID-19 coronavirus pandemic has significantly changed the world order, international and national priorities and tasks arisen and faced by the states of the world. Covid-19 has become an unexpected test of the networked readiness of states and the effectiveness of the policies in the field of digital transformation, both at the state level and individual enterprises. In general, Covid-19 has accelerated the pace of transformation in the most conservative areas such as education and healthcare globally, as well as accelerated the launch and deployment of more electronic and remote services provided by governments and the private sector to the public.

The introduction of a nationwide state of emergency in Kyrgyzstan created restrictions on general education for 1.4 million school-age children, the transition not only to distance learning in all education sectors via the Internet but also to conduct remotely all the necessary processes in the education sector such as passing exams, defending dissertations and accepting applications for admission to universities. In general, Covid-19 has become a catalyst in the digital transformation of the education sector.

Educational trends

Digital transformation is also taking place in the education sector. Particular important changes are taking place in the field of school education as a key area in determining the abilities and skills of the future of nations. The use of information technologies in the education process is described in a series of publications by the Higher School of Economics on the digital transformation of the education sector. According to the report "Digital transformation of school education. International experience, trends, global recommendations", there are three main advanced models of school education development in the world to be guided by when considering the use of technology, the formation of national policies, the development of digital skills and competencies.

Orientation on phenomenon-based learning. From a pedagogical point of view, as part of digital transformation, advanced countries are using technology together with the transformation of the entire school education system. In Finland, digital technologies are becoming a vehicle for phenomenon-based learning, where the emphasis is on the study of a phenomenon in the real world that, in turn, serves as a platform for interdisciplinary learning. In Finns' opinion, "technology is a tool that makes the learning process visible for thinking and evaluating, documenting, teaching, processing information, and searching for information. Technology should be a natural part of learning and teaching, like paper and pencil". Thus, it turns out that teaching digital skills is becoming an integral part of pedagogy, as well as a necessary factor in the transformation of the school education sector.

Orientation on creative use. Due to the fact that creative and critical thinking skills will be most in demand in the 21st century, Singapore and other countries are focusing on the digital transformation of schools to reduce the curriculum, increase the emphasis on the creative

use of information, rather than on its acquisition, use of digital solutions as teaching aids, not as a subject to be learned, and use of digital solutions for at least 30% of the training time. For information, Singapore has been at the top of the international student assessment programs (PISA) for a long time.

Orientation on personalized learning. The active use of information technology in terms of automating educational processes, generating digital data provides new opportunities for the provision of personalized learning. A number of pilot American Summit Learning schools have this experience. This approach identifies four key features of personalized learning: 1) student profiles includes the strengths, needs, motivation, progress and goals of each student; 2) a personalized teaching approach offers a wide range of content and teaching approaches for each student; 3) competency tests determine the level and progress of the student in relation to the development of key skills and mastery of knowledge; 4) a flexible learning environment allows schools to competently distribute the workload on teachers, use the learning space and time to improve the personal approach. These characteristics highlight the relationship between personalized learning approaches, information and students' performance levels. Despite its attractiveness and potential, this experience remains shared only with private schools in the United States.

It should be noted that many recent reports describe the extreme importance of the quality of teacher training and teaching methods (digital pedagogy), and the use of technology is not a transformative factor, the use of technologies by students outside the school is not related to the use of such technologies within the school framework. In general, understanding of the effective application of digital solutions and digitalization remains incomplete and different education systems are in the process of identifying effective approaches.

From the point of view of digital pedagogy, modern documents widely provide the classification model of the information technology use in pedagogy and teaching of Harvard University Professor Ruben Puentedura SAMR. This model will be used by the author in the future to analyse the current situation in digital pedagogy of the Kyrgyz Republic. Ruben has built his approach ladder and equate it with a student climbing a cognitive scale associated with Bloom's digital taxonomy (i.e., as the issue moves from the lower to the upper levels of Bloom's taxonomy, the issue moves from the lower to the upper levels of SAMR). The SAMR model includes four stages:

1. Substitution. Technology is being used to do the same things as before (before computers). The student, instead of a book, reads from electronic media. Nothing really changes in the educational process. Student engagement remains the same as there is no real improvements through the use of technology. The teacher as an instructor guides all aspects of the lesson and remains the central figure in the class.

2. Augmentation. Not only use new technology to accomplish old tasks, but also try to solve the problem more efficiently and better. An example is given when a student

not only uses the office for typing, instead of writing, but also uses its additional functions (inserting a video, spell checking, drawing tables, flowcharts) or a class survey is conducted using online tools making it more effective. At this stage, the focus of teaching begins to shift from teacher to student. The result of instant feedback is that students become more involved in the learning process.

3. Modification. Tasks common to the class are performed using information technology. An example is using online collaboration tools, posting results online, discussing them, and improving them together. There is a significant functional change in the activities of the class. While all students develop the same skills, having a real audience gives each student a personal interest in perfuming qualitative work.

4. Redefinition - Conversion. At this stage, students can create something that, in principle, was not created without information technology (website, e-book, blog, digital magazine). At this level, shared classroom tasks and information technology is not a goal but a learning tool with a focus on the student. Collaboration becomes essential and technology allows it to be organized.

The ability of a pedagogical specialist to transmit to a student the knowledge necessary for his future life, skills of independent cognition and development, and most importantly, attitudes towards this development, is based on two prerequisites: digital literacy of the teacher and his/her professional ICT competencies. In the context of this report, the definition of the teacher's ICT competence will be used as “knowledge, skills and attitudes that allow him/her to confidently use ICT to organize the educational process at all its stages - from preparation for classes to creating a digital environment that helps build individual educational ways of students, motivate them to study, analyse and predict their progress”.

Review of international approaches to forming digital literacy, skills and competencies policies

International practice in this direction is just emerging and is a logical evolutionary stage in the development of media and information literacy within which the use of technology has transformed into a separate digital dimension of literacy.

At the global level, digital competency reference frameworks have been developed to assess overall digital literacy that represent an agreed vision of what competencies are needed to overcome the challenges posed by digitalization in virtually all areas of life. Examples of such reference databases are the UNESCO Global Literacy Assessment Framework (DLGF) and the European Digital Competence Framework for Citizens (Digcomp). The third global initiative is the Program for the International Assessment of Adult Competencies (PIAAC) developed by the Organization for Economic Co-operation and Development and designed as a reference system for assessing adult problem-solving skills in OECD countries.

These reference frameworks create a general understanding through a coherent bundle of definitions and vocabulary that can be used consistently across all tasks from national policy formulation, target setting to educational planning, assessment and progress monitoring.

The objective of the DLGF is to create a methodology that can serve as a baseline for the thematic indicator of the Sustainable Development Goals 4.4.2 "The percentage of youth/adults who have achieved at least a minimum level of proficiency in digital skills".

According to UNESCO 2018 survey, setting national reference standards for digital literacy is new phenomena. Based on an analysis of 47 observed countries, it was found that only 11 countries have national systems out of which 7 have also adapted private framework systems. On the other hand, 36 of the selected countries have adopted private framework systems. The most common private frameworks were the International Computer Driver's License (ICDL), Certiport Internet and Computing Core Certification (IC3), Microsoft Digital Literacy Standard Curriculum. There are private ICDL certification courses in Kyrgyzstan since 2019.

Despite that the range of content coverage varies in the reference standards adopted by countries, they are broadly categorized into the following five types of contents: purpose of the framework, areas of competences, fields of study (such as knowledge, skills and attitudes), way of accomplishing tasks and the digital tools to be used.

The International Standard Classification of Education (ISCED), i.e., a document adopted by the UNESCO General Conference in 2011, is used to classify and present internationally comparable statistics on digital skills. The education system of the Kyrgyz Republic is also based on ISCED.

In addition to general classification and categorization, various countries develop IT competency models. For example, the Information Technology Competency Model approved by the US Department of Labour in 2012 defines all the knowledge, skills, and abilities that employers need to be successful in information technology. At the same time, the European E-competence Framework 3.0 released in 2014 identifies exclusively technical competences.

Digital Agenda in the Kyrgyz Republic

The evolution of the national knowledge economy program development including information and communication technologies and the digital economy is closely related to the import of technologies and the training of personnel to service them since the days of the Soviet Union. Historically, such large technological enterprises as the Machinery plant, the Tashkumyr Semiconductor Technology Plant, the Frunzensky Plant of Physical Devices, and the Frunzensky Computer Plant were located on the territory of the Kyrgyz SSR providing the needs of the entire Soviet Union. These enterprises created the demand for the most demanded skills.

In 1984, at a meeting of the plenum of the CPSU Central Committee a resolution was adopted on “Computerization of school education in the USSR” that entailed the introduction of a new compulsory subject “Fundamentals of Informatics and Computer Engineering” from September 1, 1985 and served as the impetus for the emergence of personal computers in schools.

15.3 example of algorithm with logical values

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алг обработка тупика                                    (A69)
 дано |Робот левее горизонтального тупика (рис. 63)
 надо |Робот в исходном положении;
      |если в тупике была хоть одна закрашенная клетка, то
      |закрашен весь тупик
нач лог q
 | q:=нет                |закрашенные клетки пока не обнаружены
 | нц пока справа свободно
 | | вправо
 | | если клетка закрашена
 | | | то q:=да                |обнаружена закрашенная клетка
 | | все
 | кц
 | утв |Робот в самой правой клетке тупика,
      |q=(в тупике есть закрашенная клетка)
 | нц пока снизу стена |т. е. пока в тупике
 | | если q |т. е. если была хоть одна закрашенная клетка
 | | | то закрасить
 | | все
 | | влево
 | кц
кон
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In advanced schools, complexes of educational computer technology (CECT) were deployed within which the programming in the languages of Russian Algorithmic Language, Rapier, Basic, Pascal. The problem of personnel connected to the introduction of a new subject was solved by attracting engineers and programmers from specialized research institutes.[3]

Since gaining independence on August 31, 1991, the technological aspect of development in the Kyrgyz Republic has been inertial using the remaining technologies, creating residual added value. Computer literacy issues were not in the priority.

On March 20, 1996, President A.A. Akaev approved the Decree UP-102 “On the main directions of the national educational program “Bilim” determining the strategy for the development of education in the Kyrgyz Republic for the period from 1996 to 2000. One of the goals of Bilim program was to equip the educational infrastructure of the Kyrgyz Republic with computer facilities, software, computers through phased computerization and technical re-equipment of educational institutions of all levels; creation and improvement of the electronic communication system between higher educational institutions in the country and abroad. The strategy also implied the development and implementation of a nationwide computerized education management information system with a coordinating centre under the Ministry of Education and Science of the Kyrgyz Republic. As a result of the program, over four years 12 schools and universities equipped with computer rooms were put into operation, 1222 new computers were installed in all regional educational institutions of the country.[4]

[3] https://zxdemos.ru/viewtopic.php?id=10997

[4] History of the Kyrgyz from ancient times to the present day, Baktygulov J.S., Mombekova Zh.K., 2001

On October 8, 1999, the Law "On Informatization and Electronic Governance" was adopted determining the basis of the information infrastructure, as well as legal, economic, and institutional powers in this area until July 19, 2017. As part of the formulation of a comprehensive development framework for the period from 2003 to 2010, a national strategy "Information and communication technologies for the development of the Kyrgyz Republic" was formulated. The program envisaged the informatization of education and knowledge management ensuring overall minimum computer literacy, 100% computerization of schools; the use of ICT for adult education including for distance education, retraining of teachers, assistance in the development of information systems by employees of state and local governments. In 2000s, the main source of ICT specialists was the national IT centre that trained demanded advanced network specialists necessary to launch and support new network technologies.

To boost the technological development within the country, on December 24, 2004, the state program "On the development of ICT in rural areas of the Kyrgyz Republic until 2010" was approved by the Decree of the Government No. 954. The country's leadership also worked out measures to develop the electronic economy, the mobile economy within the framework of which measures were envisaged to liberalize the cellular communications market.

Country Development Strategy for 2007-2010 approved by the Decree of President K.S. Bakiev on May 16, 2007 No. 249 provided the further implementation of previously adopted strategies, as well as "the creation of a high-tech telecommunications system that provides a wide range of services and contributes to the country's integration into the global information space. Mobile communications will remain the leader in terms of development rates in the telecommunications industry. It is projected that the annual growth of cellular subscribers will be 30% -50%. The total number of Internet users will reach one third of the country's population by 2010. By 2010, more than 90% of personal computers will be connected to local networks and state organizations will use 100% automated accounting systems".

A significant impetus for the development of information technologies was the adoption of the Law "On the High Technologies Park" (HTP) approved by President R. I. Otunbaeva dated July 8, 2011. This law provided preferential tax breaks for export-oriented enterprises in the sector and made it possible to create an IT outsourcing market, keep intellectual employers in the industry and create demand for new advanced skills and competencies in the labour market.

Since 2015, the HTP has shown an annual twofold growth in the revenue of residents and a constant driver of demand for educational services, new professionals and specialists in demand around the world. According to surveys, programmers have become one of the highest paid specialists at the expense of foreign clients due to the IT outsourcing.

In 2015, Kyrgyzstan, along with other UN member states, at the United Nations General Assembly adopted the 2030 Agenda and 17 Sustainable Development Goals (SDGs) and started the subsequent integration of the SDGs into its national strategic processes. The development

of digital skills and competencies is an integral part of SDG 4.4 stating that “By 2030, substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship”. The UNESCO Digital Literacy Assessment Indicators are the accepted indicator for assessing the development of digital skills.

On December 26, 2016, the EAEU Digital Agenda 2025 was adopted within the framework of the Eurasian Economic Union (EAEU). According to this document, the economic effect of its implementation will increase the GDP of the EAEU by 2025 by about 10.6% of the total expected growth of the aggregate GDP of the member states by 2025 and will provide an increase in employment in the ICT industry in the EAEU space by 66.4% by 2025 or 1 million new ICT jobs. In turn, employment growth in the ICT industry will provide an additional 2.46% growth in total employment by 2025.

The Digital Agenda states that “the identification of digital competencies and related skills is important. Therefore, it is recommended to launch a program for the development of digital skills and increase digital literacy at the Union level, as well as the adoption of the EAEU policy in the field of digital literacy and skills. It requires attention and an increase in funding for universities to organize courses on ICT, as well as programs of applied research in the field of digital technologies".

In 2017, the concept of digital transformation “Taza Koom” was developed. The vision of the project is that Kyrgyzstan is a smart country of a developed information society formed based on innovation and knowledge, effective, transparent, and accountable public administration without corruption but with extensive own digital content and active participation of citizens of the country as users of digital technologies and services. The digitalization of the economy and the wide use of innovative and advanced technologies stimulate the growth of the country’s competitiveness, the welfare, and safety of the population. This project has become an integral part of the “National Sustainable Development Strategy for 2018-2040” (NSDS) approved by President S.Sh. Jeenbekov on October 31, 2018.

The NSDS-2040 states that “Kyrgyzstan will actively implement reforms to create a competitive digital economy through the formation of truly attractive conditions for entrepreneurs, the use of innovative and environmentally friendly technologies. The widespread introduction of information technologies in production and management should become a priority of the development policy”.

By 2040, Kyrgyzstan should become a digital hub on the Great Silk Road. A network of data processing centres (DPC) of regional significance will provide ICT services to the entire region. The created digital infrastructure will allow connecting the information and communication spaces of Central Asia, the EAEU, the Middle East, China and Europe.

A base and a system for training highly qualified specialists will be formed in the country. Regional centres for the implementation of innovations in the digital economy, applied research and development using “breakthrough” technologies will stimulate the creation of new “smart” jobs. Kyrgyz employers will be able to work all over the world without leaving the country”.

As part of the practical implementation of NSDS-2040, the Government of the Kyrgyz Republic developed a medium-term five-year program “Sanarip Kyrgyzstan 2019-2023” approved by the Resolution of the Security Council of the Kyrgyz Republic on December 14, 2018.

This document states that “Digital transformation will bring technological changes in the country and will increase the competitiveness of our economy, the standard of living of citizens and the efficiency of the state. The Kyrgyz Republic is a dynamically growing innovation ecosystem that is integrated with the global world and attracts technology, investment, and qualified personnel. The Kyrgyz Republic will take its rightful place in the global economy due to the technologies and innovations that will allow Kyrgyzstan employers and local businesses to be competitive and in demand at the global market. The Kyrgyz Republic will actively use advanced digital technologies such as artificial intelligence, big data and cloud computing technologies".

“Sanarip Kyrgyzstan” is the first document that clearly defines the priority tasks in the field of digital literacy:

1. Creation of new opportunities for the population through the development of digital skills;

1.4. Priority programmatic areas needed the support;

1.4.1. Development of digital skills and digital education, innovation and R&D;

2. Development and implementation of the National Digital Skills Development Strategy;

2. Development and implementation of professional and educational standards in the field of ICT and digital skills development;

3. Development of digital skills for state and municipal employees;

4. Creation of a network of centres of excellence / professional mastering in the field of digital development;

5. Support for the creation and operation of non-state training and professional certification centres;

6. Conducting national and regional competitions in the field of innovation including piloting digital innovations using the latest technologies aimed at stimulating entrepreneurship among young people;

7. Support innovative projects to create jobs including vulnerable groups of the population;

8. Promotion of partnerships between academia and industry.

Since the election of the President S.Sh. Jeenbekov, he has declared 2018-2020 to be years of digitalization. At the high-level forum held on November 19, 2019, a key role was assigned to the issues of digitalization and coordination of all departments and development partners to achieve the goals set in this area. Development of digital skills as the target priority areas in 2020 was identified as a key task of the Government of the Kyrgyz Republic.

Thus, the above-mentioned documents identified national digital priorities, as well as the need for a National Digital Skills Development Strategy.

National priorities in the digitalization of industries and training

National priorities in the field of digitalization of economic sectors determine the demand and needs for digital skills that should become key in the formation of the National Digital Skills Development Strategy.

The concept of "Sanarip Kyrgyzstan" implies that deep digitalization should affect traditional sectors of the economy such as industrial production, tourism, agriculture, light industry, and construction. One of the fastest impacts of digital transformation can be achieved through the development of digital commerce and access to digital financial services through improved policies and regulatory mechanisms. Digitalization in the energy sector should be carried out in the direction of "smart energy" aiming at increasing energy efficiency, reducing energy losses, and efficient distribution.

Kyrgyzstan positions itself as a digital hub on the Great Silk Road prioritizing the introduction of smart contracts based on blockchain technology as a way to ensure digital traceability of cargo flows. This measure should reduce the transaction costs of enterprises and increase the export of goods from priority national economic sectors. In agriculture and the agro-industrial complex, the Internet of Things, automated machines for sowing and harvesting, the systematic collection and transmission of data, images of agricultural land through the use of unmanned aerial vehicles (drones) should increase the productivity of the industry by collecting, aggregating, and analysing large amounts of data with subsequent decision-making.

In light industry, technological priorities are 3D computer modelling and digital design, digital prototyping based on computer graphics, additive printing of fittings and accessories, automated production, and much more.

The Industry Sustainable Development Strategy of the Kyrgyz Republic for 2019-2023 approved on September 27, 2019, sets one of the objectives to expand the high-tech, competitive export industry, ensuring the transition of the state's economy from the export of raw materials to the industrial-innovative type of development. The document defines the priority industries for the development of mining and metallurgical industries, energy, food processing, construction, light industry and tourism. However, the document does not specify which technologies and skills are needed to achieve the priorities set in the field of digitalization.

Due to the lack of a sectoral strategy for the modernization of the industrial complex and the implementation of "Industry 4.0" robotization systems, there is no analytical information to assess the role of digitalization in these sectors of the Kyrgyz economy and the impact on the formation of demand for digital professions.

The Export Development Program of the Kyrgyz Republic for 2019-2022 dated December 20, 2018, identifies the following priority industries for the development of which the government's efforts are directed. These includes the garment industry, dairy industry, fruit and vegetable processing, green and innovative manufacturing.

President S.Sh. Jeenbekov has identified regional development as one of the priority tasks. The Regional Policy Development Concept for 2018-2022 emphasizes the need to develop regional economic clusters. In particular, the documents highlight the following industry priorities:

- Education (Bishkek and Osh cities);
- Construction (Chui, Osh regions);
- Tourism (Issyk-Kul region);
- Petroleum and chemical (Jalal-Abad region);
- Agro-industrial (most territories, with the exception of certain districts and cities);
- Livestock (Chui, Naryn regions);
- Transportation and communication (Naryn, Osh, Issyk-Kul, Chui regions, Bishkek city);
- Medicine and pharmaceutics (Bishkek city)

Based on the analysis of the legal framework, mentioned documents identify national priorities and those areas for which a digital skills development program needs to be developed. To date, there are not sectoral documents on the strategy for the development of agriculture, light industry that would provide more detailed information on the needs for digital skills and the expected action plan for them.

Key documents defining digital skills policy

The main Law governing digital skills policy is the Education Law of the Kyrgyz Republic, as amended on July 1, 2019. This Law establishes the principles of state policy in the field of education, conducting the educational process, performance of educational organizations, obtaining education in the Kyrgyz Republic, and also serves as a legal basis for their implementation. The executor is the Ministry of Education and Science.

The main documents defining the current activities of the Ministry of Education and Science of the Kyrgyz Republic are a set of documents included in the Decree of the Government of the Kyrgyz Republic "On strategic directions of the education system development in the Kyrgyz Republic" approved on March 23, 2012. This document defined the concept and strategy for the development of education together with an Action Plan for the implementation of the strategy for 2012-2020. The draft "Education Sector Development Strategy for 2021-2040" is under discussion and has not yet been approved.

To date, the priorities and tasks for the development of digital skills are outlined by the "Sanarip Kyrgyzstan" roadmap and include the following tasks for 2019-2023:

1) Determining the development of digital education in the Kyrgyz Republic in the long term;

2) Creation and implementation of educational management information system (EMIS);

3) Improvement of educational standards in the system of school and higher education of the Kyrgyz Republic;

4) Development of "e-textbooks";

5) Implementation of the information system "Electronic Record" in state and municipal educational organizations of the Kyrgyz Republic (schools);

6) Creation of the National Electronic Library of the Kyrgyz Republic;

7) Providing conditions of remote access for PWDs for higher professional education;

8) Introduction of e-education.

Current policy and needs: inventory list

Name of policy	Year	Governing agency	Digital skills coverage	Total score
Education Sector Development Strategy for 2013-2020	2012	Ministry of Education and Science of the Kyrgyz Republic	ICT skills training	3
Action Plan for the Implementation of the Education Development Strategy in the Kyrgyz Republic for 2018-2020 as a three-year plan for the implementation of the Education Development Strategy for the Kyrgyz Republic for 2012-2020	2012	Ministry of Education and Science of the Kyrgyz Republic	ICT advance training for teachers, an adaptation of the Guidelines for the Assessment of Information and Communication Competencies of Teachers (UNESCO)	3
Innovation Policy Concept 2017-2021	2017	KyrgyzPatent	Priorities of scientific activity, research work	3
EAEU Digital Agenda 2025	2017	EEC Digital Commission	Goals, action plan, regional initiatives	4
National Sustainable Development Strategy for 2018-2040	2018	National Commission on NSDS	Priority industries	5

Sanarip Kyrgyzstan for 2019-2023	2019	Security Council of the Kyrgyz Republic	Priority industries	5
Roadmap for the implementation of "Sanarip Kyrgyzstan"[5]	2019	Government Office of the Kyrgyz Republic	Implementation Action Plan	2
Regional Policy Concept	2019	Government of the Kyrgyz Republic	Priority industries	1
Export Development Program of the Kyrgyz Republic	2019	Ministry of Economy of the Kyrgyz Republic	Priority industries	1
Sustainable Industrial Development Program	2019	Government of the Kyrgyz Republic	Priority industries	3
Education Sector Development Strategy for 2021-2030	2020*	Ministry of Education and Science of the Kyrgyz Republic	ICT skills training	3

The analysis of the list of current policies demonstrates that the Kyrgyz Republic has consolidated its commitment to the goals and objectives of digitalization, forming an information society and digital economy, and providing the necessary digital skills and jobs with the adoption of the UN 2030 Sustainable Development Goals, supranational documents of the EAEU and a long-term development strategy until 2040.

In the medium term, the needs for digital skills are disclosed in detail in the five-year strategy "Sanarip Kyrgyzstan", however, they are poorly represented in sectoral programs, action plans of departments that would improve the country's indicators in international ratings of the country's development. The action plan for the development of digital skills provided in the Roadmap for the implementation of "Sanarip Kyrgyzstan" needs a critical assessment of compliance with the national goals and objectives.

Concept documents defining the activities of the Ministry of Education and Science of the Kyrgyz Republic, such as the Education Development Strategy 2012-2020 and the Action Plan for the Implementation of the Strategy for 2018-2020, demonstrate the implementation of basic initiatives in the application of information technology in the education sector, as well as training in computer and ICT skills that, in turn, do not comply with the goals and objectives defined by national strategic documents.

[5] http://cbd.minjust.gov.kg/act/view/ru-ru/216896

On the one hand, the absence of an approved concept for the development of the education sector for future periods creates uncertainties, on the other hand, it opens a window of opportunities for a clearer integration of the national strategy for the development of digital skills and competencies into the main document of the Ministry of Education and Science of the Kyrgyz Republic. Thus, the overall average score for digital skills coverage by national programs is 3 out of 5.

Digital Skills Training Management

The key Councils forming the general direction in the preparation of digital skills are the Expert Council on digital transformation under the President of the Kyrgyz Republic approved by the Decree of the President of the Kyrgyz Republic dated June 4, 2018 No. 134. This consultative and advisory body was formed in order to attract the expert community to work on the formation and implementation of state policy in the field of digital transformation. The main task of the Expert Council is to develop recommendations on digital transformation issues including the development of information and communication technologies, create favourable conditions for the digital economy and other issues related to digital transformation.

On July 6, 2015, the Government of the Kyrgyz Republic, by its Decree No. 449 approved the Council for Science, Innovation and New Technologies under the Prime Minister of the Kyrgyz Republic as an advisory body formed to ensure interaction between government agencies and research institutions when considering issues related to the development of science, as well as the development of recommendations to the Government of the Kyrgyz Republic on relevant issues of state policy in the field of scientific and technological development. The Council's tasks are to prepare proposals on priority areas for the development of science, determine the main directions for the development of new technologies, as well as coordinate activities to develop strategic directions of state policy in the field of new technologies and the development of departmental regional research centres.

The function of supporting and coordinating the implementation of the "Sanarip Kyrgyzstan" Concept was assigned to the Secretariat of the Security Council of the Kyrgyz Republic which main tasks are to track progress by priorities, study the problem and intervene to solve it, solve problems with a lack of capacity (training system), ensure focus on result and its impact on citizens.

"Sanarip Kyrgyzstan" assigns the implementation of digital skills development tasks to the Ministry of Education and Science of the Kyrgyz Republic. The development of goals for the digital economy is entrusted to the Ministry of Economy of the Kyrgyz Republic. The State Committee for Information Technologies and Communications is responsible for improving the regulatory environment and developing the digital infrastructure of the country.

For the overall coordination of the actions of government departments, international donors and development partners, the involvement of civil society and the private sector, a high-level

development forum with the participation of the President of the Kyrgyz Republic, as well as regular consultative meetings with representatives of the Coordination Council of Development Partners in the Kyrgyz Republic are held.

Policy Tools for Governance and Coordination of Digital Skills Development

To achieve the goals and objectives set by the national development programs, several projects are being implemented in the country in the education and technology sector.

The Digital CASA Kyrgyz Republic project under the Digital CASA Regional Program has as the main development objective: "Expanding access to more affordable Internet, attracting private investment in the ICT sector and increasing the government's ability to provide digital government services in the Kyrgyz Republic, contributing to the development of a regionally integrated digital infrastructure and favourable environment" that will create the basis for the development of the digital economy in the Kyrgyz Republic. This project provides funding to improve the regulatory framework of the Kyrgyz Republic for building a digital economy.

The Skills for Inclusive Growth Sector Development Program financed by the Asian Development Bank aims to create a labour market responsive, inclusive, gender-sensitive TVET system including the development of entrepreneurial skills. This program aims to achieve economic growth in the Kyrgyz Republic by improving the knowledge and skills of the labour resources and improving productivity in industry and agriculture in the country.

The Learning for the Future project financed by the World Bank aims to improve learning outcomes by preparing children to improve their readiness to learn; forming teachers' competencies and pedagogical skills in order to increase the effectiveness of teaching; improving assessment to collect data and information to measure progress and provide information for learning, and align critical resources and materials to support teaching and learning.

The UNDP project "Digital skills and youth employment opportunities in the digital economy in the Kyrgyz Republic" financed by the Russian Federation-UNDP Trust Fund for Development aims to help the Government of Kyrgyzstan to strengthen an enabling environment and ecosystems contributing to the expansion of opportunities for youth and especially young women in the digital economy, supporting their better integration into the global development community and creating sustainable jobs. The coherent intervention proposed by the project will lay the foundation for increasing the capacity of the formal education system and applying new educational standards for digital skills, providing a demand-driven curriculum to better prepare youth for the digital economy and create a platform for innovative partnerships with the private sector in support of initiatives that could accelerate the growth of digital jobs and businesses in the country.

Besides these projects, international donors, government departments are carrying out programs to develop programs including components for the development of digital skills and competencies in digital entrepreneurship.

SWOT Analysis of Current Digital Skills Policy

Strengths: • Commitment to the supranational goals of the EAEU Digital Agenda and the UN SDGs; • Long-term strategic documents emphasizing the role of digital skills initiatives; • Medium-term program of digital transformation of the Government of the Kyrgyz Republic; • Financial support by the projects of the Ministry of Education and Science of the Kyrgyz Republic with the assistance of development banks and Digital CASA.	*Weaknesses:* • The Roadmap of the "Sanarip Kyrgyzstan" strategy is not in line with the achievement of target indicators; • Targets for the education sector are in the early stages of digitalization, while targets for the sector are forward-looking; • Weak compliance of sectoral development programs with strategic digitalization documents; • Compliance with digitalization goals and availability of investments; • Lack of industry baseline data to formulate the Digital Skills Strategy.
Opportunities: • Integration of digital skills initiatives into the concepts and strategies of education development in the Kyrgyz Republic for 2021-2030; • Developing industry strategies based on digital skills and competencies; • Creation of national reference standards for digital literacy; • Development of a framework environment for the competencies of ICT specialists; • Making additions to the Roadmap of the "Sanarip Kyrgyzstan"; • Innovation policy Concept for 2021-2205.	*Threats:* • Changing priorities for digitalization; • Decrease in economic activity in the medium term; • Growing deficit of the state budget; • Accelerating digital gap between developed countries and rest of the world; • Several interdepartmental centres for the coordination of the digitalization process and the development of educational initiatives.

The SWOT analysis of the current digital skills policy shows that the government is demonstrating a clear commitment to reforms to digitize industries and to increase the level of digital literacy and skills of the population. Commitment is also strengthened by the availability of projects to finance these initiatives supported by international development banks. However, the weak side is the presence of inconsistency or lack of industry indicators for digital skills, lack of clearer initiatives and action plans for digitalization tasks. It should also be noted

that the ambitious goals of national concepts of digital transformation may require significantly more financial investments than expected.

The opportunities include making recommendations and comments to sectoral and interdepartmental documents that determine the strategy for the development of the education sector, innovative activities in the republic, sectoral programs that are currently being developed. There is an opportunity for adopting a digital literacy framework, a competency framework for ICT professionals.

The potential threats to the implementation of the project include the presence of several over-departmental centres for coordination of digitalization issues and policy in the field of digital skills and competencies. The pandemic of coronavirus infection Covid-19 is already affecting the state budget deficit and the availability of funds for unprotected items. A further economic downturn and slowdown observed in the first half of 2020 may lead to a decrease in revenues to the state budget, subsequently, to the decrease of the financing sources for the implementation of national development programs. This could also negatively affect national priorities and goals of the digital transformation program.

The potential acceleration of the technological gap between developed and developing countries should also cannot be missed that could reduce the digital dividend from digital policies.

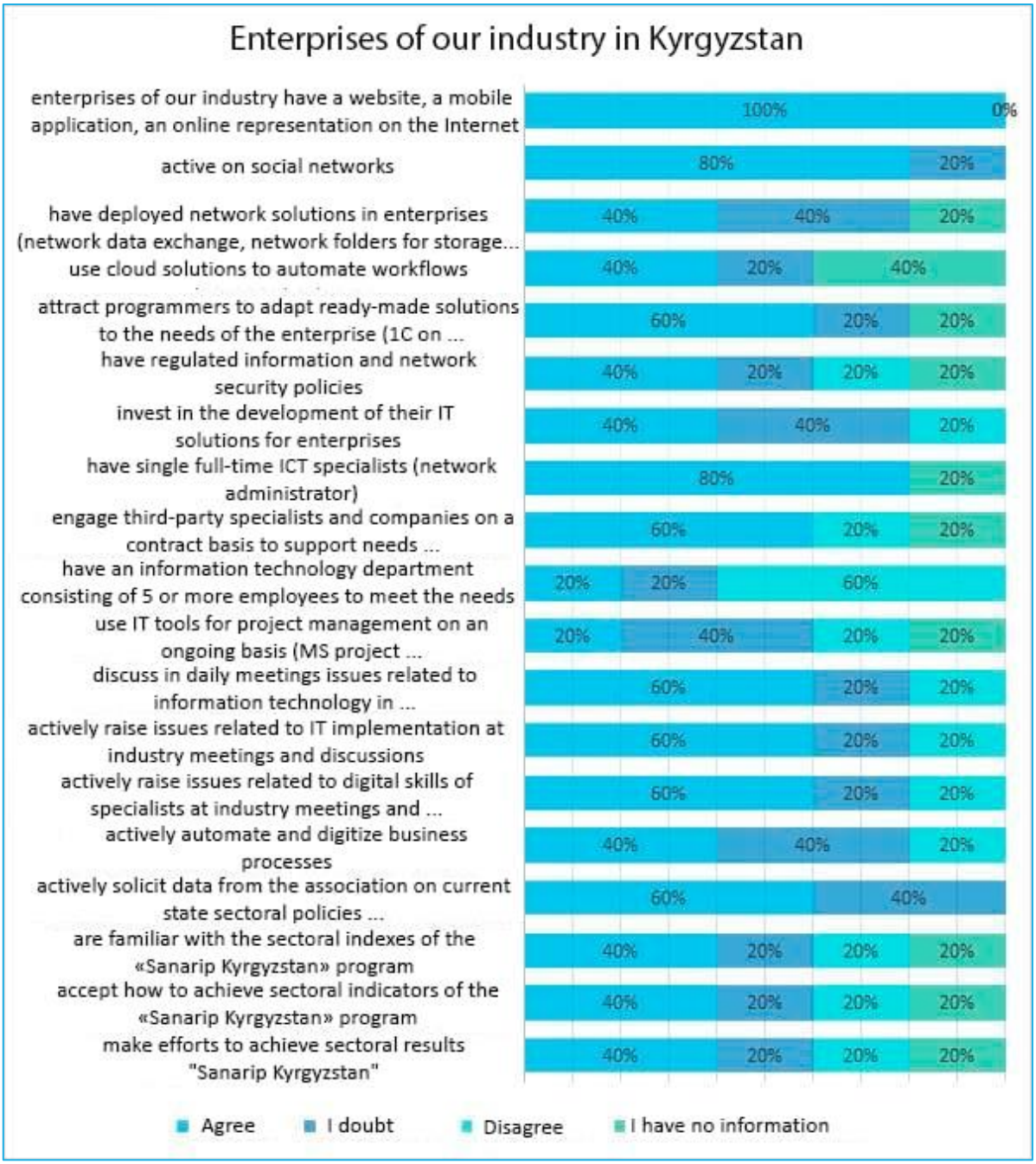
Current and future needs of the Kyrgyz economy

As of 2019, the main sector of GDP formation in the current structure of the Kyrgyz economy are mining and service sectors, and, in terms of employment, agriculture. At the same time, in the last five years, there has been an increase in the contribution of industry and a decrease in the share of agriculture in the structure of GDP. By business type, small and medium-sized businesses account for 41.5% of the gross value added.

According to the data of the National Statistical Committee, in 2018, 19.4 thousand economic entities (enterprises, organizations and institutions) were surveyed across the country out of which 63% used information and communication technologies that increased by 15% compared to 2013. In 2018, the number of specialists of enterprises and organizations engaged in computer equipment and information and communication technologies increased 1.7 times compared to 2013. Thus, the process of computerization of the sectors of the economy is observed, however the intensity of use is absent.

Within the framework of this project, a detailed study of the state of the level of digital skills and competencies in various sectors of the economy was conducted by surveying of business associations. Leaders of five leading business associations out of 60 sent invitations responded to the invitation to participate in the survey. The author of the survey assumes that the COVID-19 pandemic in the spring-summer 2020 period was one of the reasons for the low engagement of business associations in survey on digital skills. The members of the business associations of the interviewed respondents are enterprises from the sectors of the mining industry, information technology, services and trade, agricultural processing, and tourism.

The results of the survey show that enterprises in Kyrgyzstan actively use the Internet, have online offices, mobile applications, and are actively presented in social networks. For these purposes, they hire full-time ICT specialists.

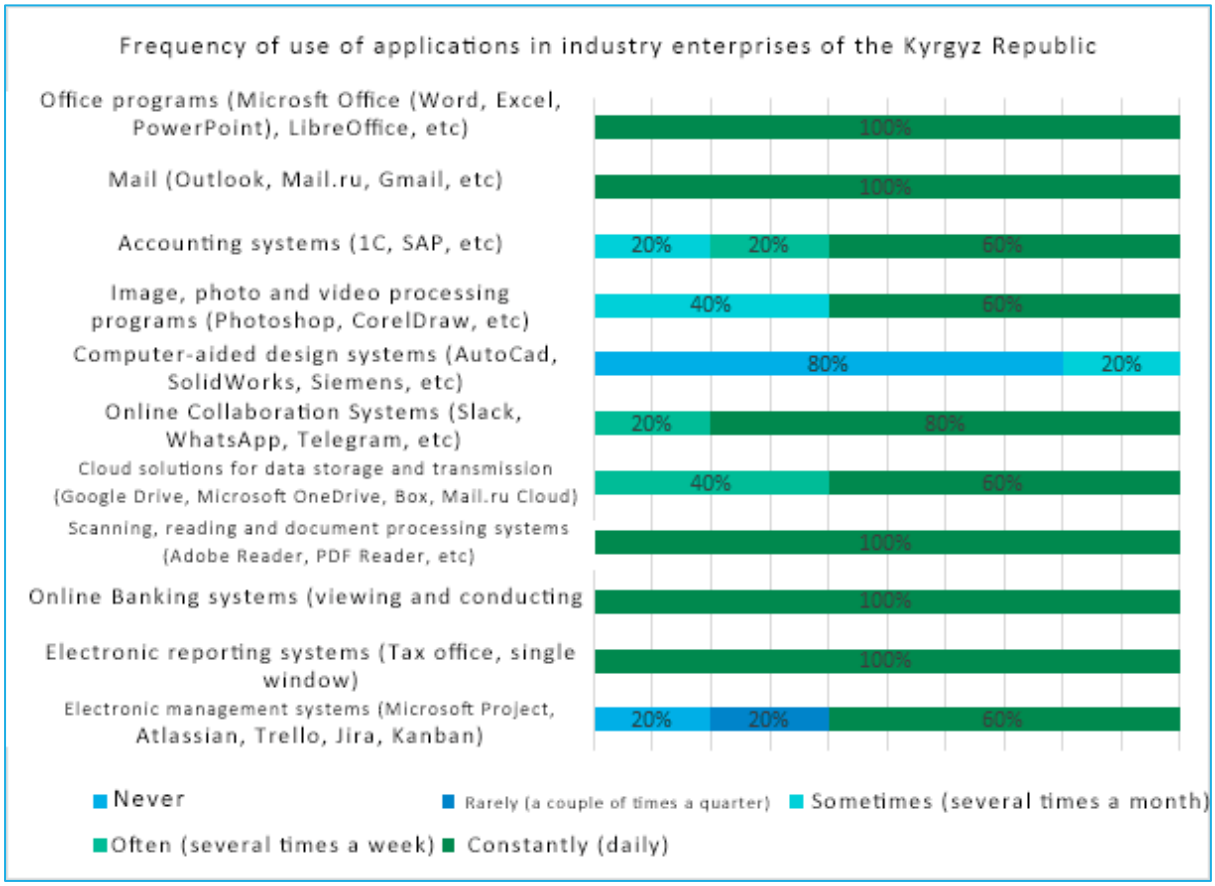


60% of enterprises attract programmers and other specialists to adapt ready-made technological solutions to the needs of the enterprise, as well as to fulfil ICT needs (SMM, SEO, etc.). 60% of respondents agree that industry enterprises discuss issues related to the use of IT in workflows on a daily basis, actively raise issues related to IT implementation in industry meetings and discussions, and raise issues related to digital skills experts at industry discussions asking associations for information on the industry's policies in this area.

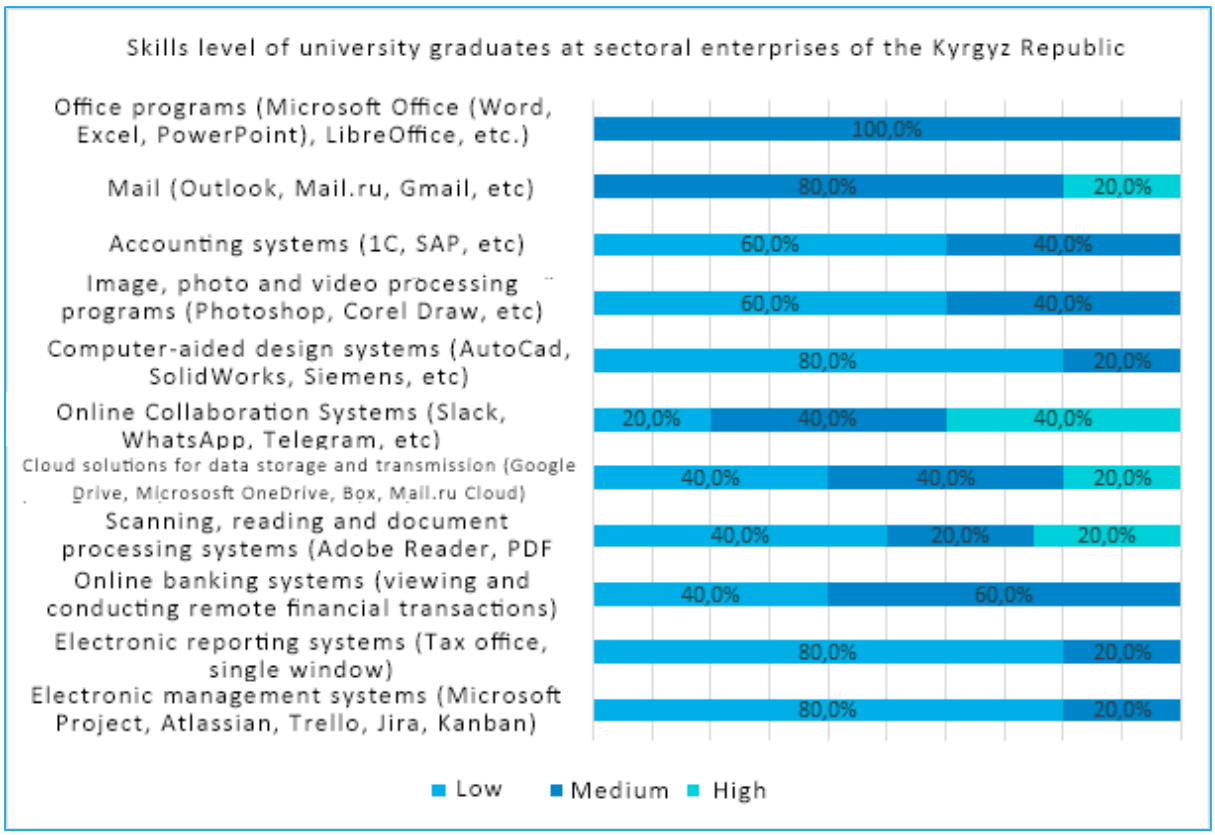
Only 40% of respondents agreed with the statement that enterprises have deployed network solutions, cloud solutions are used to automate and digitize work processes, and enterprises are investing in their own IT solutions. 40% of respondents believe that industry enterprises

are familiar with the sectoral indicators of the “Sanarip Kyrgyzstan” program, understand how to achieve them and make efforts to achieve them.

In many aspects, the respondents expressed more doubts, disagreements and lack of such information in matters related to the network infrastructure of enterprises, their maintenance and development. There is also a lack of confidence that enterprises are actively using IT solutions for project management.



The interviewed respondents indicated the active use of IT solutions in enterprises. 100% of the respondents agreed with the statements that enterprises in the industries use office programs, e-mail, scanning systems, reading and processing documents, and electronic reporting systems on a daily basis. Only 60% said that accounting systems, image, photo and video processing programs, cloud storage and transmission solutions, and project management systems are constantly used in the industry. 100% of respondents believe that computer-aided design (CAD) systems are never or only a few times a month used by members of associations.

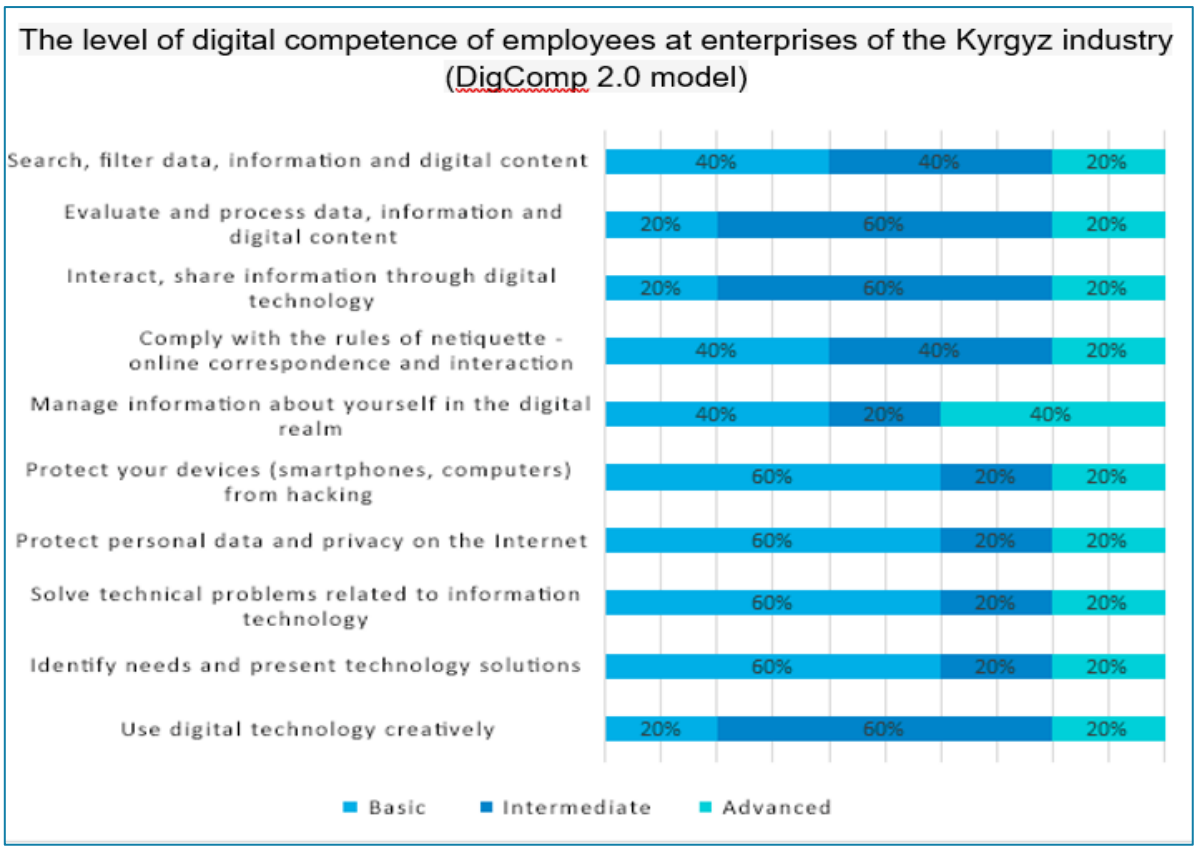


A certain set of questions related to the level of digital skills of graduates who started working in industry enterprises and the level of skills of existing employees in the industry.

80% of the respondents considered that the level of university graduates is low in the use of project management systems, electronic reporting systems and computer-aided design systems. 60% consider low skills in accounting systems, programs for processing multimedia files. Above 80% of respondents believe that the skills in knowledge of office programs and e-mail are at the intermediate level.

Also, the respondents were given the opportunity to assess the competencies of employees in the industry using the European Commission's DigComp 2.0 digital skills assessment model. Representatives of the information technology sector indicated a high level of advanced competencies, and a low level of competencies in terms of parameters was more common in the answers for the agricultural sector of the republic.

Respondents believe that existing employees have basic skills in the competencies to protect their devices, protect personal data and privacy on the Internet, and the ability to solve technical problems related to IT. 60% believe industry employees have intermediate skills in evaluating and processing data, information and digital content, interacting and sharing information through digital technologies, and using digital technologies creatively. The highest indicator for advanced competencies was for the parameter "manage information about oneself in the digital sphere" (40%). In general, these questions revealed the need for a more detailed study of the level of competencies by industry and identification of clear needs.



Among advanced technologies, respondents noted that members of the association use data analytics, Internet of Things and machine learning the most. Respondents to the multiple-choice question did not mention technologies such as 3D printing, big data, virtual reality, industry 4.0, artificial intelligence, data science, cloud solutions.

According to the data of business associations, enterprises of their industries do not have training programs for teaching digital, computer skills. However, industry associations are working to train future personnel with such universities as KTU, INAI, KRSU, AUCA, Ala-Too University.

The role of key sectors of the economy in forming the demand for digital skills

Following the analysis of the key sectors of the economy of the Kyrgyz Republic, it was revealed that each of these sectors needs specialists of different levels of digital skills, both in quantitative and qualitative terms. At the same time, the below table reflects the level of technological complexity of these industries that affects the overall competitiveness of the industries' products in the international market. The highest demand for advanced skills is generated by the communications and information services sectors that in general represent the digital economy of the Kyrgyz Republic.

According to the National Statistical Committee, the share of people employed in the Information and Communication sector by type of activity is 28.1 thousand people out of 2.38

million employed in 2018. This is about 1.1% of all employed in the Kyrgyz economy. While in Russia this indicator is at the level of 2.44%, and world leaders reach 4.3% of the total employed population.

Sector	Metrics (share of GDP, share of employment, growth potential)	Main professions within the sector	Digital skills requirements (basic, intermediate, advanced)	Key associations and companies in the sector
Communication services	3% of GDP, largest taxpayers	Network administrator, engineer of network connections and systems, installer of fibre-optic communication lines	Advanced: Huawei, ZTE, Cisco, cloud technologies, 4G / 5G,	Association of Telecom Operators, Megacom, Beeline, Nurtelecom, Elcat, Kyrgyztelecom
Information Technology	The most growing direction of export of services of the Kyrgyz Republic	Developer, web designer, layout designer, data analyst, SMM, SEO	Advanced: C, C +, Java, Py-thon, Android, Php, 3D unity	Kyrgyz Software and Services Developers Association (KSSDA), High Technologies Park
Mining industry	18% of GDP, The largest taxpayers	Excavator driver, engineer-technologist, geo-logger, mining equipment driver	Intermediate: Geological Exploration Technology	International Business Council, Kumtor, Alliance Altyn, Kaz Minerals Bozymchak, KyrgyzAltyn, Altynken
Hydroelectricity	4% of GDP	Mechanical engineer, electrical engineer, hydraulic engineer	Intermediate: CAD, 3D modelling, Business information modelling (BIM), Internet of things, neural networks, blockchain	Power stations, “SeverElectro”
Service industry: tourism and trade, others	44% of GDP, 15.6% of employment comes from trade	Salesperson, storekeeper, computer expert, data analyst	Intermediate: accounting systems, e-commerce	Association of Young Entrepreneurs, Association of Suppliers, Trade House Narodny, Partner KG, individual entrepreneurs
Agriculture	26.8% of all employed	Farmer, livestock breeder, plant breeder, agronomist	Basic, intermediate: Digital agronomist, digital agricultural analyst, agricultural engineering	Farm households

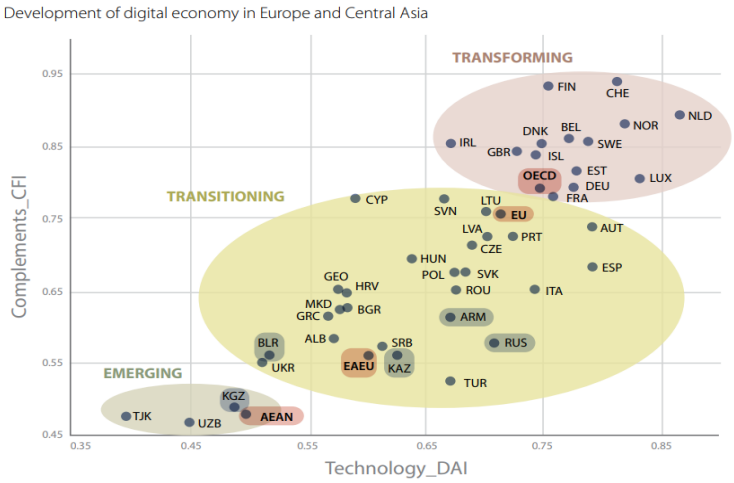
Priority sectors of the economy such as mining, hydropower, and the service sector that are the main generators of GDP and employment in the republic, require, on average, confident intermediate skills. However, specialists with high ICT competence are also required for deep digital transformation of industries. In total, the need for IT specialists in these sectors of the economy may turn out to be higher than the sector of the digital economy upon further detailed consideration.

The agriculture plays a significant role in providing employment for the population and needs basic digital skills. However, the achievement of the "Sanarip Kyrgyzstan" sectoral indicators in agriculture means an increase in productivity, automation of processes and a decrease in the share of employment in this sector. Subsequently, less qualified staff with more advanced ICT skills will be required to achieve the targeted indicators.

According to the World Bank's report on the prospects for the digital agenda of the EAEU, Kyrgyzstan is at origin stage in terms of the level of development of the digital economy. Within the EAEU, Kyrgyzstan has the lowest indicators of technology development and the level of a supportive environment for the development of the digital economy. According to the National Statistical Committee, the contribution of the digital economy to the GDP of Kyrgyzstan is 0.4% of the country's GDP.

In order to reach the EAEU 2025 indicators, Kyrgyzstan needs to bring the share of the digital economy's contribution to 2.4% that is six times more than the current level of development. To achieve such indicators, it is necessary to, at least, double employment in the ICT sector and bring it to the level of 56 thousand people by 2025.

Figure 1: The level of development of the digital economy in Europe and Central Asia



Source: EEC Digital Agenda 2025: Prospects and Recommendations. World Bank, 2018

According to expert estimates, in Kyrgyzstan, the annual inflow of ICT specialists into the economy is 9-10 thousand specialists who graduate from educational institutions of the country including private short-term training courses on technical specialties. Taking into account the achievement of the target indicator of 56 thousand specialists employed in the ICT sector,

Kyrgyzstan needs to double the number of graduates to digitize the economy in the next five years.

Current and Future Digital Skills Needs for Government

For the last three years, the state system has been experiencing a significant process to create new digital information systems, change the algorithms for interdepartmental interaction and data exchange. The digitalization of business processes is taking place in all branches of government and regional departments. In this connection, it is necessary to implement measures to improve the qualifications of state and municipal services on digital literacy, new competencies, as well as conduct an awareness promotion on the role and sectoral application of new technologies within the framework of the implementation of the “Sanarip Kyrgyzstan” strategy.

The prescribed pace of implementation of e-government creates a significant demand for improving the digital qualifications of civil servants, increasing the level of digital literacy of the population and taxpayers for the development of electronic services of the state. For the successful achievement of the set tasks for the next three years, significant information and awareness-rising campaign among the population, the organization of retraining courses for state personnel, as well as the involvement of IT specialists in the civil service will have to be carried out.

Assessment of existing training channels on digital skills

In Kyrgyzstan, digital skills training is provided by various educational institutions for different age groups of citizens, as well as depending on the required skills. The analysis of this section aims to identify the main channels that digital skills programs offer, as well as those that can potentially be used, their distribution, the availability of the necessary infrastructure and the level of qualifications of teachers.

Table. Digital Skills Learning Channels in the Kyrgyz Republic

Channel	Quantity	Location	Infrastructure	Teachers
	How many facilities are there in the country?	What is their geographic distribution? (e.g., in urban / rural areas)	What is the degree of possibility of establishing a connection, what is the state of the computing equipment?	What are the qualifications / skills of the teachers? Including skills, knowledge and attitudes
Formal education				
Secondary schools	2,141 public schools, 142 private schools	Across the country, coverage is 1.4 million students	Satisfactory	In the process of transition from basic to intermediate skills
Professional vocational schools	99	92 000 students	Satisfactory	Intermediate level of digital skills of teachers
Institutes of higher education	51	164 000 students	Good, PCs are good	Average level of qualification of teachers
Informal education				
Public libraries	1061	1.5 million visitors annually	Provided with hot spots	Basic skills
Private educational courses	50	6000 prs.	Good technical infrastructure	Advanced digital skills
Distance learning systems	70	Kyrgyz Republic	Average	Intermediate level of digital skills
NGOs and clubs	15	Bishkek, Osh	Excellent	Basic and intermediate level of digital skills
High Technologies Park	1	Bishkek	Excellent	Advanced digital skills

Fab labs, makerspaces	3	Bishkek	Weak	Advanced digital skills
Acceleration programs		Bishkek, Osh	Excellent	Specialized advanced digital skills

Distribution channels can be divided according to the criteria of formal education provided within the framework of training programs in schools, universities, retraining institutes, and non-formal education, i.e., ways of receiving knowledge independently, voluntarily or in addition to basic education.

Formal education

Secondary education

In Kyrgyzstan, secondary education covers 1 million 311 thousand children of school age and is the main way of obtaining general literacy of the growing population. Over the past five years, the number of students in schools has grown by 16%. This year 103670 students completed the 9th grade, and 58730 students finished the 11th grade. On September 1, 2020, public schools will open doors for 150 thousand of first-graders.

Despite the high enrolment of schoolchildren in educational institutions (97.8% of the population aged 7-17), the main challenges for the education sector are still the lack of funding for material and technical support, the lack of highly qualified teachers and the need to improve the efficiency of sector management.

In the long-term retrospective, there has been a significant nominal improvement in the material and technical situation in schools. Over the years of independence, the number of public schools has grown by 270 educational institutions. Over 80 schools are located in rural areas. The relative ratio of the number of students per computer has grown from 606 to 30 computers. The coverage rate of schools with the Internet has grown from 5% in 2014 to 99% as of July 2020.

Year	Number of public schools	Number of students	Number of students / computers	% of school with Internet
1996	1967	1.08 million	606 actual	less than 0.1%
2001	2052	1.16 million	249	1% (21 schools)
2011	2200	1.01 million	57 actuals	2.4% actual
2014	2205	1.04 million	50 planned	5% planned
2020	2217	1.43 million	30 planned	20% planned - 99% actual

Source: surveys of different years and https://kaktus.media/doc/397205_kak_izmenilos_kolichestvo_shkol_ychiteley_i_ychenikov_v_kyrgyzstane._infografika.html

However, a comparative analysis of the use of information technologies in advanced countries and the actual situation in Kyrgyzstan reveals a technological gap between the future goals of the state and the current equipment of schools.

A detailed comparative analysis of the computer equipment of schools in relation to the number of students by region demonstrates an imbalance towards the city of Bishkek and the weak technical equipment of rural schools. Only 5% of all public secondary schools are provided with the necessary computer labs and interactive tools for teaching mixed lessons. The overall level of network infrastructure in schools remains low and insufficient to provide wired or wireless connectivity for the entire perimeter of schools in addition to purchasing computers and buying Internet.

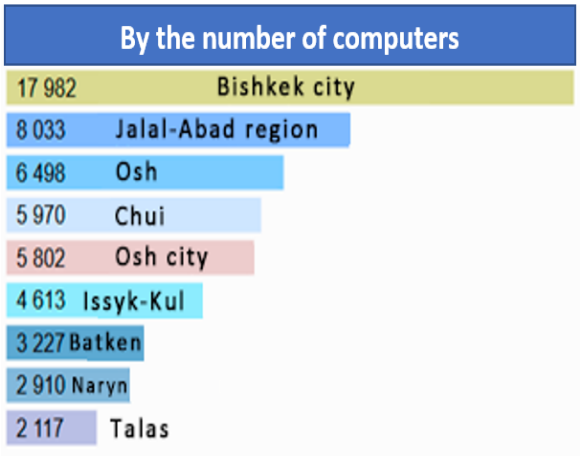
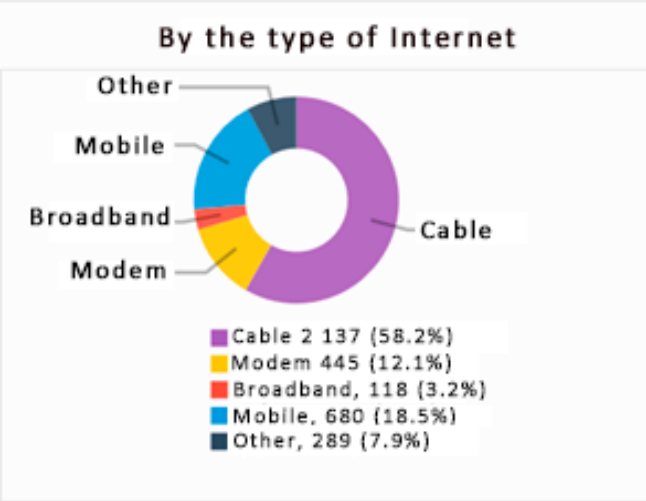


Figure 2 Source: https://public.edu.gov.kg/index.php

In Kyrgyzstan, it is declared that 99% of schools are provided with the Internet. However, the quality of the connection remains at a low level, insufficient even for use by students in computer science lessons. According to official open data, only 61% of schools have broadband or cable Internet using Metro Ethernet or ADSL technologies. Others use mobile modems to provide mobile Internet for a limited number of computers. The type of mobile connections in many regional schools is provided at a 3G speed that is sufficient only for administrative purposes of schools, but not for educational use.

One of the reasons for the heterogeneous Internet is perhaps the lack of clear indicative technical indicators of the minimum speed in schools in departmental action plans. For example, in Kazakhstan, all secondary schools achieved an Internet speed of at least 4 Mbps in 2016, and the goal for 2020 is to ensure an Internet speed of at least 20 Mbps.



It should also be noted that the budget of the Ministry of Education and Science of the Kyrgyz Republic covers the amount of monthly expenses for the Internet for schools in the amount of 2000 KGS, which are insufficient to acquire the bandwidth required to provide high-quality computer education, especially in rural areas where broadband optical - fibre Internet is a capital-intensive investment.

In general, the level of IT adaptation according to the SAMR model remains at the basic level - substitution. Until 2016, the curriculum included computer science lessons, taught only in grades 8-9 according to the educational standards developed in Soviet Union times. Students were taught the basics of using computers, as well as the basics of the outdated Basic programming language, Pascal. On 21 July 2014, new educational standards for general school education were adopted, according to which the revision of standards, which also include the necessary skills and competencies, should be carried out «at least once every five years for the purpose of ensuring that the training of schoolchildren corresponds to the strategic priorities enshrined in the strategic documents of the Kyrgyz Republic, the needs of employers, the needs of students and their parents». Based on this document, significant changes have been taking place since 2015, and informatics lessons have been taught as a separate subject starting from the sixth grade.

An association of informatics teachers has been established in Kyrgyzstan, and professional development courses are regularly held. The teacher, as the instructor, guides all aspects of the lesson and remains the central figure in the class.

To address the shortage of textbooks, they are converted into digital formats, electronic libraries of textbooks are created containing files in .pdf formats, in which the texts are saved as bitmap images. Sometimes some textbooks can be 500-600 megabytes in size that significantly exceeds the weight of electronic textbooks in machine-readable formats.

In Kyrgyzstan, by school age, children already have a lot of experience of interacting with mobile devices. Thanks to the liberal policy of the state in the development of mobile technologies, the number of mobile operators' subscribers by 2010 exceeded the number of citizens of the republic, and by 2020 the share of smartphones is at least 80% of all devices used by citizens. According to analytical studies, Kyrgyzstan is in the list of the top five states with the cheapest mobile Internet. These factors also contributed to the spread of the use of mobile Internet on smartphones among school-age children.

At the same time, taking into account all the features of the pedagogical process, the psychological stages of development of children, as well as in the absence of an extensive evidence base about the use of smartphones in the educational process, schools have strict rules on the use of mobile phones, up to a complete ban on bringing them to school. Thus, the pedagogical process currently excludes the use of mobile technologies for the development of digital skills of school-age children within the school territories.

Nevertheless, children actively use these technologies and independently master the necessary skills for navigating the Internet and using devices. Proof of this is the fact that the most popular free mobile application in Kyrgyzstan is the Likee application - a social network for children and teenagers. Despite the fact that this application is aimed at age 17+, the main users are teenagers due to the fact that there is no age verification and increased security

measures. For new users, by default, the display of geolocation to published video content is configured, the platform has audio and video content aimed at an audience of 18+, there are no built-in parental control systems.

Due to the social and economic situation in society, children, spending significant time alone with smartphones, are exposed to various kinds of cyber violence (bullying), as well as remote manipulative influence. For example, an example of digital violence was the Blue Whale game, which spread across social networks and messengers, where children most susceptible to remote influence in a playful way performed various tasks with the final committing of suicidal actions. These cases show that there is a greater fusion of digital and physical space and there is an increasing need for teaching digital hygiene to children and their parents to ensure the safe mental and physical development of children. Thus, the formal system of education cannot ignore the general availability of technologies, however it is necessary to use achievements to develop the skills necessary for a harmonious life in current times.

In connection with the coronavirus pandemic, on March 22, 2020, a state of emergency was introduced in the country, as a result of which schoolchildren were forced to receive education remotely through various technologies. Video tutorials on the school curriculum were broadcast through 5 main and 10 cable TV channels, the video hosting platform Youtube and the educational portal oku.edu.gov.kg. Mobile operators provided free access to educational channels. In private schools, online learning was provided using a variety of educational platforms. Through the joint efforts of 300 teachers and methodologists, 10 video studios were created 1,500 video lessons, covering the school curriculum for the fourth quarter.

For students, teachers and parents, distance education has become a real challenge to overcome technological fears, increase the level of digital literacy, master new computer technologies and advanced digital services. In general, the educational process continued, children mastered new technologies from different teachers, and elder teachers began to master new technologies, in general, teachers received a good impetus for mastering new forms of communication and development[6].

One of the biggest impediments, both for students and children, was the technical aspect - low Internet speed in remote areas and insufficient mobile Internet coverage. Many families lacked televisions and did not have the funds to purchase smartphones. For two months of the quarantine regime, philanthropists donated 3748 TVs and 47284 smartphones to children from vulnerable groups of society.

To summarize, school education may become the main driver of the overall level of digital literacy in society over the next five years. Further improvement of technical support, the level of digital pedagogy and methodological potential for the development of online educa-

[6] https://24.kg/obschestvo/161710_vyidumali_ihnet_pyat_plyusov_distantsionnogo_obucheniya_/

tional materials. However, the school sector will have to undertake significant curriculum efforts to move to a higher level of IT adaptation in the SAMR model, as well as to pilot new innovative teaching approaches used in advanced countries.

Professional vocational schools

Over the past ten years, vocational schools have almost doubled the number of students. Today, the system of primary vocational education covers 19% of young people of the corresponding age, 92 thousand of students study in lyceums and colleges. In 2020, 22 thousand applicants applied for training in the system of primary vocational education. According to the National Statistical Committee, vocational schools are filled only by 74%, and in the capital by 67%.

Within the framework of the Ministry of Education and Science of the Kyrgyz Republic project "The Skills for Inclusive Growth Sector Development Program", a Manual was prepared for the development of educational programs on a competency basis. It is planned that the testing of ICT programs will be organized in the new academic year at the Centre of best practices in ICT based in the Vocational Lyceum No. 98 in Bishkek. In particular, the profession of a system administrator is taught at the Lyceum.

Along with this, an IT cluster was created in cooperation with Kyrgyz Software and Services Developers Association (KSSDA), it is planned to open six IT academies throughout the country from the summer of 2020 in order to train 50 thousand programmers in Kyrgyzstan. Currently, the State Scientific and Methodological Centre (SSMC) and KSSDA have developed and adopted curricula, educational institutions are working on obtaining a license for this specialty, teachers at educational institutions will be KSSDA employees, and upon completion of training, graduates will be employed in High Technologies Park (HTP).

In the summer of 2020, teachers of state lyceums participate in improving competencies in the direction of "web design and development" according to World skills standards designed to raise the general level of professional competence.

In terms of developing digital skills, vocational schools could become the main quick way to improve the level of intermediate skills of young professionals, as well as a source of generation of personnel with advanced digital skills at the entry level. Training of specialists with the knowledge and skills of working on specialized industry solutions (CAD, 3D modelling) can provide the necessary flow of personnel for the digitalization of priority sectors of the economy, defined in the "Sanarip Kyrgyzstan" program. This initiative should be carried out in cooperation with the policy on the transfer of foreign innovative industry technologies. For example, to open centres of best practices in digitalization of light industry, digital agriculture. In the next, the best practices of the pilot year can be transferred from one to all lyceums of the country.

Institutes of higher education

In total, there are 64 universities in Kyrgyzstan out of which 32 are state-owned, 32 are non-state. At the beginning of the 2018-2019 academic year, more than 164 thousand students were registered at the universities of the Kyrgyz Republic. In five years, the number of students decreased by 50 thousand people. In 2019, 33 thousand students graduated from the universities of the Kyrgyz Republic.

The priorities for training specialists are developed based on the methodology for forecasting the need for labour resources of the Ministry of Education and Science of the Kyrgyz Republic and the Ministry of Labour and Social Development of the Kyrgyz Republic. The last update of the map of the need for specialties for 2018 – 2022 was carried out in 2018. According to the results of the analysis, specialties in the field of industry, education, construction, agriculture, medicine turned out to be the most priority and demanded in the labour market. The 10 most demanded specialties today include such specialties as: information security, information and communication technologies and communication systems, mining, geological exploration technology, technological machines and equipment, medicine, management and marketing, agricultural engineering, construction, education. The government allocates grant places for the training of demanded specialists. Annually, the Government of the Kyrgyz Republic allocates 5705 scholarships to higher education institutions out of which 485 are for specialties in computer technologies.

All universities have a well-coordinated network infrastructure, Internet supply, computer laboratories, as well as specialists to support the technical infrastructure. Together with the definition of the digital agenda, the teaching staff take courses to improve digital literacy, the use of IT according to the SAMR model differs depending on the university, faculty and the subject of study itself. In certain universities, IT is used as a replacement for traditional textbooks for electronic media, but in others it is integrated for transformation.

Most universities have created online distance learning systems on open educational platforms such as Moodle. The shift to distance learning due to the Covid-19 coronavirus infection has forced universities to start reviewing the quality of the courses offered, and educators and students to explore online collaboration, interaction and assessment tools to effectively build learning.

Universities are an important channel not only for training specialists with highly specialized digital skills, but also for increasing the level of competencies from intermediate to initial advanced level. Universities have the potential to develop highly specialized, advanced skills. However, it is necessary to implement activities on the creation of innovative laboratories to study and conduct research on the use of advanced technologies in various sectors of the economy, as well as to create domestic innovative solutions. The preparation of a sectoral qualification framework for ICT professions and digital sectoral competencies would ensure a uniform high level of training for specialists.

Informal education

Public libraries

There are 1061 libraries in Kyrgyzstan located in all regions of the country from large cities to rural areas. It is estimated that 1.5 million people visit libraries annually, mainly in large cities where higher education institutions are located.

In September 2019, the Ministry of Culture, Information and Tourism of the Kyrgyz Republic announced the development of a concept for the creation of educational centres based on libraries. In particular, it was supposed to create training centres that will work in three areas: creativity (music, additional education), IT-technologies (courses in robotics, programming) and language courses.

International experience shows that libraries could be an effective way to increase general digital literacy, reach the adult population and residents of rural areas. However, today, the level of network infrastructure, technical equipment of libraries remains low, which is a limitation for quick victories in digital educational promotion. However, it should be emphasized that in remote and rural areas, libraries can be an important educational function for teaching skills to work on public Internet platforms and for receiving electronic public services.

Distance learning systems

Along with the increase in the coverage of the country with the Internet, online educational courses are gaining popularity. Especially the popularity of such digital platforms began to grow with the introduction of a quarantine regime and restrictions on movement in the county.

Many popular global platforms such as Coursera, Udemy and leading universities have opened educational courses for free access reducing the financial barrier to testing courses. In Kyrgyzstan, only on the open educational platform Moodle, 67 sites have been deployed offering various educational courses. The platforms were created mainly based on the educational institutions, however, there are platforms initiated by government departments and the private sector.

The end of 2019/2020 and the beginning of the new academic year 2020/2021 are forcing all stakeholders to rethink the role and importance of educational institutions contributing to their digital transformation. The creation of an appropriate regulatory framework for organizing the activities of online learning platforms can create at least 67 new educational platforms that will compete with each other creating the right to choose the best teacher for students, and for teachers the opportunity to monetize knowledge through online sale courses. Technically, courses on platforms are designed in a way that they can be easily transferred from one information system to another. The adoption of standards for the creation of e-learning courses like SCORM and Tin Can would allow democratizing education, increasing internal competition among educational service providers and improving the overall quality of distance learning.

For the development of digital skills, distance education systems play an important role in terms of reducing the cost of adapting technologies and focusing on the production of the necessary content, especially in the Kyrgyz language, for subsequent distribution through digital platforms.

Private educational courses

Along with the formal sector, private educational courses on such advanced digital skills as programming, web design, and software development are successfully operating in Kyrgyzstan. The main advantage is that teachers are practitioners in their field and in a short period of time can teach not only key competencies, but also the technological environment of work in the relevant profession.

At the same time, even private training organizations predominantly train specialists of the initial level of ICT such as web design, web layout, which are in demand locally, but globally these professions are already being replaced by artificial intelligence algorithms. For example, a start-up b12.io, which also has an office in Kyrgyzstan, can develop an automated website for simple businesses in five clicks and 60 seconds.

However, it is the private education courses that offer courses on advanced technologies. For example, in the city of Bishkek there are thematically related courses on data science, data analytics, machine learning, artificial intelligence, IT project management.

From the point of view of the national strategy, the function of testing demand and the first training materials on advanced technologies, highly specialized digital skills necessary to strengthen the innovative environment and the digital economy in the country can be provided by private educational centres.

A special role among private courses is occupied by the National Centre of Information Technologies located in Bishkek, which for 16 years has been preparing highly qualified specialists in the field of network infrastructure, network security, and databases. Such centres are required throughout the country to provide the personnel necessary for the network infrastructure of the digital sphere.

Acceleration and incubatory programs

The skills of digital entrepreneurship and ability to create business models in the digital space are highly specialized digital skills that require to master many prerequisite competencies. To develop such skills, there are acceleration programs, start-up contests. In Kyrgyzstan, several international organizations and public private entities provide such courses in partnership with industry organizations and government agencies. To date, acceleration programs are being successfully held only in Bishkek, since a critical cohort of specialists with preliminary digital competencies has not yet formed in the regions. Despite the presence of a good training infrastructure, training expertise and financial incentives, the general level of entrepreneurs in the regions requires the strengthening of intermediate and advanced digital skills.

NGOs and High Technologies Park

The NGO sector in Kyrgyzstan is actively developing. In the past three years, organizations promoting the role of science, technology (STEM) among women, students and young people (Techwomen, Techaim, Technovation) have been step up the pace. There are Ololo networks of co-working spaces have been deployed in the country where events are held in aggregate, increasing the role of information technologies, digital professions and creative industries among young people. The creation of a physical site for the High Technologies Park has created another place for increasing the role of digital literacy and attracting new personnel to the ICT sector. Basically, these organizations are engaged in increasing the general awareness of the population about new opportunities in the digital sphere providing advanced and highly specialized digital skills, and are flagships of the development of a digital society and economy. These organizations have the technical infrastructure, qualified specialists necessary to achieve the target indicators of the “Sanarip Kyrgyzstan” strategy.

Conclusion

This analytical report demonstrates that significant reforms have been carried out in the education sector of the Kyrgyz Republic over the past decade, creating favorable conditions for further changes and achievement of international human development Indicators.

In order to effectively achieve the goals and targets for the digitization of all economic sectors and the creation of new jobs and professions as defined in the National Strategy for Sustainable Development 2018-2040, it is necessary to develop and adopt a national strategy, a road map and a plan of activities for the development of digital skills and competencies, with the broad involvement of the civil sector and non-governmental organizations in its implementation.

The National Strategy should be a road map to implement the Digital skills and competences development concept for the period from 2020 to 2025 and to achieve the goals and objectives stipulated in the subsection of the National Program "Sanarip Kyrgyzstan" dedicated to the development of digital skills in the Kyrgyz Republic.

The future strategy should focus on the seven pillars where the efforts of the state, civil sector, and development partners should be directed to.

1) Improving the educational infrastructure for digital transformation

Educational institutions of the republic need to build a new generation digital infrastructure in order to create comprehensive access for students to education, to accelerate the introduction of a new understanding of learning, and to improve the quality of services provided. The activities should include measures to strengthen the network infrastructure of general

secondary education schools, provide high-speed Internet access with clear technical parameters, as well as create an information system with a student's personal account, where information on all academic success of citizens, starting from preschool education to continuing adult education, will be available.

2) Improving and evaluating the overall level of digital literacy, including vulnerable groups and persons with disabilities

This set of initiatives should focus on media campaigns on information technology, digital hygiene, and digital security through media, popular digital platforms, bloggers, as well as target groups using public spaces, regional and rural public libraries. Attention should also be paid to working with parents of pre-school children to ensure the full psychological development of the child in the digital era. The adoption of a national digital literacy system, as well as a methodology for the regular assessment of population literacy, is also planned.

3) Integration of digital skills and competencies into educational standards

The strategy should include the integration of digital culture into the educational process at all levels of education and in all educational programs. At the level of the general education system, the review should be focused on further integration of information technology into the curriculum, moving from learning computer science as a separate subject to the use of information technology for the cognitive and creative development of students. Informatics should become a cross-cutting subject, i.e., introduced into all relevant subjects in secondary schools from 6th to 11th grades.

As part of technical vocational education, the addition of digital skills to current occupations, as well as the launching new applied digital occupations, based on existing industry digital boards, should be planned, per the needs of sectoral development programs. In secondary vocational education institutions, digital competencies should be integrated to enhance the general qualifications of graduates.

At the higher education level, it is planned to review professional and educational standards, strengthen digital competencies, and develop a sectoral qualification framework for ICT professions and digital industry competencies. It is intended to develop a program to support ICT innovation in education by stimulating inter-university cooperation and developing joint curricula at the intersection of information technology and vocational subjects.

The digital skills road map should include an increase in the number of grant places in cross-cutting ICT-related professions and priority development sectors of the KR, such as agro-engineering, bioinformatics, and others.
Important and key at all levels of education is the introduction of ICT skills development for teachers and support for initiatives to improve teachers' digital competencies. The Strategy defines the establishment of a center of excellence for digital pedagogy as one of the key measures to improve the level and quality of education in the Republic.

4) Development of national digital content in the State language

The improvement of the overall level of digital literacy can be achieved by developing the availability of knowledge in Kyrgyz. Therefore, the national strategy on digital skills and competencies should plan the development of the Kyrgyz language in the digital space through the development of technologies and methods of natural language processing in the public domain for subsequent adaptation for the most popular operating systems browsers, digital platforms, and voice systems.

5) Improved readiness of state and municipal employees

The rapid pace of digitization is creating a plethora of new information systems and elements of the e-Government ecosystem that require from the government and municipal officials knowledge and skills. The Strategy should therefore focus on the need to introduce skills-building programs for public officials; training, testing, and certification in digital literacy programs. To accelerate the achievement of the Sanarip Kyrgyzstan goals, support is needed for the establishment and operation of non-governmental training and certification centers in the field of digital competence.

6) Development of IT education and training of specialists with highly specialized ICT competencies

To ensure the international competitiveness of priority sectors of the economy through the effective introduction of digital technologies, the Strategy should envisage a series of activities, aimed at raising the awareness of enterprises about the role of ICT in the enterprise through training activities and encouraging the opening of training centers with advanced international industry technologies in agriculture, light industry, and tourism. Special attention should be paid to the creation of competence within the country on the 5G mobile communication standard, data analysis, artificial intelligence, digital health care, and other advanced technologies.

7) Youth digital entrepreneurship development

Digital technologies offers new opportunities to create new businesses and jobs. In this regard, the Strategy and the accompanying regulatory instruments should focus on the development of entrepreneurial skills, particularly training in innovative business modeling methodologies, Product Thinking, Product Analysis, and Product Design to create a critical mass of technological enterprises and specialists needed to increase the Republic's export potential through the IT sector. National and regional innovation competitions, start-up competitions, thematic hackathons, and sector-specific acceleration programs should be planned.

The combination of these initiatives will make it possible to create the conditions for the successful development of the economy of the Kyrgyz Republic and to adapt society to the challenges of the digital age. As a result of the successful implementation of the abovementioned recommendations, the Kyrgyz Republic will be able to achieve the goals and targets approved

in the NSDS-2040 set out in the UN Sustainable Development Goals for the year 2030, as well as those set out in the EEA digital agenda for the period 2021-2025.

As a result of the implementation of the Strategy, the following positive results will be achieved in the Kyrgyz Republic:

- Citizens will have digital literacy skills for living in digital space,
- KR enterprises will have access to human resources to enhance the competitiveness of enterprises through the digitization of business processes,
- Graduates of educational programs will be able to access higher-paying jobs at the expense of acquired in-demand digital skills,
- Increase citizens' income and acquiring skills for mastering digital professions,
- The number of new jobs in new occupations will increase,
- The Program will contribute to reducing labor migration by providing training professions, skills, and competencies for distance work via the Internet,
- Digital competence will become an integral part of the curricula of educational institutions,
- The training standards for teachers in all specialties include ICT competencies, which are formed with the application of advanced technologies and the attraction of ICT specialists,
- Citizens living in rural areas will be able to take digital literacy courses,
- Educational standards and programs in informatics and other subjects include competencies aimed at developing interoperability and communication skills, developing critical thinking, improving skills in search, evaluation, and creative use of information sources, products, and technologies already available in the public domain.

Annex. The Roadmap of the “Sanarip Kyrgyzstan”

Defining the long-term development of digital education in the Kyrgyz Republic	77.1. Develop and approve the Program for the Development of Digital Education in the Kyrgyz Republic for 2019-2022 and the Action Plan for its implementation	The Program and the Action Plan for its implementation are approved	MOES, SCITC, NAS, universities (as agreed)
Creation and implementation of educational management information system (EMIS)	78.1. Develop and approve the Regulation on the EMIS	The Regulation on the EMIS is approved	MOES, SCITC, NSC, NAS, universities (as agreed)
	78.2. Create and implement an EMIS including the National database on the teaching staff of the system of preschool, school and higher education and an updated National database of state and municipal preschool and general educational organizations, universities and research organizations	The EMIS is introduced for collecting, storing, distributing information in the education system, as well as for automating the management activities of education management bodies at all levels. National Database is created	MOES, SCITC, NSC, NAS, universities (as agreed)
Improvement of educational standards in the system of school and higher education institutions in the Kyrgyz Republic	79.1. Develop / improve new educational standards in the system of school and higher education institutions for digital development	Educational standards have been approved. Conditions have been created to improve competencies, knowledge and skills in the use of modern ICT	MOES, SCITC, NAS, universities (as agreed)
Development of "electronic textbooks"	80.1. Development of “electronic textbook” standards	The standards of “electronic textbook” are approved	MOES, universities, NAS (as agreed)
	80.2. Develop content for "electronic textbooks" in the system of school and higher education institutions of the Kyrgyz Republic in the state and official languages	The content for "electronic textbooks" in the system of school and higher education institutions of the Kyrgyz Republic in the state and official languages	MOES, universities, NAS (as agreed)
	80.3. Place in free access on the website of the MOES and other educational online resources all developed “electronic textbooks”	The “electronic textbooks” are posted with a free access	MOES, universities, NAS (as agreed)
Implementation of the IS "Electronic Record" in state and municipal	81.1. Develop a Regulation on the IS "Electronic Record"	The Regulation on the IS "Electronic Record" is approved	MOES, SCITC

educational organizations of the Kyrgyz Republic (schools)	81.2. Ensure the full functioning of the IS "Electronic Record" in Bishkek	Introduced IS "Electronic Record" with the ability to remotely provide places for children in state and municipal schools in order of priority	MOES, SCITC
Creation of the National Electronic Library of the Kyrgyz Republic	82.1. Develop and implement a technological infrastructure for the creation of the National Electronic Library of the Kyrgyz Republic	Technological infrastructure for the National Electronic Library is introduced. Conditions are created for digitizing the library fund of the Kyrgyz Republic and posting the materials in free online access	MCIT, MOES, SCITC, universities, NAS, “KRENA” Association (as agreed)
Providing conditions for remote access for PWDs for higher professional education	83.1. Develop and approve the Rules and Requirements for providing remote access for PWDs to obtain higher professional education	the Rules and Requirements for providing remote access for PWDs to obtain higher professional education are approved	MOES, MOH, SCITC
Introduction of e-education	84.1. Develop a Regulation on the Unified State IS "Education"	The Regulation on the Unified State IS "Education" is approved	MOES, NAS (as agreed)
	84.2. Develop and approve regulatory legal acts in terms of the introduction of electronic textbooks	Regulatory legal acts in terms of the introduction of electronic textbooks are approved	MOES, NAS (as agreed)

The sources of financing for each activity are within the funds provided in the state budget, donor funds, private investments.

The structure of the Digital Competence Framework for Citizens (DigComp): Areas of Competence

According to DigComp, there are five areas of competence. Each of the areas contains a number of specific skills, levels of mastery, knowledge, skills and attitudes associated with each of the skills.

1. Information and data literacy
1.1. Browsing, searching and filtering data, information and digital content
1.2. Evaluating data, information and digital content
1.3. Managing data, information and digital content

2. Communication and collaboration
2.1. Interacting through digital technologies
2.2. Sharing through digital technologies
2.3. Engaging in citizenship through digital technologies
2.4. Collaborating through digital technologies
2.5 Netiquette
2.6 Managing digital identity

3. Digital content creation
3.1 Developing digital content
3.2 Integrating and re-elaborating digital content
3.3 Copyright and licences
3.4 Programming

4. Safety
4.1 Protecting devices
4.2 Protecting personal data and privacy
4.3 Protecting health and well-being
4.4 Protecting the environment

5. Problem solving
5.1 Solving technical problems
5.2 Identifying needs and technological responses
5.3 Creatively using digital technologies
5.4 Identifying digital competence gaps

Source: DigComp 2.0: The Digital Competence Framework for Citizens11 This 48-page document contains many examples of the skills listed in ascending order from basic to more advanced to better clarify the concepts used in the DigComp framework. https://ec.europa.eu/jrc/en/digcomp/digital-competence-framework

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Key words

Digitization, digital skills, digital competence, electronic state services, Taza koom, Sanarip Kyrgyzstan, digital transformation of the education sector, distance education, distance education systems.