United Nations
Educational, Scientific and
Cultural Organization

Almaty
Office

ICT-Competency Teacher Readiness Survey

Final Report

Nur-Sultan, 2021

Authors: Kaidar Nurumov, Ulzhan Ospanova, Timur Buldybayev, Alexander Pilipenko, Mukhit Baimakhanbetov.

Editor: Miraim Atanayeva

Contributors: Madina Tynybayeva, Aida Akhmetzhanova, Aizhan Kuzekova, Aida Amirova, Kymbat Yesenbekova

Contents

Summary

Recognizing the importance of the digitalization of the education system, the development of students' skills in the use of information and communication technologies (ICT), and teachers' unique role, UNESCO has developed an *ICT Competency Framework for Teachers* (ICT-CFT).

The ICT-CFT identifies six critical competencies required for effective teaching using ICT: (1) understanding the role of ICT in educational policy; (2) curriculum and assessment; (3) teaching practices; (4) digital skills; (5) organization of the educational process and its management; (6) professional development. In addition to the ICT-CFT, UNESCO has developed and implemented assessment tools.

The ICT-CFT serves as a tool to guide education policy-makers, educators, training providers, and active teachers on the role of ICT in education reform.

Distance learning in schools during the pandemic has highlighted challenges related to teachers' ICT skills and the need to rethink teaching methods rapidly. In particular, often without ICT skills or with only a limited set of them, teachers and students were forced to quickly master ICT tools for delivering lessons.

ICT education policies and teacher training programs should be in line with the latest ICT sector developments to make the education system more resilient to future crises. Simultaneously, the further development of online platforms, digital educational resources in the post-COVID-19 period and their successful use in traditional education format will depend primarily on the ability of teachers to adapt and use ICT tools in their daily teaching activities.

The findings of international comparative studies confirm the importance of efforts aimed at developing ICT competencies. According to the Teaching and Learning International Survey 2018 (TALIS-2018) results, 30% of Kazakhstani teachers noted that ICT skills' progress is one of the essential needs for teachers' professional development (*TALIS 2018 National Report, 2019*) The results of the International Computer and Information Literacy Study 2018 *(ICILS-2018)* showed that Kazakhstan is active in the development of ICT competencies: the majority of teachers over the past two years have completed one or more advanced training courses in the use of ICT, which is more than 10% higher than the average for the countries-participants of the study. However, at the same time, Kazakhstan is among the countries with the lowest percentage of teachers who have 5 or more years of using ICT during the lesson and preparing lessons (*IEA, 2018)*.

In this context, it is critical to assess and define teachers' level of ICT competencies in Kazakhstan and provide recommendations for improving them both at the policy and teacher training levels. This study will be the first step towards creating a National ICT Competency Framework for Teachers and an action plan to improve these competencies further to develop comprehensive vocational and technical education, higher education and in-service training programs.

This final report consists of two main sections. Section 1 "National Context of the State and Development of ICT in Education" contains 8 subsections following one of the questionnaires

provided by the UNESCO Almaty Cluster Office as a guide to form the section's contents. This section was compiled on the basis of a series of consultations with stakeholders and analysis of regulatory and strategic documents in the field. It is of descriptive character and designated to build understanding with the readers of the current state of ICT development in education.

Section 2 “Main Studies Results”. Teacher Readiness Survey describes the results of the survey that took place in January 2021-February 2021 with the aim to gather information on teachers' competencies in ICT-related tasks. The survey was conducted on a representative sample of teachers according to standards of probability sampling and weighting. Since the UNESCO instrument contained a set of questions on self-assessment, JSC IAC project team included an additional scale to test the presence and measure socially desirable responses.

According to results of the survey Kazakhstan has digital divide between rural and urban teachers access to fast and stable Internet. The vast majority of teachers are unaware of the lack of ICT policy in education. Regarding the aspects of competencies, overall, teachers in Kazakhstan tend to assess their ICT related skills as relatively high. At the same time their self-assessment is influenced by social desirability bias, which in comparison with other socio-demographic variables indicates the biggest statistically significant effect. Furthermore, roughly one-third of teachers in Kazakhstan attended no ICT courses for the past 2 years while slightly less than a half of teachers indicated their need for basic ICT training.

These results are not exhaustive and detailed information on survey findings is provided in the second part of the report. However, one thing is certain: Kazakhstan needs to focus efforts on the use of ICT in education. For this, it is necessary develop a comprehensive ICT use policy with clear implementation strategy and work simultaneously in several areas of the policy. Sections on conclusion and recommendations based on survey findings and international experience provide several crucial steps to balance and further develop existing areas of ICT use in education.

The UNESCO ICT Competency Framework for Teachers (ICT-CFT)

The ICT Competency Framework for Teachers is a UNESCO-developed framework that defines the competencies required for efficient teaching using ICTs. Following the Sustainable Development Goals (SDGs), the document considers the principles of inclusion, non-discrimination, free and equal access to information, and gender equality in education using modern technologies (*UNESCO ICT Competency Framework for Teachers, 2018*).

The third version of the document of 2018 focuses not only on competencies related to teachers' ability to apply ICT in practice, but also on the use of ICT to develop students' learning skills at a higher level.

The ICT-CFT contains recommendations addressing six aspects of teachers' work in three levels of ICT use, covering 18 competencies (Table 1).

Table 1. ICT Competency Framework for Teachers

	Level «Knowledge Acquisition»	**Level «Knowledge Deepening»**	**Level «Knowledge Creation»**
ASPECT 1 Understanding ICT in Education policy	**Education Policy Understanding** *Competency* – To understand how classroom work relates to institutional and/or government policies and contributes to their implementation	**Education Policy Application** *Competency* – To develop, modify and apply in the educational process methods of work that are consistent with institutional and/or national policies, international documents and social priorities	**Policy Innovation** *Competency* – To critically assess institutional and government education policies, propose changes, work on policy improvements, and proactively assess the impact of such changes in the future
ASPECT 2 Curriculum and Assessment	**Basic Knowledge** *Competency* – To analyze curriculum and educational standards, identify opportunities for the pedagogical use of ICT to ensure standards compliance	**Knowledge Application** *Competency* – To integrate ICT into the curriculum of the subject, into the learning process and the assessment system at various stages, to create a learning-friendly environment in which students can successfully master the curriculum material using ICT	**Knowledge Society Skills** *Competency* – To identify ways to maximize the effective use of a student-centered approach to collaborative learning for students to master a multidisciplinary educational program
ASPECT 3 Pedagogy	**ICT-enhanced Teaching** *Competency* - To choose ICT wisely to support specific teaching and learning methodologies	**Complex Problem-solving** *Competency* - To develop project-based learning activities using ICT to help learners create, implement and monitor project-based plans, as well as solving complex problems	**Self-management** *Competency* - To promote the development of students' skills of self-management in the process of student-centered and collaborative learning by defining the parameters of learning
ASPECT 4 Digital Skills	**Application** *Competency* - To choose different hardware and standard software based	**Infusion** *Competency* - To combine various digital tools and resources to create an	**Transformation** *Competency* – To build communities that use digital tools to support

	on their functions, as well as be able to use them	integrated digital learning environment to develop students' higher-level thinking and problem-solving skills	pervasive learning
ASPECT 5 Educational Process Organization and Administration	**Standard Classroom** *Competency* – To organize the classroom to support various inclusive learning methodologies using technology	**Collaboration Groups** *Competency* – To apply a flexible approach when using digital tools to facilitate the process of collaborative learning, organizing work with students and interacting with other participants in the educational process	**Learning Organizations** *Competency* – To lead the development of an institution's ICT strategy to transform the school into a learning organization
ASPECT 6 Professional Learning	**Digital Literacy** *Competency* – To use ICT for independent professional development	**Networking** *Competency* – To use technology for interaction with the professional community for professional development	**The teacher as an Innovator** *Competency* – To continually evolve, experiment, teach, innovate and share best practices to identify the most effective ways to use technology in school

Source: UNESCO (2019). The ICT Competency Framework for Teachers. UNESCO recommendations. Version 3. Paris

The role of ICT and innovation in improving the quality of education and inclusion and achieving the SDGs cannot be overestimated. Since the term itself can be interpreted broadly enough.

This study uses the definition of ICT-CFT's glossary. Information and communication technologies (ICT) means “computers, mobile phones, digital cameras, satellite navigation systems, electronic instruments and data recorders, radio, television, computer networks, satellite systems or almost anything that handles and communicates information electronically. ICT includes both the hardware (the equipment) and the software (the computer programs in the equipment)” (*UNESCO ICT Competency Framework for Teachers, 2018*).

In this regard, assessing teachers' readiness to actively use ICT for teaching, assessing the readiness of the education systems to introduce ICT to create a knowledge society becomes more relevant.

1. National Context of the State and Development of ICT in Education

This section of the report describes the analysis of the development strategy and integration of ICT in education; it was prepared following the questionnaire on the national context received from the UNESCO Cluster Office in Almaty, following a series of consultations and information exchange with the following stakeholders:

- Ministry of Education and Science of the Republic of Kazakhstan;
- Committee for Preschool and Secondary Education;
- Department for Digital Transformation of Education;
- JSC Orleu National Center for Professional Development (Orleu NCPD);
- Center for Pedagogical Excellence, Autonomous Educational Organisation Nazarbayev Intellectual Schools (CPE NIS)
- Uchebnik Republican Scientific and Practical Center;
- I. Altynsarin National Academy of Education;
- pedagogical colleges and tertiary institutions;
- school teachers and educators.

The analysis of strategic documents, legal acts and the synthesis of statistical information related to the development of ICT in education serve the basis for the National Context section. Statistical data obtained from the National Educational Database (NEDB) are reported as of 11/19/2020 - the closest reporting period to the time of work on the report. This is conditioned by the fact that the NEDB is filled by schools independently in real-time mode, and constant changes in data can create discrepancies in the calculations. In addition, statistical information on ICT is presented exclusively on schools falling within the jurisdiction of local authorities. Private schools, Nazarbayev Intellectual Schools and schools under the jurisdiction of other authorities were excluded from the analysis. It should be noted that the collection of statistics on some of the questions included in the questionnaire is not carried out in the country, and the report contains available data.

We also do not specifically focus on results and impact of distance learning and pandemic response measures on ICT development, though this impact is undeniable, expected to pose long-term effect on education system and endure for the unknown period. Statistics given in this report include data for the year of 2020 which reflects the impact of COVID, also the report includes some insights on pandemic response measures and practices.

1.1 ICT Development Policy

ICT in education *has been a priority in public education policy* over the past 24 years. Informatization of the education system began with adopting the State Program for Informatization of the Secondary Education System for 1997–2002. The program was designed to implement the tasks of providing schools with computers and equipment, digital infrastructure development, development of regulatory legal acts (RLA), creation of a telecommunication network system, teachers training and retraining to use and implement new information technologies (*Secondary Education System Informatization Program UNESCO, 1997).*

In the next three State Programs for the Development of Education, the ICT policy has kept development consistency. These strategic documents were aimed at creating a unified educational information environment; introduction of e-learning; creation of conditions for the implementation of the educational process automatization; improvement of regulatory legal acts related to integration of ICT in educational process; computerization of secondary education organizations; development and implementation of distance learning technologies at all educational levels; provision of secondary education organizations with electronic educational publications in accordance with educational programs, and other (*State Programs for Development of Education 2005-2010, 2011-2020, 2016-2019).*

2016 was a start of transition to the updated content of secondary education, where the use of information and communication technologies *(Order of the MoES of the RK No. 604, 2018)* becomes one of the broad-spectrum skills development goals of primary (grades 1-4), basic (grades 1-9) and general (grades 1-11(12) secondary education (S*tate Compulsory Education Standards, 2018).*

Currently, the development of ICT in the field of education is carried out in line with the *national level strategic document* - Digital Kazakhstan State Program, and the *sectoral strategic document in the field of education* - the State Program for the Development of Education and Science of the Republic of Kazakhstan for 2020-2025 (SPDES).

According to the *Digital Kazakhstan Program*, the key tasks related to ICT in education are human capital development by increasing digital literacy in secondary, technical and vocational, tertiary education and increasing digital literacy of the country's population. SPDES provides a set of activities to accomplish these tasks, such as measures related to updating educational programs (curricula) at all levels of education to develop students' digital skills, increase teachers' ICT-competency, improve professional standards in relation to ICT, establishment of Astana IT University, etc.

SPDES 2020-2025 preserves the continuity of the development of ICT in education. The goal of the *SPDES 2020-2025* is to increase the global competitiveness of Kazakhstan education and science, upbringing and training of the individual based on universal human values.

SPDES 2020-2025 contains *11 priority areas*, all of which to some extent provide for the development of ICT. It should be noted that ICT in the context of the SPDES is considered not as a goal but as a means of achieving the program's goals, and the development of ICT may not be singled out as separate tasks. Tasks such as building digital infrastructure and ensuring modern material and technical provision in educational organizations; modernization and digitization of scientific infrastructure are directly related to ICT and development of ICT use competencies in educators' practices. The following tasks are also associated with the development of ICT: (a) raising the status of the teaching profession and modernizing teacher education which provides for such activities as conducting advanced training courses including those for small/underfilled school teachers and online, developing and testing educational programs for teachers in tertiary institutions; (b) improving conditions for the safe and comfortable life of children; (c) reducing the gap in education quality between urban and rural schools, regions, educational institutions, students; (d) improving the quality assessment system for students, teachers and educational organizations, etc.

Measures to modernize the education system are carried out within the framework of the *Action Plan for SPDES implementation* with indication of funding source and amounts. The finance allocation procedures for activities, including ICT development, are carried out under the Budget Code of the Republic of Kazakhstan. Individual levels of the International Standard Classification of Education (ISCED) within these documents are not distinguished.

The Action Plan for SPDES implementation provides the *Budget Estimates* to achieve the program objectives. However, calculations of the amounts allocated for ICT development funding are not available since ICT is not defined as a separate cost item in the Action Plan. The plan for development of ICT in education has not been adopted as a separate strategic document, which makes determining the exact amounts allocated from the state budget, including as a percentage of GDP, impossible.

The main source of ICT procurement funding in schools is the state budget (republican and local). Also, computer equipment, interactive whiteboards, etc. can be donated by sponsors. Development of digital infrastructure in public educational organizations is funded from local government budgets based on planning, along with targeted funding from the republican budget.

The Department of Digital Transformation of Education (DDTE) under the Ministry of Education and Science of the Republic of Kazakhstan *coordinates the ICT strategy implementation* in terms of *infrastructure and material base provision*. According to the *Regulations on the Department*, the main tasks of this structural subdivision of the Ministry of Education and Science of the Republic of Kazakhstan are legal regulation of education informatization, improvement of education and science legislation and regulations, examination and expert assessment of technical specifications of information systems, modernization of the information and computing complex and telecommunication systems, regulation of implementation, operation and maintenance information systems and control over the effective use of the information and computing complex in the Ministry, Committees and subordinate organizations. The Committee for Preschool and Secondary Education (CPSE) of the Ministry of Education and Science of the Republic of Kazakhstan supervises the development of ICT *in relation to education content* at schools and pre-school organizations.

The teacher qualification system is based on attestation and consists of two stages: national qualification testing and the procedure for qualification category awarding (confirmation). Digital skills are indicated as qualification requirements among other professional competencies (see Table 2).

Table 2 - Qualification characteristics of teachers

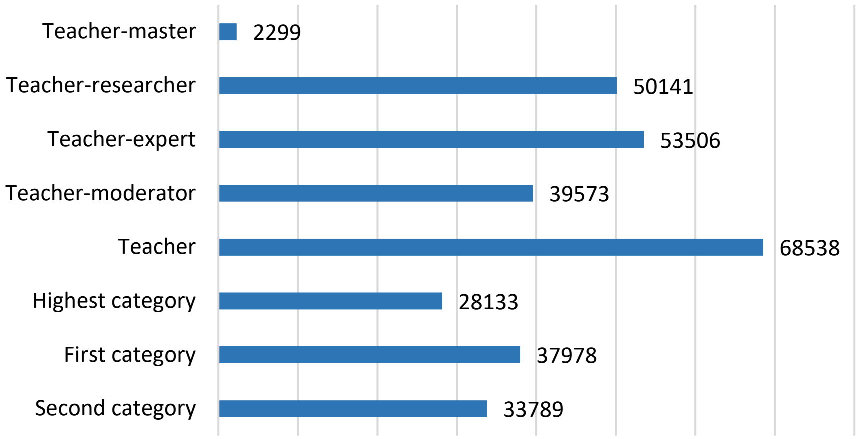
Teacher	Teacher-moderator
Higher (or postgraduate) vocational or technical and vocational (secondary vocational, secondary specialized) education in the specialty without requirements to work experience, the following professional competencies: knowledge about the content of the subject, the educational process, teaching and assessment methods, the ability to plan and organize the educational process, taking into account the psychological and age characteristics of students; contribute to the formation of the general	Higher (or postgraduate) vocational or technical and vocational (secondary vocational, secondary specialized) education in the specialty; teaching experience of at least two years, the following professional competencies: compliance with the general requirements for teacher qualifications; the ability to use innovative forms, methods and teaching means, generalize experience at the level of educational organization; to have in class participants in Olympiads, competitions, competitions at the level

culture of the student and his or her socialization; take part in events at the level of the organization of education; implement an individual approach to education and training, taking into account the needs of students; skills of professional and pedagogical dialogue; *ability to use digital educational resources* (italics are highlighted by us).	of an educational organization.
Teacher-expert	**Teacher-researcher**
Higher (or postgraduate) vocational or technical and vocational (secondary vocational, secondary specialized) education in the specialty, teaching experience of at least 3 years, the following professional competencies: compliance with the general requirements for the qualifications of a teacher-moderator; proficiency in the analysis of organized educational activities; the implementation of the mentoring and constructive definition of priorities for professional development (own and colleagues at the level of educational organization); generalization of experience at the district/city level; have participants in Olympiads, contests, competitions at the district/city level in class.	Higher (or postgraduate) professional or technical and vocational education in the specialty, teaching experience of at least 4 years, the following professional competencies: compliance with the general requirements for the qualifications of a teacher-researcher; the skills of lesson research and development of assessment tools; ensuring the development of research skills of students, ability provide mentoring and constructively define development strategies in the pedagogical community at the district/city level, generalize experience at the level of the region/cities of Nur-Sultan, Almaty, Shymkent, the presence of participants in Olympiads, competitions, competitions at the level of the region/cities of Nur-Sultan, Almaty and Shymkent in class.
Teacher-master	
Higher (or postgraduate) vocational or technical and vocational education in the specialty, teaching experience of at least 5 years; the following professional competencies: compliance with the general requirements for the qualifications of a teacher-researcher; availability of an author's program or copyright (co-author) right to publish textbooks, educational and methodological manuals that were approved by the regional, republican educational and methodological council; ensuring the development of scientific design skills; the ability to mentor and plan the development of a network of the professional community at the regional level; participation in international and republican competitions and Olympiads, or the presence of participants in international and republican contests and Olympiads in a class.	

Source: Order of the Ministry of Education and Science of the Republic of Kazakhstan dated January 27, 2016, No. 83 "On the approval of the Rules and conditions for certification of teachers holding positions in educational institutions that implement general educational curricula for preschool education and training, primary, basic secondary and general secondary education, educational programs of technical and professional, post-secondary, additional education and special educational programs, and other civil servants in the field of education and science"

214 thousand teachers have qualification categories under the new certification system. Only 0.7% of teachers have the highest qualification category "Teacher-Master" (Figure 1).

Figure 1. Teachers by qualification category, %



Source: Data from the National Education Database as of 11/19/2020

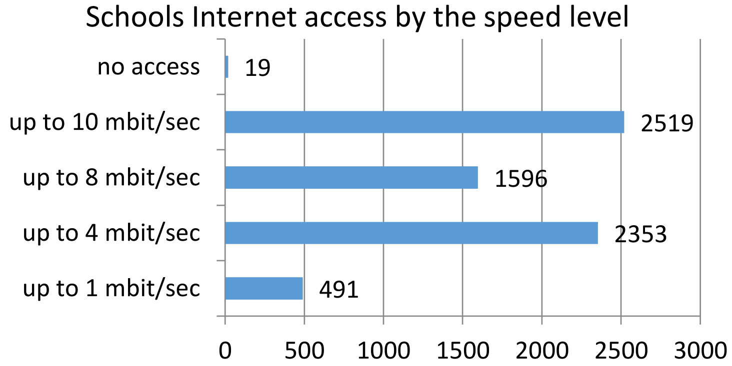
Mandatory *accreditation of teacher training institutions/teacher training colleges* was abolished in 2020 and is carried out on a voluntary basis. According to the accreditation procedure, educational institutions undergo specialized and institutional accreditation once every 5 years. Curricula are checked for compliance with professional standards as a part of specialized accreditation.

Providers of in-service training services can be accredited voluntarily. However, public procurement for teacher training services is placed only in organizations that have obtained the approval of the course programs from the Committee for Preschool and Secondary Education of the Ministry of Education and Science of the Republic of Kazakhstan in accordance with the *Rules for the Development, Coordination and Approval of Educational Training Programs for Teachers (Order of the MoES of the RK No.175, 2020)*.

1.2. ICT Infrastructure in Secondary Education

Nearly all public schools have *access to the Internet* (99.7%) at a different speed of 512 Kbit/s and above. 59% of schools have access to a *fixed broadband network* (Figure 2).

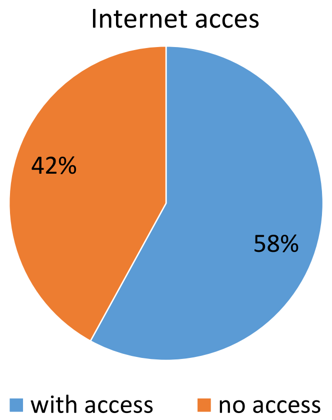
Figure 2. Schools that have access to the Internet

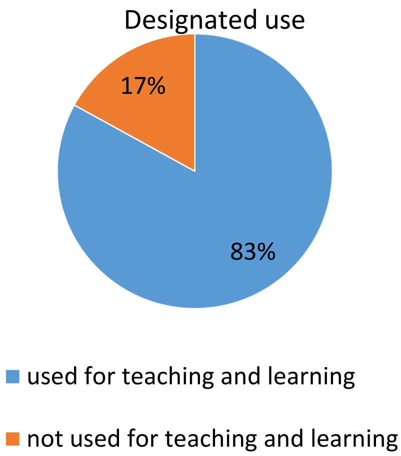


*Source: NEDB as of 11/19/2020

Statistical information on technical equipment in Kazakhstan schools is collected in NEDB, where schools file data on acquisition of computers, including laptops and tablets. The total number of computers in public schools exceeded 714 thousand as of 11/19/2020. The overwhelming majority of computers are used in the educational process, 58% of which have access to the Internet (Figure 3).

Figure 3. Computers with Internet access used for teaching and learning





Source: NEDB as of 11/19/2020

Since computer equipment data breakdown by ISCED 1, 2 and 3 is impossible due to national statistics collection specifics, breakdown by education levels is made as follows: primary schools (grades 1-4), basic secondary schools (grades 1-9), and general secondary schools (grades 1-11 (12)

12% of schools in the country have *computer classes* (primary - 14%, basic - 16%, general - 12%). *Classroom computers* indicator means computers used for learning and not by teachers. On average, there are 39 such computers in one school (in primary schools - 7, in basic secondary schools - 14, in general secondary schools - 47). *Interactive equipment* includes interactive boards, projectors and panels. The share of schools with interactive equipment in the country is 93%. The collection of statistics on the availability of the local network is not carried out. Additional information is presented in Table 3.

Table 3 - ICT infrastructure in public schools

Indicator		Primary schools (grades 1-4)	Basic secondary schools (grades 1-9)	General secondary schools (grades 1-11 (12))
Number of computer classrooms		153	1234	14093
	Number of computers in such classrooms	881	9315	152798
Classroom computers (*used solely by students)				
	Number of classrooms	2155	8995	143612
	Number of computers in such classrooms	2584	13229	250111
Interactive equipment (including interactive boards, projectors and panels)				
	Number of schools with interactive equipment	423	865	5212
	Share of schools with interactive equipment, %	68	89	97
	Number of interactive boards	569	2096	37938

Source: NEDB as of 11/19/2020

As of 11/19/2020 the student/computer ratio in the country is 6 to 1, but the average values vary at different education levels, especially in basic secondary schools (Table 3). It is also necessary to note that as a result of the pandemic response measures taken by the MoES, this indicator is expected to change by the end of 2021, and by the finalization of this Report the student/computer ratio was 4 to 1.[1]

Table 4 - Student/computer ratio

Education level	Number of computers.	Number of students	Student/computer ratio
Primary schools	4319	20655	5
Basic secondary schools	19860	66622	3
General secondary schools	523393	3281425	6

Source: NEDB as of 11/19/2020

Digitization of education system is also implemented in the form of public private partnerships, as well as private companies contracting. *Access to e-learning materials and digital resources* for primary and secondary schools is carried out on a subscription basis with the PPP organizations which provide for their development, distribution and provision of services to schools. Suppliers of such services create digital educational resources on school subjects developed in accordance with the curriculum based on updated secondary education content[2]. The subscription fees for schools and students are funded by the state budget. Thus, the provision of access to schools to servers by the government is not required.

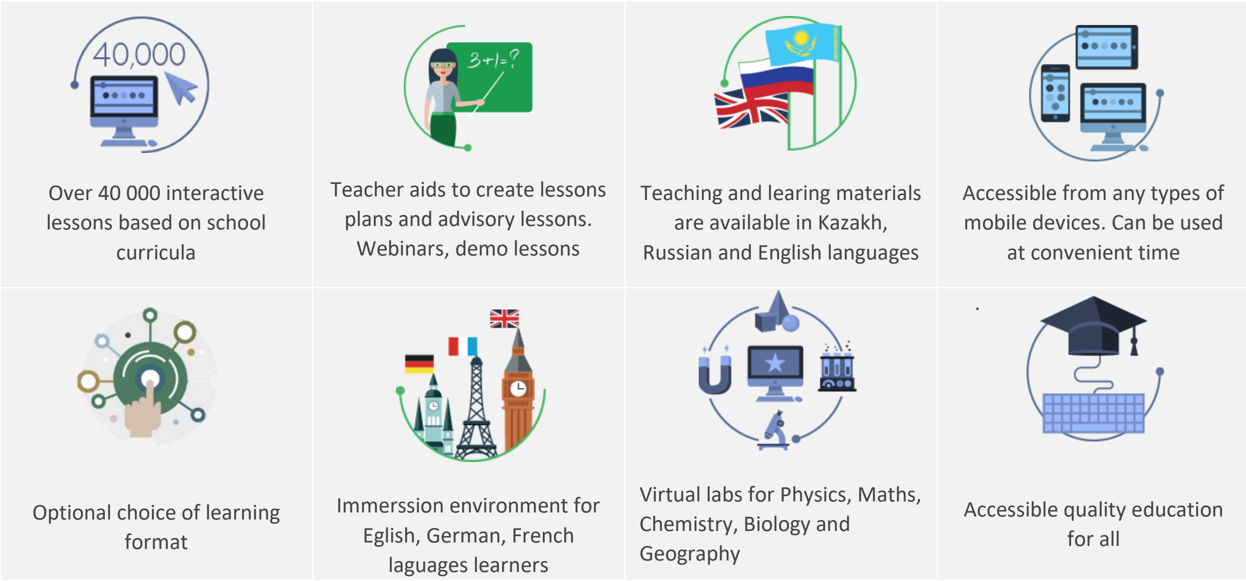
Digital educational resources (DERs) are developed in compliance with the requirements of State Compulsory Educational Standards and Standard Curricula Programs by education levels, in compliance with students' age characteristics, the principles of tolerant attitude towards representatives of various religious, ethnic and cultural groups, openness to interethnic and interfaith dialogue, accessibility and comprehensibility for students regardless of gender, nationality and place of residence, etc.

Educational portals with digital educational resources include bilimland.kz, itest.kz, imektep.kz, twig-bilim.kz, onlinemektep.org, etc. The *Bilimland.kz platform* contains various multimedia materials (videos, animated presentations, interactive exercises, etc.), demonstration lessons, lesson plans, lesson development guidelines in accordance with the requirements of the SCES of the Republic of Kazakhstan (see Figure 4). The use of BilimLand resources in daily practice greatly contributes to teachers' and students' ICT-competency improvement. 100% of schools have access to digital educational resources of the online platform Bilimland.kz. In addition, electronic versions of compulsory textbooks are provided to students in open access.

Figure 4. Educational portal Bilimland.kz

[1] NEDB as of 11/03/2021

[2] https://bilimland.kz/ru



Source: https://bilimland.kz/

Such platforms as kundelik.kz[3], bilimal.kz[4], imektep.kz and mektep.edu.kz[5] were initially developed as electronic journals to keep records of student academic performance, attendance and administrative planning. To date, along with providing access to digital educational resources they are also used for curriculum planning, assignments, learning outcomes evaluation and feedback.

All schools have the right to conclude contracts or hire staff for *technical maintenance and support* for on-site ICT devices independently. Technical maintenance and support, as well as training of school staff to use publicly available nation-wide educational ICT technologies (described above systems and resources, NEDB, etc.), is carried out by the service providers and IS operating organizations. Provision of such services is funded by the state budget.

1.3 Curriculum and evaluation

In Kazakhstan, schools base their syllabuses on textbooks which are approved by the Ministry of Education and Science of the Republic of Kazakhstan, including learning and teaching packages, teaching aids and other additional materials, including those in electronic format *(Order of the MoES of the RK No. 216, 2020).* For each subject, this list includes several optional textbooks that can be used for teaching, with the exception of those for primary schools. For example, the list offers 3 textbook options for Computer Science in 5th grade by different publishers. The inclusion into the list is conditioned by a series of procedures in accordance with the Rules for Organization of Works on Preparation, Expert Examination, Approbation and Monitoring, Publication of Textbooks, Teaching Packages and Teaching Aids *(Order of the MoES of the RK No. 211, 2020)*.

Creation of textbooks, teaching packages (TP) and teaching aids (TA) must comply with the State Compulsory Educational Standards (SCES) and Standard Curriculum Programs (SCP) by education level, Hygienic Standards for Educational Publications approved by the Order of the Minister of National Economy of the Republic of Kazakhstan No. 611 dated August 19, 2015 and

[3] https://kundelik.kz/
[4] https://www.bilimal.kz/
[5] https://mektep.edu.kz/

should be carried out based on modern methodological, didactic, methodical, ergonomic approaches to the design of the educational literature content.

Scientific and pedagogical expert examination of textbooks, TPs and TAs is conducted before and after the approbation on the basis of the electronic examination platform with the involvement of external experts and in compliance with the non-disclosure. Criteria for expert assessments are divided into two main blocks: (1) the didactic apparatus of the textbook and (2) the implementation of didactic functions. Based on the results of scientific and pedagogical expert examination average score, conclusions and recommendations, an expert resolution on suitability/non-suitability (recommended, not recommended, requires adjustment) is adopted.

Currently, in order to improve the quality of textbooks and digital educational resources, the MoES of the RK works on improving the procedures of creation, expert examination and publication of textbooks. In collaboration with the World Bank, a project to improve the national textbooks quality assessment system by updating the requirements (standards) and increasing the textbook assessing expert potential is underway. The framework of the project provides for renewed requirements for the creation of textbooks, as well as renewed criteria for the expert examination. New requirements will be formalized in by-law acts and amendments to the Law of the Republic of Kazakhstan "On Education". It also plans for experts training on educational programs with accounting of updated methods of evaluation of textbooks and to introduce an electronic platform of expertise (*Order of the MoES of the RK No. 91, 2016).*

All public secondary education organizations are provided with educational materials in accordance with the *Rules on Provision of Textbooks and Teaching Packages for public education institutions learners*. Digitized copies of all textbooks are available on the MoES of the RK website (edu.gov.kz). There are platforms providing interactive adaptations of school textbooks[6].

It should be noted that teachers can use digital educational resources platforms for their teaching activities by selecting electronic teaching materials and adapting them for their lessons, as well as developing their own lesson plans and digital learning materials in accordance with the SCESs and SCPs. Teachers can upload the materials developed by themselves to Online Mektep system, which allows replenishing the platform’s digital educational materials library on the one hand and developing teachers’ creativity on the other.

Explicit measures/incentives to support innovative ICT-enhanced teaching and learning are not specified in the country’s strategic documents. However, within the framework of the transition to the updated educational content, during the compulsory advanced training courses teachers must complete modules on ICT-competencies development even in the framework of those not specifically designated for their development. The learning outcomes of these courses are taken into account in awarding teacher qualification category, obtaining of which results in additional pay, the amount of which depends on the category level.

National curriculum in Kazakhstan are State Compulsory Educational Standards (SCES) and Standard Curriculum Programs (SCP). All school curricula must comply with the requirements of the standards, but the exact content of the curriculum is determined by schools and teachers independently by the development of Working Curriculum Programs (WCP).

[6] https://www.opiq.kz/

The development of ICT skills is one of the tasks of the SCES of primary, basic secondary and general secondary education and educational programs *(Order of the MoES of the RK No.604, 2018*).

The SCES for primary education define the purpose of primary education - the creation of educational environment favorable for the harmonious formation and development of a student's personality developing a wide range of skills as follows: functional and creative application of knowledge, critical thinking, research mindset, *ICT use*, application of different communication skills including language skills; team work and individual work. Development of ICT skills in students is carried out primarily during Mathematics and Informatics lessons. The content of Information and Communication Technologies subject in the primary school is aimed at the formation of elementary ICT tools user skills, skills to search, choose, transmit information, design objects and processes, apply the basic methods of working with spreadsheets, charts, graphs and diagrams to analyze, interpret and present data.

The SCES for basic secondary education introduce Computer Science subject at this level, the content of which is aimed at the formation of the ability to determine and understand the role of Computer Science in the world; ensuring the continuity of the secondary education level, preservation of interdisciplinary and intra-subject interrelation during Computer Science studies; mastering basic knowledge of the theoretical foundations of programming technologies and modern ICT, formation of skills to apply and transform models of real objects and processes with the use of ICT during Computer Science studies; development of functional literacy, logical, algorithmic and operational thinking, spatial perception, the ability to use different programming languages; interpret and critically analyze information presented in different format.

In accordance with the SCES for of general secondary education, the content of the Informatics subject course is aimed at the development of skills to search, analyze, critically evaluate, select, organize, transmit and process information, modeling objects and processes; on mastering IT methods and tools, problem solving methods. The curriculum provides for the development of skills to apply, analyze and transform of information models of real objects and processes; algorithmic and computational thinking; development of intellectual and creative abilities through the use of computer models.

In accordance with the SCES, upon completion of the ICT course in the secondary school, the student must demonstrate a certain level of ICT skills (see Appendix A). Moreover, some ICT skills, for example, related to information searching and processing, self-guided work with various information sources, including Internet resources, are developed within the framework of other subjects' curricula, not included into Mathematics and Informatics subject field.

In national educational programs ICT are reflected both as a separate course, and as a component in the framework of individual subjects.

The updated content of secondary education provides for a *new assessment approach* - criterion-based assessment. The new approach for student academic achievement assessment includes formative and summative assessment. Evaluation criteria are settled for each subject *(Order of the MoES No.52, 2016).* For Information and Communication Technologies and Informatics subjects there are set criteria for academic achievement assessment, which as well as the learning outcomes SCES, are in accordance with Bloom's taxonomy f: knowledge, understanding, application, analysis, synthesis and evaluation (see Appendix B).

The education system provides for the following *forms of student assessment*: national exams, Unified National Testing (UNT), school exams, intermediate assessment by teachers, media/channels to demonstrate achievements, portfolio documentation. Comparison of the tables in Appendices A and B shows that the learning outcomes are consistent with the educational achievement assessment, only educational achievement assessment criteria are easier to measure. It should also be noted that the hierarchy of achievement criteria grows from level to level. ICT skills themselves are assessed only during school exams and intermediate assessment by teachers in the framework of Computer Science and Informatics subjects. But accomplishing homework tasks in other subjects require students to know and use ICT for collaborative work, research, and project-based learning.

1.4 ICT-enhanced pedagogy

Data on the percentage of teachers implementing ICT-enhanced pedagogy are not collected in the national statistics system.

Also, in the national strategic documents in the field of education, there are no clear recommendations for such pedagogical approaches as co-education, project-based learning, real-world problem solving, etc. However, as part of the transition to the updated content of education and criterion-based assessment, the I. Altynsarin National Academy of Education (subordinate organization of the Ministry of Education and Science of the Republic of Kazakhstan responsible for the content of education) has developed methodological guidelines on the above pedagogical approaches for basic secondary and general secondary education. *Methodological guidelines* are aimed at helping teachers to implement such approaches as functional and creative application of knowledge; critical thinking; research work; ICT use; the use of different means of communication; teamwork and self-guided work; problem solving, decision making, collaborative teaching into their classroom practices. They also explain the features of formative assessment in student-centered learning with a shift in focus from defining the level of academic achievement to improving the students' learning process (assessment of a student's advances in individual achievements regardless of the achievements of other students). These recommendations serve as guidance for urban and rural schools, small/underfilled schools and resource (support) centers.

Incentives for teachers to implement ICT for innovative pedagogical activities are provided through awarding qualification categories within the framework of the new teacher attestation system adopted in 2016, increase in which result in the increase in wages. There are also mechanisms to encourage such activities in schools.

The attestation procedure consists of two main stages: national qualification testing (NQT) and a comprehensive analytical generalization of the results of activities *(Order of the MoES No.83, 2016).* To pass the NQT in electronic format, as well as in case of the need for an appeal claims, the teacher must demonstrate ICT skills and be able to work online. NQT test items include two blocks: the academic subject contents and pedagogy, teaching methods. The test items include questions on the use of ICT for teaching. Also, the second stage - a comprehensive analytical generalization of the results of activities - takes into account the teacher's innovative activities: demonstration lessons, video lessons, presentations, certificates and publications of regional and republican significance, etc. In this regard, a teacher is interested in taking part in various seminars, workshops, conferences and competitions to demonstrate innovative teaching. One of such events is the annual Best Teacher competition, where a teacher can receive recognition, as well as an award and a cash prize for exceptional work (*Order of the MoES No.12, 2015)*. As a result of successful accreditation, the teacher levels-up his/her qualification category and is entitled to additional payment as follows: teacher-master (50%), teacher-researcher (40%), teacher-expert (35%), teacher-moderator (30%) *(Resolution of the Government of the RK No.1193, 2015).*

1.5 ICT in initial teacher education

Qualification requirements for primary school teachers include completion of 3-4-year training in TVE organizations; persons with a Bachelor's and a higher degree (4 years and more) are eligible to teach in upper grades in general secondary education institutions.

Professional training and retraining of personnel, as well as professional development (advanced training) of teachers is carried out in accordance with the *"Teacher" Professional Standard (2017)*. This Standard describes the professional competencies of a teacher in accordance with the qualification level of the sectoral qualification framework. These competencies include ICT competence at the following levels *(Order of the Chairman of Atameken National Chamber of Enterpreneurs No. 133, 2017):*

1) general user level of ICT-competency: independently types and prints texts; selects information from Internet sources; independently prepares computer presentations and resources for teaching students;
2) the general pedagogical level of ICT-competency: independently selects and uses existing educational and game programs, web resources, simulators for practicing skills; organizes work in a computer classroom or with the use of ICT tools; applies ICT to achieve learning outcomes, to conduct assessment activities; under the guidance of a mentor, develops training and game programs, web resources, simulators for practicing skills; analyzes digital educational resources; uses software tools, visualization, data analysis tools, modeling and role-playing games; leverages network resources for student collaboration, uses ICT to develop plans and assess their implementation in individual and group learning projects.

Pedagogical tertiary institutions curricula are developed on the basis of professional standards. In this regard, all professional competencies specified in the *"Teacher" Professional Standard*, including ICT skills, form the basis of "Education" 6B01 - Pedagogical Sciences curricula. Moreover, in accordance with the *SCES for Higher Education* (*2020)* one of the learning outcomes is the use of various types of information and communication technologies: Internet resources, cloud and mobile services for the search, storage, processing, protection and dissemination of information for personal activities.

In the curriculum of initial pedagogical training, the development of ICT-competencies occurs both within the framework of separate Informatics courses and through the integration of ICT component into the programs of other subjects. At the same time, the training of future teachers can be carried out in on-campus, part-time and distance (online) modes.

Governmental control is implemented through the approval of the *SCES for Higher Education (2020)*, where Informatics subject is mandatory for all institutions providing the initial professional training of teachers.

1.6 ICT in the in-service training

Within the framework of professional development, teachers of the republic can advance their professional competencies in various educational programs. Teachers have the right to take advanced training at their own expense, also there is mandatory advanced training once every 5 years funded from the state budget. From 2020, service providers can undergo state accreditation on a voluntary basis. However, the programs of advanced training courses for teachers must undergo expert evaluation in the Ministry of Education and Science of the Republic of Kazakhstan (*Order of the MoES of the RK No. 175, 2020*).

Advanced training is carried out in accordance with the *Rules for Organizing and Delivering Training Courses for Teachers, as well as Post-Course Support of a Teacher's Activities (2020)*. The programs of the courses include 6 modules: regulatory legislation, management and administration, psychological and pedagogical module, content related module, technological module and selective module. All modules provide for the use of active teaching methods. The priority for the listeners are innovative forms (master classes, trainings, business games, work in small groups, etc.) and methods (case techniques, project methods, research, etc.) of teaching (*National Report on the State and Development of Education in the Republic of Kazakhstan, IAC, 2020*) The main goal of teacher advanced training programs is to study the features of curricula in all subjects, aspects of criterion-based assessment of students' academic achievements, mastering methods and approaches in teaching and lesson planning, as well as developing ICT skills. During consultations with the representatives of teacher training courses providers, it was found that ICT skill developing modules in all advanced training course programs include 2-8 hours of training, depending on the duration of the course. Teacher professional development training providers submit reports to the MoES on a quarterly basis.

The major providers of such services funded from the state budget in Kazakhstan are the Center for Pedagogical Excellence of Nazarbayev Intellectual Schools (CPE NIS) and Orleu National Center for Professional Development (Orleu NCPD). In 2020, Orleu delivered short-term training courses for 20,358 teachers of secondary education organizations and training on the updated educational content for 33,535 teachers, including primary school teachers (10,138 people) and subject teachers (23,397 people).

One of the professional development course programs for teachers is *"Fundamentals of Building Educators' Digital Literacy"*. The goal of this program is the formation of teacher's digital competencies with the use of digital technologies and mobile applications for professional activities to improve the education quality. As a part of the course, listeners master modern teaching skills as Flipped Learning, SMART-, STEAM-learning, robotics; digital pedagogy and gamification of education. The course is intended for directors, deputy directors and teachers of secondary education institutions with Kazakh and Russian languages of instruction.

The Technological Module of professional development training courses for teachers include 8 hours dedicated to teachers' ITC-competency development. The level of teachers' ICT skills is assessed based on the results of the survey at the beginning of the course and on the results of self-guided work and testing after the completion of the technological module by the Monitoring Department of the Orleu NCPD. The entrance survey was developed in accordance with the *Requirements for Digital Competencies of Teachers* based on the recommendations of ICT-CFT by UNESCO. Training programs by Orleu NCPD provide for classroom-based training (full-time learning format) and in-service training (mixed and distance learning formats).

In 2020, CPM NIS delivered professional development training courses for 39,052 teachers of secondary education institutions. In addition, as one of the responses to the pandemic, the CPM NIS has developed a 40-hour online course for teachers "Learn to teach remotely", which includes 5 modules: 1) specifics of distance learning; 2) motivation and student engagement, including the assessment and organization of the student's self-guided activities; 3) ICT tools and services, including streaming programs and services; 4) professional cooperation; 5) effective interaction with parents. In 2020, over 340 thousand educators completed this course.

1.7 Partnership

The main source of financing for ICT procurement in schools is the state budget - republican and local. Also, ICT procurement can be funded from the school budgets, sponsorships and donations from the private sector, NGOs, PTAs, philanthropists, etc.

As a part of a 3-year budget planning cycle, schools submit information on the need for computer equipment and software to local education departments, and local executive bodies allocate funding within their own budgets if available.

Technical maintenance is carried out on the basis of contracts between schools and private firms or individuals, and is funded from school budgets, which, in turn, are finances from the local state budget, but spendings from school budget funds is at the discretion of schools.

The government sector actively cooperates with the private sector, NGOs, UN agencies and other multilateral and bilateral donors in the field of ICT development in education. For example, the Asian Development Bank, within the framework of the Knowledge and Experience Exchange Program, published a regional report on ICT development in 2011, and is currently planning a project with the MoES of the RK related to ICT and data analysis within the 4th phase of the Program. Soros Foundation Kazakhstan finances research in selected areas, including in the field of education: in 2020, a study on the problems of ICT accessibility in small/underfilled schools of the Republic of Kazakhstan was carried out. UNICEF, as part of its activities, also deals with the improving access to ICT for children. For example, in 2018, as part of the UNICEF Data for Children Forum, one of the sessions was devoted to opportunities of using data in the context of ICT and digitalization of the public and private sectors. Digital education resources, electronic journals and educational platforms have been implemented in the form of PPPs. Also, the MoES of the RK cooperates with private companies such as Microsoft, Beeline, etc., in order to increase the ICT accessibility and develop ICT-competencies in the educational process stakeholders.

1.8 Monitoring and evaluation of government initiatives

The MoES of the RK carries out monitoring of the education system, including in relation to digitalization, by the means of National Educational Database AIS (NEDB). Monitoring of education is carried based on a set of statistical and analytical evaluation indicators for external and internal assessment of the quality of the education system (*the Order of the MoES No. 459, 2014*). Methodological support and administration of NEDB is carried out by JSC Information and Analytical Center (IAC).

NEDB is designated to collect educational statistics (administrative data), on the basis of which the MoES of the RK conducts systematic monitoring, assessment and analysis of the implementation of educational policy, including the development of ICT. More than 20.7 thousand educational organizations from preschool to higher and postgraduate education levels are registered in the NEDB regardless of the form of ownership and affiliation. The NEDB operates in real-time mode. Data in NEDB IS is collected at the school level, and individual data categories - at the student and teacher level.

The NEDB indicators related to ICT in education mainly relate to the ICT infrastructure in schools: the number of computers, interactive boards, linguaphone and multimedia classrooms; Internet access, etc.

In addition, in order to conduct an external independent assessment, Kazakhstan participates in international comparative surveys like ICILS, TALIS, PISA which among other skills assess ICT competencies. The results of the ICILS survey showed that more than half (54%) of Kazakhstan eighth-graders do not have basic computer literacy skills. In 2018, among 14 education systems, Kazakhstani eighth-graders showed the lowest result - 395 score points, which is 101 points lower than the ICILS average *(Country Digital Readiness Report: ICILS 2018 Results, IAC, 2020).*

According to the results of Teaching and Learning International Survey TALIS-2018, 30% of Kazakhstani teachers noted that the development of ICT skills is one of the most important needs for professional development of teachers (*TALIS 2018. National Report, 2019*).

It should also be noted that the results of the PISA-2018 survey which was held for the first time in a computer format showed that the results of participants who use a computer and the Internet when doing homework are respectively 36 and 37 points higher comparing to the results of those who do not have such resources at home *(National Report on PISA 2018 Results. IAC, 2020).*

The above indicates that even taking into account the governmental efforts aimed at digitalization of education and development of ICT in education there is still a large room for improvement.

References:

1. UNESCO (2018), ICT Competency Framework for Teachers. Paris
2. TALIS (2018). National Report. Nur-Sultan. Retrieved from http://iac.kz/sites/default/files/nacionalnyy_otchet_talis-2018_russ.pdf
3. IEA (2020) Preparing for Life in a Digital World. IEA International Computer and Information Literacy Study 2018 International Report Retrieved from https://www.iea.nl/sites/default/files/2020-04/IEA%20International%20Computer%20and%20Information%20Literacy%20Study%202018%20International%20Report.pdf
4. UNESCO (1997), Secondary Education System Informatization Program UNESCO. Retrieved from http://old.unesco.kz/rcie/data/progr_inf1997.htm
5. State Program for Development of Education of the Republic of Kazakhstan for 2005-2010
6. State Program for Development of Education of the Republic of Kazakhstan for 2011-2020
7. State Program for Development of Education and Science of the Republic of Kazakhstan for 2016-2019
8. On approval of state compulsory education standards at all levels of education Order of the Minister of Education and Science of the Republic of Kazakhstan No. 604 dated October 31, 2018. Retrieved from: http://adilet.zan.kz/rus/docs/V1800017669#z199
9. On approval of the State Program "Digital Kazakhstan" Resolution of the Government of the Republic of Kazakhstan No. 827 dated December 12, 2017. Retrieved from: http://adilet.zan.kz/rus/docs/P1700000827
10. On approval of the State Program for the Development of Education and Science of the Republic of Kazakhstan for 2020 - 2025 Decree of the Government of the Republic of Kazakhstan No. 988 dated December 27, 2019 Retrieved from: http://adilet.zan.kz/rus/docs/P1900000988
11. Regulations on the Department of Digital Transformation of Education of the Ministry of Education and Science of the Republic of Kazakhstan, approved by the Order of the Executive Secretary of the Ministry of Education and Science of the Republic of Kazakhstan
12. Standard qualification characteristics of the positions of teaching staff and equal-status persons. As amended by the Order of the Minister of Education and Science of the Republic of Kazakhstan No. 169 dated April 30, 2020.
13. On amendments to the Order of the Minister of Education and Science of the Republic of Kazakhstan. Order of the Minister of Education and Science of the Republic of Kazakhstan No. 83 dated January 27, 2016
14. On Approval of the Rules and Conditions for Certification of Teachers and Equivalent Persons Holding Positions in Educational Institutions Implementing General Education curricula of preschool, primary, basic secondary, general secondary, educational programs of technical and vocational, post-secondary education, and other civil servants in the field of education and science. Order of the Minister of Education and Science of the Republic of Kazakhstan No. 152 dated April 12, 2018

15. On approval of the Rules for the Development, Coordination and Approval of Educational Training Programs for Teachers, order of the Minister of Education and Science of the Republic of Kazakhstan No. 20567 dated May 4, 2020
16. National report on the state and development of education in the Republic of Kazakhstan -2019. IAC, Nur-Sultan, 2020. - 369 p.
17. On the characteristics of educational process in the educational organizations of the Republic of Kazakhstan in the 2020-2021 academic year: Instructive and methodological letter, Nur-Sultan, I. Altynsarin National Academy of Education, 2020. - 426 p.
18. On the approval of the list of textbooks, educational and methodological complexes, guidelines and other additional literature, including on electronic media. Order of the Minister of Education and Science of the Republic of Kazakhstan No. 216 dated May 22, 2020
19. On approval of the Rules for organizing work on preparation, examination, approbation and monitoring, publication of textbooks, educational and methodological complexes and teaching aids. The Order of the Minister of Education and Science of the Republic of Kazakhstan No. 344 dated July 24, 2012.
20. On amendments into Order of the Minister of Education and Science of the Republic of Kazakhstan No. 344 dated July 24, 2012. The Order of the Minister of Education and Science of the Republic of Kazakhstan No. 211 dated May 19, 2020
21. On the approval of the Rules on Provision of Textbooks and Teaching Packages for public education institutions learners. Order of the Minister of Education and Science of the Republic of Kazakhstan No. 91 dated January 28, 2016.
22. Website for Teachers. Retrieved from: https://rao.kz/jelektronnye-uchebniki.html
23. State Compulsory Educational Standards for primary education. Order of the Minister of Education and Science of the Republic of Kazakhstan No. 604 dated October 31, 2018 (No. 182 amended as of May 5, 2020)
24. State Compulsory Educational Standards for basic secondary education. Order of the Minister of Education and Science of the Republic of Kazakhstan No. 604 dated October 31, 2018 (No. 182 amended as of May 5, 2020)
25. State Compulsory Educational Standards for general secondary education, Order of the Minister of Education and Science of the Republic of Kazakhstan No. 604 dated October 31, 2018 (No. 182 amended as of May 5, 2020)
26. On the approval of the criteria for assessing the knowledge of students. Order of the Minister of Education and Science of the Republic of Kazakhstan No. 52 dated January 21, 2016
27. On the approval of the Rules and conditions for the attestation of teachers holding positions in educational organizations that implement general educational curricula of preschool education and training, primary, basic secondary and general secondary education, educational programs of technical and vocational, post-secondary, additional education and special educational programs, and others civil servants in education and science. Order of the Minister of Education and Science of the Republic of Kazakhstan No. 83 dated January 27, 2016.
28. On the approval of the Rules for conferring the title "Best teacher", Order of the Minister of Education and Science of the Republic of Kazakhstan No. 12 dated January 16, 2015. Registered with the Ministry of Justice of the Republic of Kazakhstan on

February 18, 2015 No. 10279. Retrieved from: http://adilet.zan.kz/rus/docs/V15H0010279
29. On the system of remuneration of civil servants, employees of organizations maintained at the expense of the state budget, employees of state-owned enterprises, Resolution of the Government of the Republic of Kazakhstan No. 1193 dated December 31, 2015. Retrieved from: http://adilet.zan.kz/rus/docs/P1500001193
30. "Teacher" Professional Standard. Order of the Chairman of the Board of the National Chamber of Entrepreneurs of the Republic of Kazakhstan "Atameken" No. 133 dated June 8, 2017, Retrieved from: https://atameken.kz/uploads/content/files/PS%20Pedagog.pdf
31. On approval of the Rules for the development, coordination and approval of educational programs for advanced training courses for teachers. Order of the Ministry of Education and Science of the Republic of Kazakhstan No. 175, 2020
32. Rules for Organizing and Delivering Training Courses for Teachers, as well as Post-Course Support of a Teacher's Activities. Order of the Minister of Education and Science of the Republic of Kazakhstan No. 95 dated January 28, 2016 (as amended by the order of the Minister of Education and Science of the Republic of Kazakhstan dated 09.04.2020).
33. National Report on the State and Development of Education in the Republic of Kazakhstan by the end of 2019. Nur-Sultan: Information and Analytical Center, 2020.-- 369 p.
34. Fundamentals of Building Educators' Digital Literacy Course Program. Retrieved from: http://bl.orleu-edu.kz/Home/Info?course_id=43&lang=ru
35. On the approval of the Rules for the implementation of educational monitoring. Order of the Minister of Education and Science of the Republic of Kazakhstan No. 459, 2014
36. Country Digital Readiness Report: ICILS 2018 Results. Information and Analytical Center, Nur-Sultan, 2020
37. TALIS 2018. National Report. Information and Analytical Center, Nur-Sultan, 2019. Retrieved from http://iac.kz/sites/default/files/nacionalnyy_otchet_talis-2018_russ.pdf
38. Achievements in reading, mathematics and science: results of the PISA-2018 study in Kazakhstan, National Report. Information and Analytical Center, Nur-Sultan, 2020

2. Main Study Results. Teacher Readiness Survey

This section incorporates major findings of Teacher Readiness Survey based on country-adapted version of questionnaire developed by UNESCO Bangkok Asia and Pacific Regional Bureau for Education[7].

2.1 Methodology: sampling and weighting[8]

Sampling

Sampling design consisted of explicit stratified selection with proportional allocation of units. The target population included all subject teachers directly participating in the teaching process and working in full-time secondary public schools under local executive authorities. The definition does not cover those who do not directly participate in the teaching process, such as school librarians, psychologists, school therapists, technical workers. The effective sample size of 2194 teachers was calculated to give precise estimates at rural-urban level. With the adjustment for potential non-response (30%) the effective sample size became 2851 subject teacher. The sampling frame was constructed on subject teachers' data taken from November 2020 version of National Educational Data Base (NEDB). Explicit stratification was conducted according to natural territorial-administrative division of the Republic (14 regions and 3 cities with republican status).

Weighting

Weighting strategy consisted of four steps. Overall response rate at the end of data collection was 86.8%. During the first stage each respondent received a base weight calculated as inverse probability of inclusion. For *epsem* designs the inclusion probability is the same for every respondent. The second stage constituted adjustment for unknown eligibility based on the disposition codes. During the third stage to account for potential effect of non-response, adjustment for non-response was conducted. The fourth stage included calibration of survey totals to known population totals via post-stratification and lastly extreme weights larger than a threshold value were trimmed with subsequent distribution of excessive weight values among the respondents.

2.2 Major findings

Attitude toward ICT

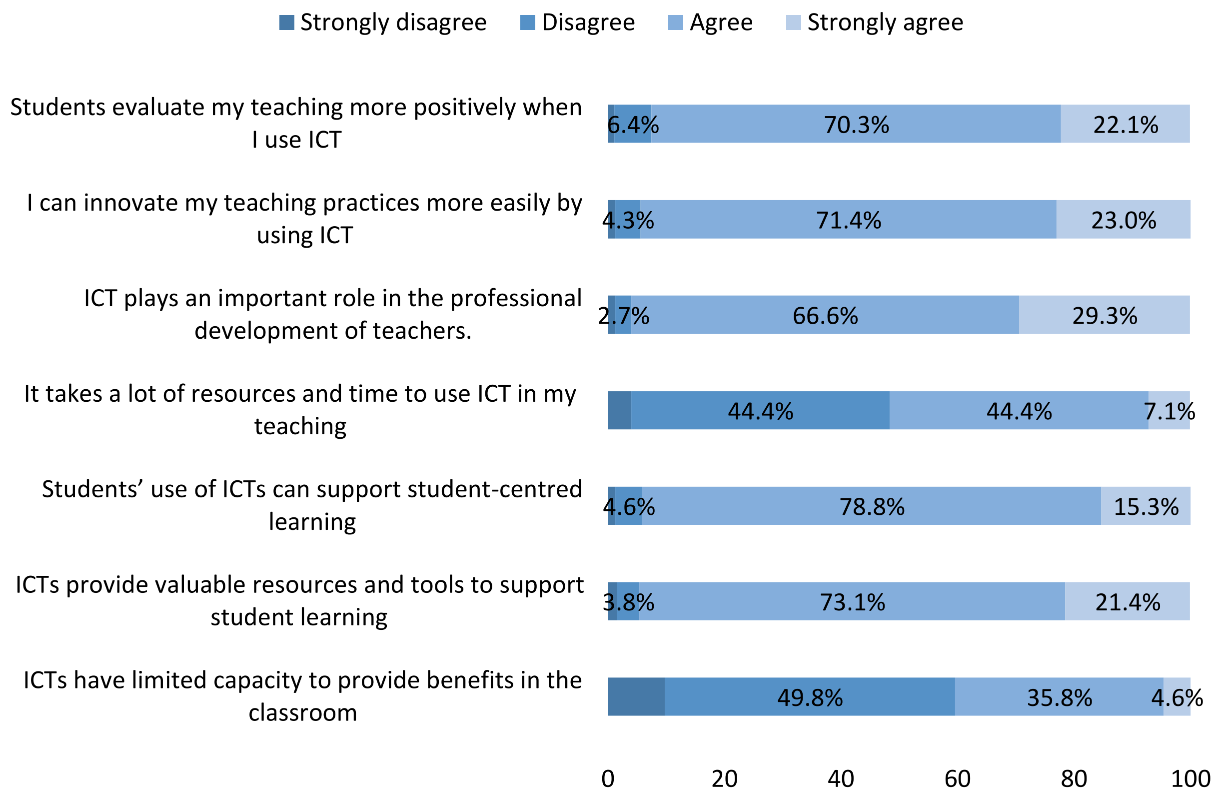
Question 12 of the questionnaire asks respondents about their general attitude toward ICT in education. 59.6% of teachers disagreed or strongly disagreed that ICT have limited capacity to provide benefits in the classroom. At the same time 94.5% of teachers agreed or completely agreed that ICT provide valuable resources and tools to support student learning. Almost all teachers agreed or completely agreed with important role of ICT in the professional development of teachers, and more easy innovation of teaching practices by using ICT with

[7] https://bangkok.unesco.org/

[8] For full information on sampling and weighting see Appendix C

95.9% and 94.4% of answered respectively. Figure 1 below presents the results of the weighted analysis.

Figure 1. General attitude toward ICT



Percentages of "strongly disagree" are not shown

Question: to which extent do you agree with the following statements

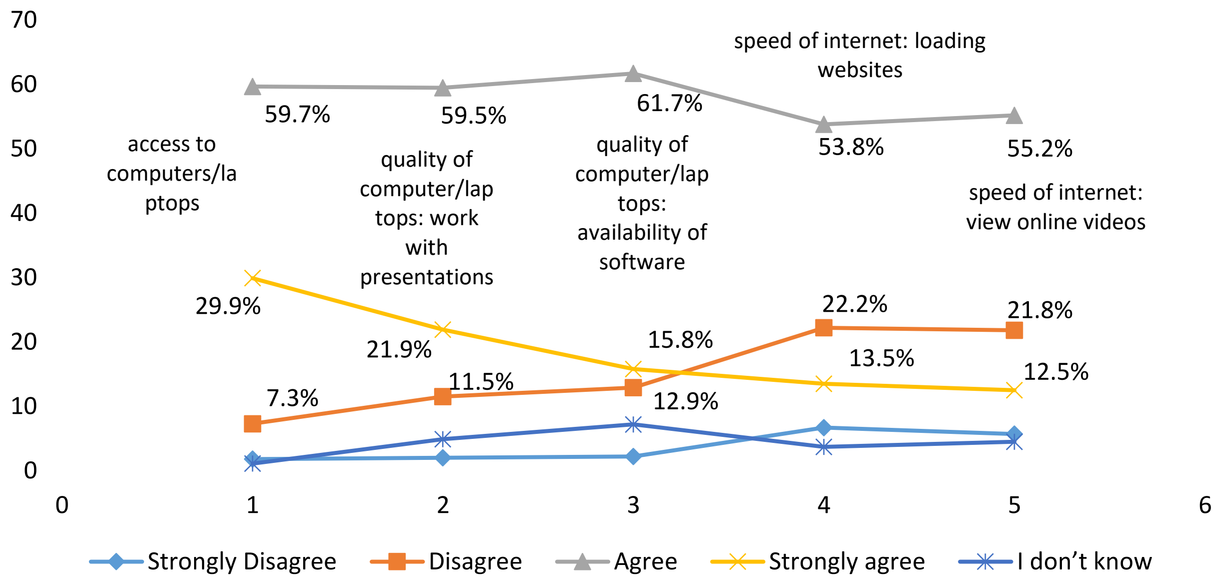
Source: teachers questionnaire

In addition, the absolute majority of teachers agreed or completely agreed that the use of ICT can support student-centered learning (94.1%) and more positive evaluation of teaching practices by students (92.4%). As for the challenges, 51.5% of teachers think the use of ICT in teaching requires a lot of time and resources, while 48.4% of teachers think otherwise.

ICT infrastructure

Questions on infrastructure ask teachers about availability and quality of school computers/laptops, quality and speed of internet, as well as access to learning devices and resources. Infrastructure plays crucial role in generic and national education strategies. Among different parts of infrastructure, OECD countries pay special attention to availability of high speed Internet connection and availability of computers (OECD, 2020). In Kazakhstan, majority of teachers agree or completely agree that schools provide them with computers and laptops for teaching (89.6%), provided computers work well with presentations containing text, video and pictures (81.4%), and lastly provided computers have software applications necessary for teaching (77.5%). Fast Internet connection required for loading websites for teaching purposes was confirmed by 67.3% whereas Internet connection required to view online videos during teaching was confirmed by 67.7% of teachers. The above written results are presented in the Figure 2 below.

Figure 2. ICT infrastructure: availability and access.

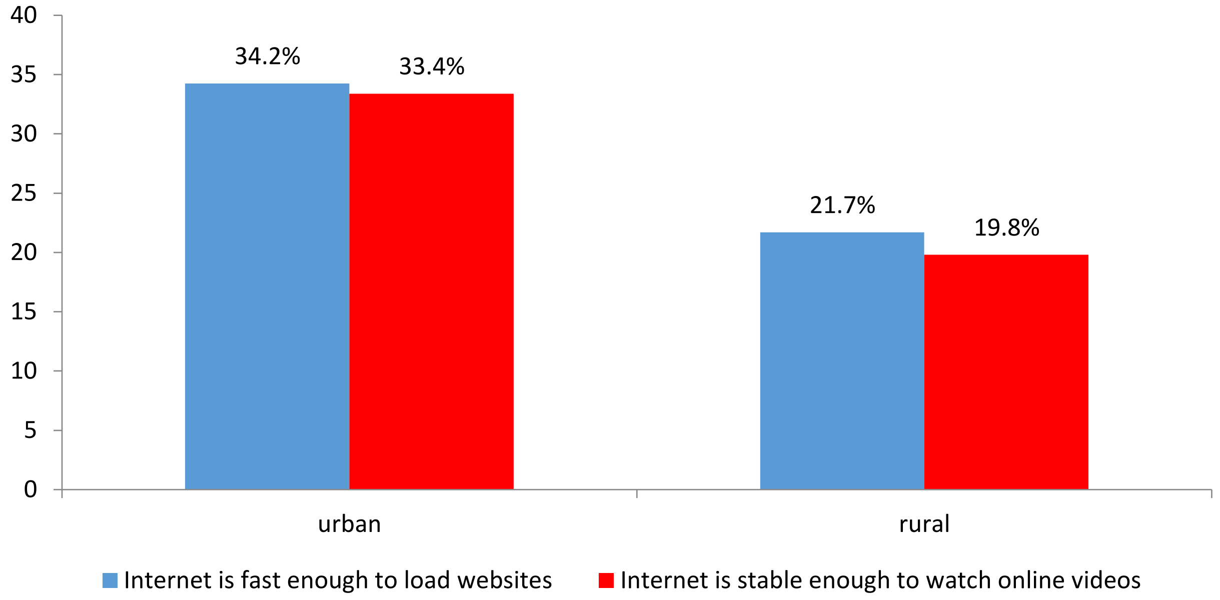


Question: check the appropriate column that reflects the ICT infrastructure at your school.

Source: teachers questionnaire

One can notice a comparatively high disagreement of teachers with the speed of Internet connection. The orange line indicates proportion of teachers who disagreed that their Internet connection is fast enough to load websites (22.2%) and stable enough to load online videos (21.8%). The overall proportion of disagreed and strongly disagreed is 28.9% with the former and 27.5% with the later statement. At the same time 87.2% of teachers agreed or strongly agree that their computer/laptop is connected to the Internet. Thus, on average the difference between percentages of agreement on items of availability of Internet and speed of Internet is 20%. Another important thing to notice is the difference in overall disagreement between rural and urban teachers (Figure 3). According to the results, rural teachers have slower and less stable access to online learning materials such as websites (34.2%) and online videos (33.4%) than urban teachers (21.7% and 19.8% respectively). Apparently, Kazakhstan has *digital divide* between rural and urban schools regarding the speed of Internet. Without necessary steps to decrease digital divide it can lead to widening technological inequality between rural and urban schools.

Figure 3. Proportion of respondents who strongly disagree and disagree that they are provided with fast Internet connection



Question red: the Internet connection in school is fast enough to load websites I commonly use for teaching.

Question dark blue: the Internet connection in school is stable enough to view online videos that I commonly use for teaching.

Source: teachers questionnaire

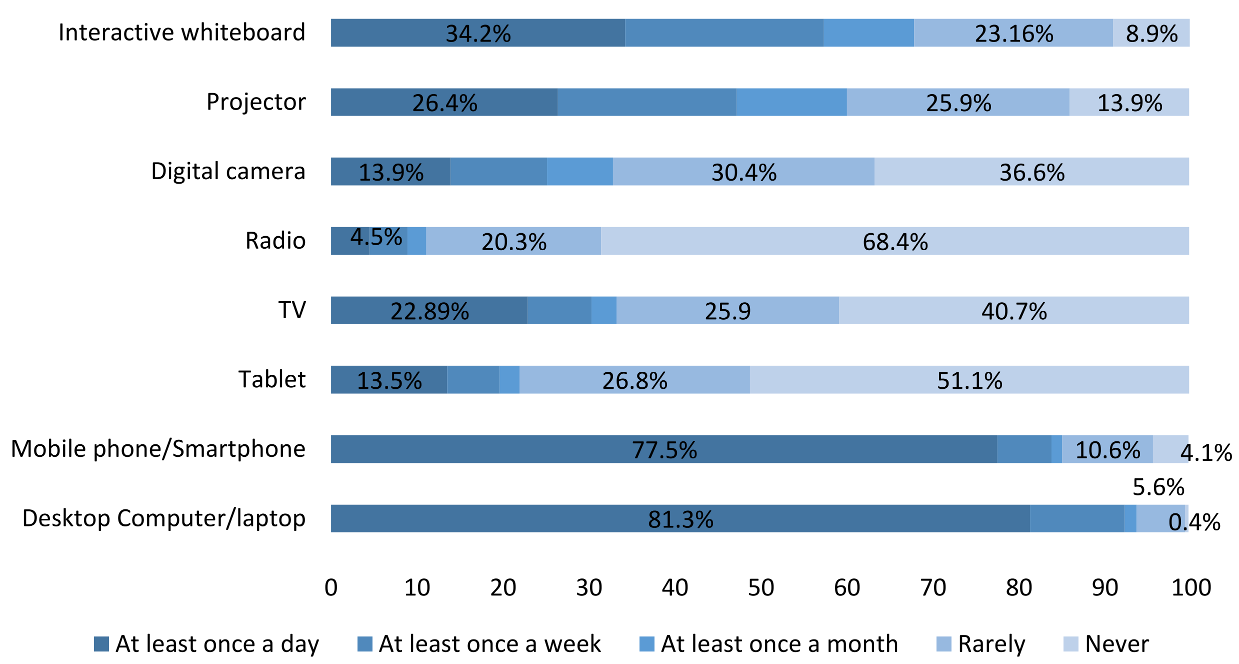
Box 1

Digital divide refers to the gap between groups of people who have access to technologies and who do not have such access. It can be seen worldwide between developed and developing countries, as well as within the countries between different socio-economic classes and geographic areas. A potential issue with digital divide is that it can aggravate existing levels of economic inequality (Cullen, 2001). For students, unequal access to internet can create differences in grade and development of inquiry skills (Venezky, 2000). For teachers, digital divide creates inequality in access to the Internet, restricts the use of online instructional materials and leads to underdevelopment of necessary ICT skills. For instance, Valdez & Duran (2007) show those teachers who have more access to computers and the Internet use them more creatively for instructional purposes, more often communicate with students by email and more often engage into online communication with other teachers.

Other results show major proportion of agreed and strongly agreed that their schools have sufficient power supply (90.6%), schools provide them with the access to functional computer/laptop for administrative tasks (82.7%), teachers have access to digital learning resources that can be used in class (83.2%), availability of technical support at school (74.3%) as well as usage of prescribed application by the Ministry for entering information about students and their marks (95%). Interestingly, despite of high agreement with provision of access to computers and laptops, 79% of teachers prefer to use their own devices at school[9].

Regarding the use of digital devices, teachers were asked how often they use various digital devices. Two of the most commonly used devices (at least once a day) are computers/laptops (81.3%) and mobile phones/smartphones (77.5%). Two of the devices that teacher never used in classroom teaching are radio (68.4%) and tablets (51.1%). The figure below shows the results for the rest of the devices.

Figure 4. Use of ICT devices in classroom



Note: Percentages of "at least once a week" and "at least once a month" are not shown

Question: Do you use any of these devices for your classroom teaching, and how frequently do you use each? Choose the most appropriate frequency of use per device.

Source: teachers questionnaire

Using the categories "at least once a day" and "never" it is possible to construct separate hierarchies of the devices used in classroom (table 1).

Table 1. Hierarchies of ICT devices use in classroom

Frequency	Device	Percentage	Frequency	Device	Percentage
at least once a day	computer/laptop	81.3%	never	radio	68.4%
	mobile phone/smartph	77.5%		tablet	51.1%
	interactive board	34.2%		tv	40.7%
	projector	26.4%		digital camera	36.6%
	tv	22.89%		projector	13.9%
	digital camera	13.9%		interactive board	8.9%

[9] agree – 60.1%, completely agree – 18.9%

	tablet	13.5%		mobile phone/smartph	4.1%
	radio	4.5%		computer/laptop	0.4%

Source: teachers questionnaire

Box 2

As was written above, in Kazakhstan more than half of teachers never use tablets in classrooms. Though ICT infrastructure pays special attention to availability and quality of computers, tablets nonetheless play an important role in students learning and pedagogical practices. For instance, Montrieux et al., (2015) reported that introduction of tablets provided students with authentic experience and original learning activities; the effect was especially pronounced for young students due to their flexibility. Hassler et al., (2015) systematically reviewed literature on use of tablets in primary and secondary school. According to their survey, introduction of tablets led to positive learning outcomes and provided specific advantages such as faster learning curves due to ease of use, price availability and ability to work directly with cloud technologies. On the contrast, tablet devices in comparison with personal computers and laptops tablet devices have less functionality, which is considered to be their main disadvantage.

Regarding digital resources, teachers mostly prefer to use open educational resources (73.6%) and various educational websites (51.6%). Somewhat less teachers use internet/online course (29.6%) and CDs/DVDs from the Ministry of Education (24.5%). Almost 20% of teachers develop their own digital resources with rural teachers indicating 21.8% and urban teachers 18.4%. Only 6% of teachers use face-to-face trainings and 9% employ school bought CDs/DVDs.

As for the students' access to digital devices, 15.1% of teachers stated students use their own ICT devices in the learning process, 37.4% confirmed ICT devices are provided by school and 41.2% noted students use ICT devices that teachers specifically use in class. Moreover, 6.1% of teachers answered "no" when they were asked whether students are allowed to use ICT in school as part of the learning process. In this category rural teachers showed 4.7% whereas urban indicated 8%.

In case students are allowed to use ICT as part of their learning process they can access ICT devices in computer labs (64.9%), in the classrooms (44.3%), in multimedia classrooms (36.7%) and in libraries (13.9%). However, 11.9% of students are not allowed to use internet at school as part of their learning process.

While rural and urban percentages of answers are approximately equal (11.2% and 12.9% respectively) more rural teachers (66.7%) than urban (57.5%) answered that students access school internet when they are allowed to use it. In contrast more urban teachers (29.5%) than rural (22%) report students access their own devices when they are allowed to use the Internet. These results to some extent come in line with existing findings from literature on digital divide. For instance, in a study of ICT use among Canadian youth, Looker & Thiessen (2003) found out that access to computers and ICT competencies of rural students are not hampered by the lack of home computers because they offset it by a greater use of school computers. Thus, school is an effective mechanism with ability to reduce existing digital divide and its entailed negative effects.

Policy environment

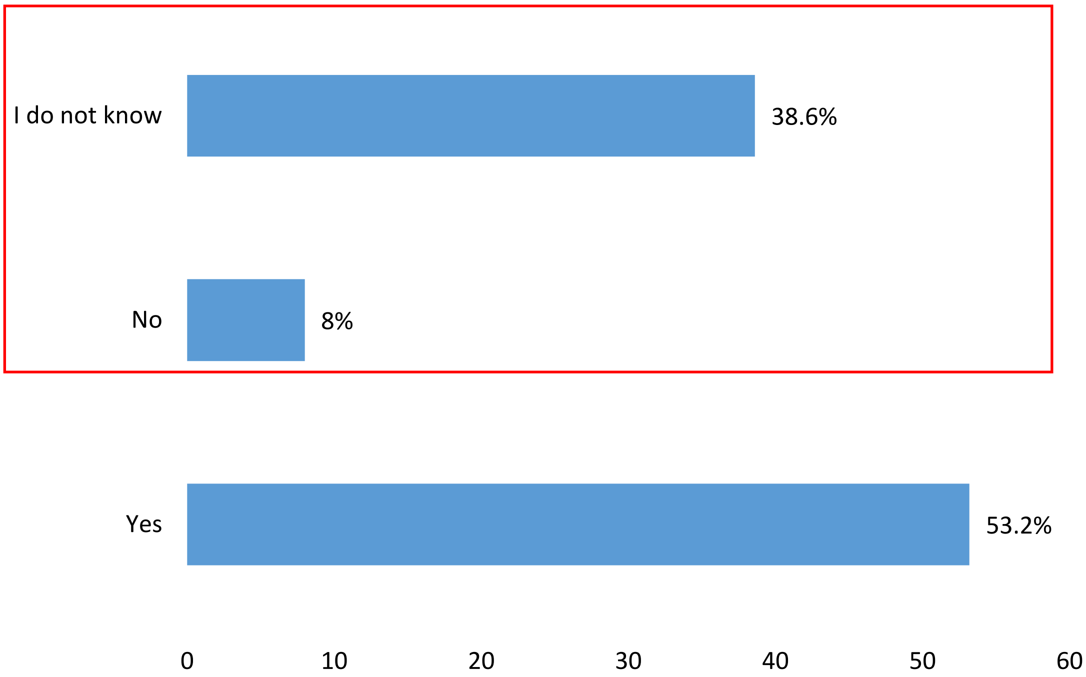
Elaborated ICT policy is the key part for successful adoption of ICT in everyday life. ICT offer benefits that can be utilized to bring economic and societal change. However even policy alone is not enough, without strategy "policy becomes techno-centric, promoting the purchase of equipment or the training of teachers without providing strong educational purpose or goal for the use of technology" (Kozma, 2008, p. 1084-1085).

Box 3

The role of ICT in societal and economic development is hard to underestimate. There were statistical evidences in favor of positive link between investments in ICT and economic development (Colecchia & Schreyer, 2002; M.Vu, 2011; Niebel, 2018). However no matter how sophisticated and fruitful technology is, it all starts with a vision which helps to understand how and when to use technologies. Therefore, an elaborated policy of ICT use is of paramount importance. In 2017 promotion of ICT skills and competencies and adoption of ICT in education were among top priorities in OECD countries (OECD, 2017). Well-structured ICT policy will bring benefits not only to teachers and students but to whole spheres of social and economic life. For instance, Kozma (2008) pointed out four rationales of ICT policies in education: (1) support of economic growth, (2) promotion of social development, (3) advance of education reforms, (4) support of education management.

The first question on policy environment asked teachers about existence of national policy on using ICT in education. Here 53.2% of teachers answered "yes", 8% answered "no" and 38.6% do not know whether such policy exists or no (Figure 5).

Figure 5. Policy environment: existence of national ICT policy



Question: Is there a national policy on using ICT in education?

Source: teachers questionnaire

Formally, these 53.2% of teachers who confirmed existence of the national policy gave the wrong answer. In Kazakhstan, technically there is no document containing national ICT policy in education, neither there is document outlining national ICT strategy in education.[10] Probably, one of the reasons of why teachers gave positive answer is existence of official government program – "Digital Kazakhstan" (Digital Kazakhstan 2018-2022). The program is aimed at digitalization of economy, formation of innovative ecosystem, evolution of human capital, transition to the digital state and implementation of digital Silk Way. The part of human capital proposes digitalization of particular spheres of secondary education. Namely, they are:

1. Introduction of basics of programming for students of primary school

2. Inclusion of programming languages (Java, C, Python) into the subject "Informatics"

3. Introduction of the foundations of entrepreneurship and business

4. Olympiads and competitions for students in technical areas

5. Digitalization of educational process

These steps are considered to be important to raise digital literacy and competencies as well as digitalize school education. Moreover, the program covers higher education and continuing education. Special emphasize is put on the development of creative and critical thinking.

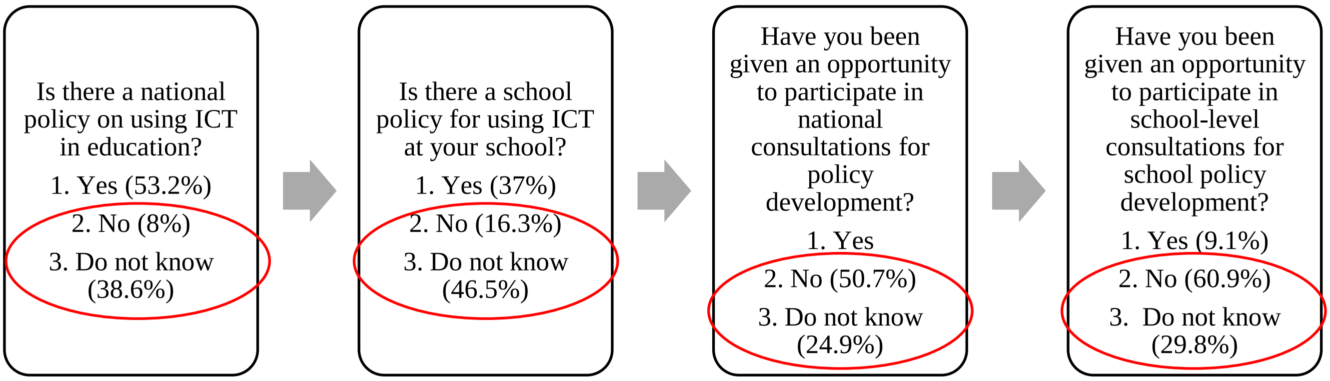
Box 4

[10] Russian and English versions of question on national policy have certain difference. In Russian version the word "policy" is replaced by word "strategy".

Though the program covers secondary education, nonetheless "Digital Kazakhstan" is not an independent national strategy, solely aimed at ICT in education. Some OECD countries specifically develop such strategies where they comprehensively cover different aspects of ICT in education. For instance Australian Queensland developed 4 years digital strategy in education (2019-2023) where the main priorities were given to educational technologies, collaborative learning, digital skills, learning environment and ICT infrastructure (Queensland Government, Department of Education, 2019). Canadian Alberta adopted Learning and Technology Policy Framework with the focus on student-centered learning, ICT infrastructure and learning environment (Alberta Government, 2013).

The questionnaire design redirects those respondents who answer "no" and "do not know" to question asking about existence of school strategy and then redirects to questions on opportunity of participation in development of national and school strategies. For the sake of clarity these redirections and respective results are given in the figure below. Because teachers who confirmed existence of national ICT policy technically pointed to the wrong answer, further analysis is concentrated around the groups of teachers who answered "no" and "do not know".

Figure 6. Political environment and participation



In accordance with the redirections the analysis is narrowed to "no" and "do not know" categories in every subsequent question. Thus, only those who answered no (8%) and do not know (38.6%) were left for the analysis of question asking about existence of school ICT policy. Here 16.3% of teachers gave negative answer and 46.5% do not know whether such policy exists. Teachers from these two categories were left for the analysis of question on opportunity to participate in national consultations for policy development. Among these teachers, 50.7% was not given the opportunity and 24.9% do not know about such opportunity. Eventually, teachers from these two categories were left for the analysis of answers on question about opportunity to participate in school-level consultations for school policy development. Here 60.9% of teachers answered "no" and 29.8% of teachers said they do not know about the consultations. Converting to population totals it is possible to estimate the raw number of teachers who think that there is no national and school ICT policies, who do not know about such policies and who was not given or do not know about opportunity to participate in national and school level discussions of ICT policy development. The mean number of this subgroup is 62856 with rural 33246 (s.e. 1921) and urban 29610 (s.e. 1827).

Competencies

Without necessary human skills and competencies any ICT policy and/or strategy, no matter how well developed, will not bring any significant results. Section on competencies of the survey offered teachers to self-assess their level of ICT skills through series of questions on ICT-supported tasks. Teachers evaluated their level of competencies from 1 (least competent) to 7 (most competent) in general ICT skills, ICT skills used for teaching, learning and professional learning. Table 2 below shows percentages of teachers' answers. The items are sorted according to their mean values from the maximum to the minimum value. The categories indicating highest percentage of responses are highlighted in red. In particular, item "use of electronic journals" has the largest mean value (6.35), whereas item - "create audio-visual materials" has the smallest (4.51).

Table 2. Self-assessment: general ICT skills

Q30	1	2	3	4	5	6	7 (most competent)	mean
use electronic journal	1%	1%	2%	4%	10%	15%	67%	6.35
read, write, and send emails	2%	2%	3%	6%	13%	14%	60%	6.09
store and organize files into folders	2%	1%	3%	7%	14%	16%	57%	6.07
use a word processor	2%	2%	3%	8%	13%	15%	58%	6.04
use chat applications and other social media applications	2%	2%	4%	9%	19%	20%	45%	5.82
produce presentation slides	3%	2%	5%	11%	14%	17%	48%	5.77
use videoconferencing applications	2%	3%	5%	9%	19%	21%	41%	5.68
search for and access educational resources and tools online	2%	1%	5%	10%	22%	24%	36%	5.64
evaluate the credibility of information on the web	2%	2%	6%	16%	28%	20%	26%	5.29
use a spreadsheet	3%	4%	9%	13%	21%	19%	31%	5.28
learn new ICT applications and tools on your own	3%	2%	7%	14%	27%	20%	26%	5.25
edit digital photographs or other graphics	5%	4%	9%	15%	24%	18%	25%	5.01
download/install programmes and software	5%	4%	9%	15%	24%	17%	25%	5.00
evaluate the relevance of a digital application or content for a learning activity	3%	3%	9%	18%	29%	19%	18%	4.96
use the prescribed school administrative system NEDB	6%	4%	8%	16%	23%	17%	25%	4.96
use collaborative online applications and folders	8%	7%	12%	17%	24%	14%	18%	4.56
create audio-visual materials	8%	7%	14%	18%	23%	13%	18%	4.51

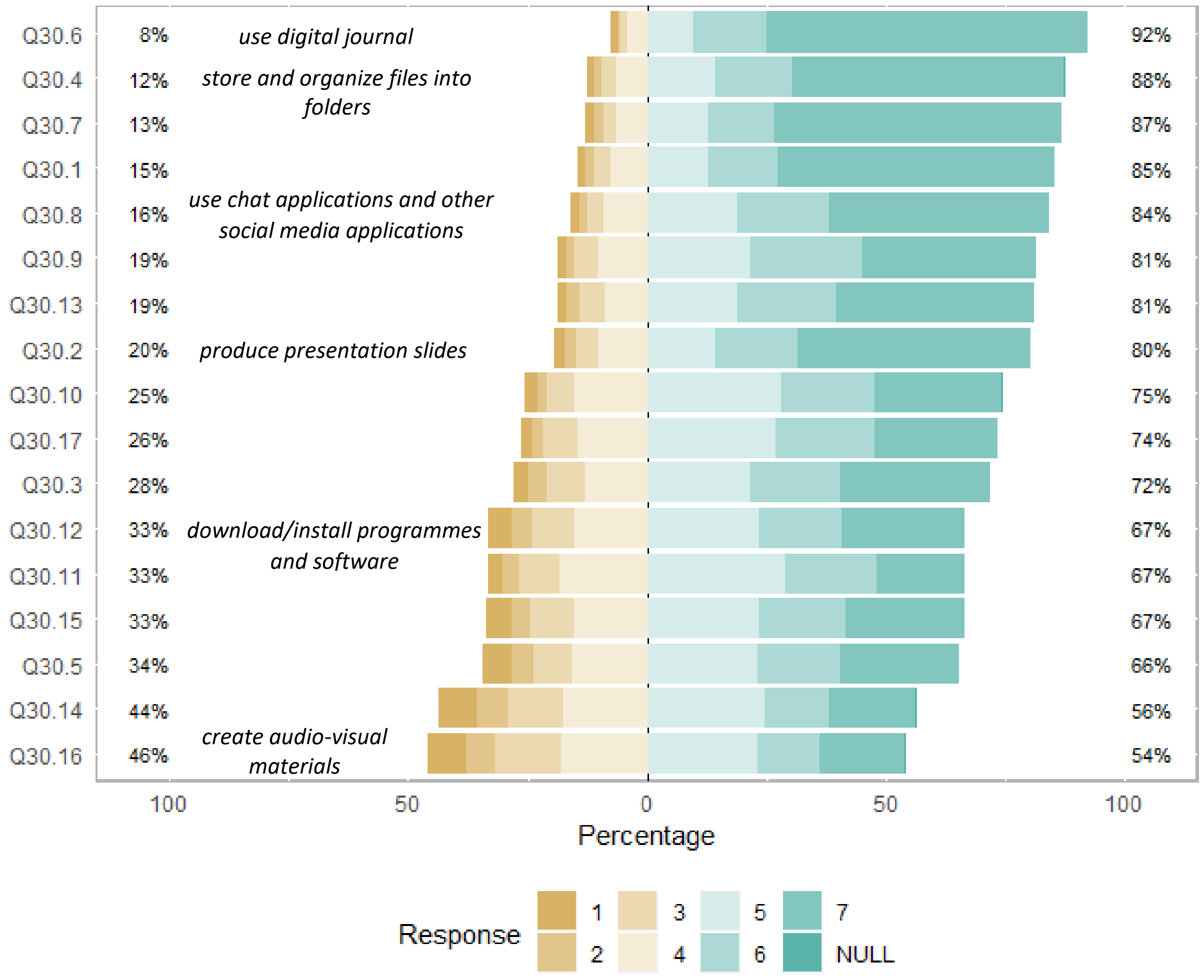
Question: How do you rate your level of competency in the following ICT-supported tasks?

Source: teachers questionnaire

In the table above 12 items out of 17 received the highest percentages of answers in category "most competent" (7). Only items on evaluation of credible information (28%), independent learning of new ICT applications (27%), ability to evaluate relevance of digital applications (29%), use of collaborative applications (24%) and ability to create audio-visual materials (23%)

received highest proportion of answers in category 5. Yet this category stands above the middle value of the scale (3.5). Moreover, the mean values of all items (last column) are far above the middle of the scale. A visual representation of the results in figure 7 helps to better understand skewness of the self-assessment toward high scores (from light green to green).

Figure 7. Self-assessment: general ICT skills



Note: Not all items are shown, see Appendix D for coding information

Question: How do you rate your level of competency in the following ICT-supported tasks?

Source: teachers questionnaire

Teachers also evaluated their ICT skills used for teaching and learning (table 3 and figure 8). The items are sorted in decreasing order according to their mean value.

Table 3. ICT skills used for teaching and learning

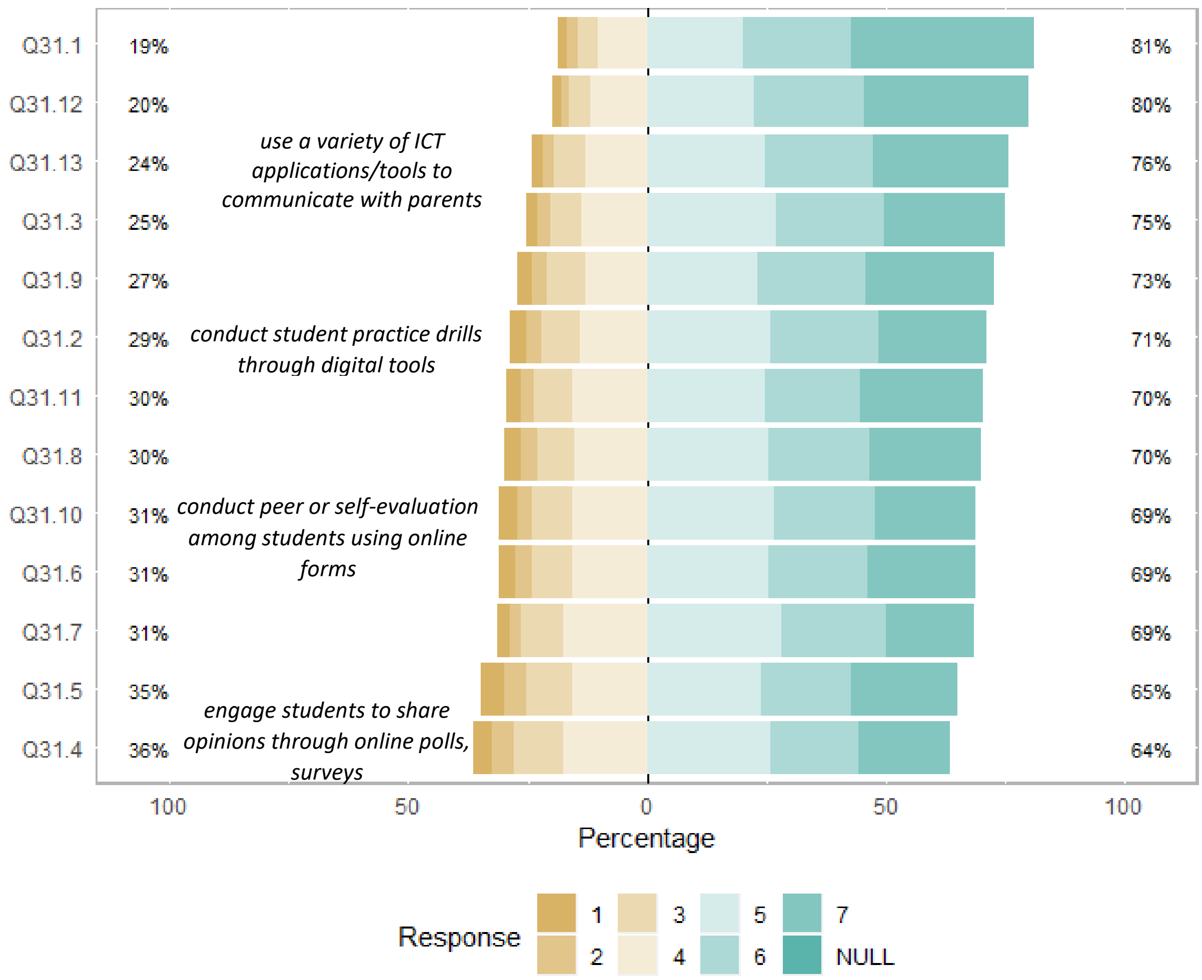
Q31	1	2	3	4	5	6	7	mean
incorporate multimedia elements (e.g. video, animation, or simulation) to support learning of concepts	2%	2%	5%	10%	20%	22%	38%	5.66
use appropriate social networking sites for teaching purposes	2%	2%	4%	12%	22%	23%	34%	5.58
use a variety of ICT applications/tools to communicate with parents, caregivers/guardians,	2%	2%	7%	13%	25%	22%	29%	5.37

and peers								
use digital tools/games to engage student participation	2%	3%	7%	14%	27%	23%	25%	5.29
use online assessment strategies and tools	3%	3%	8%	13%	23%	23%	27%	5.25
discuss with students their online rights, safety, privacy, and ethical behaviour	3%	3%	8%	16%	25%	20%	26%	5.18
conduct student practice drills through digital tools	3%	3%	9%	14%	26%	22%	23%	5.15
organize collaborative activities/projects among students using various ICT tools	4%	3%	8%	15%	25%	21%	23%	5.12
guide students in conducting online research	4%	3%	9%	16%	26%	20%	22%	5.07
conduct peer or self-evaluation among students using online forms	4%	3%	9%	16%	27%	21%	21%	5.05
integrate ICT into teaching strategies that stimulate students' critical thinking, problem-solving skills, and creativity	3%	3%	9%	17%	28%	22%	18%	5.05
engage external experts via electronic means (emails, forums, videoconference, etc)	5%	5%	10%	16%	24%	19%	22%	4.93
engage students to share opinions through online polls, surveys, forums, blogs, and other social media	4%	5%	11%	18%	26%	18%	19%	4.87

Question: How do you rate your level of competency in the following ICT-supported tasks?

Source: teachers questionnaire

Figure 8. Self-assessment: ICT skills used for teaching and learning



Note: Not all items are shown, see Appendix D for coding information

Question: How do you rate your level of competency in the following ICT-supported tasks?

Source: teachers questionnaire

Overall, table 4 suggests almost the same picture of self-assessment as table 2. Six out of thirteen items received the highest percentage of answers in the category "the most competent" (7). Another 8 items indicated major proportions of answers in the category 5. As in the case above the mean values of all 13 items are above the middle of the scale. Figure 8 provides visual representation of the answers. Again, like in figure 7 one can notice considerable skewness of the results toward the high scores.

In the last question on self-assessment teachers reported their competencies in ICT-supported tasks required for professional learning. As previously the results are presented in table 4 and figure 9 below.

Table 4. Self-assessment: ICT skills used for professional learning

Q36	1	2	3	4	5	6	7	mean
access educational websites to stay up-to-date and enhance my skills	3%	2%	4%	12%	24%	24%	31%	5.48
share ICT in education trends with peers and colleagues in your school	2%	2%	5%	13%	25%	21%	31%	5.45
reflect on my own teaching practices	2%	2%	6%	13%	30%	24%	23%	5.34

enroll in webinars and/or online courses	3%	4%	7%	14%	25%	20%	26%	5.20
coach/mentor peers and colleagues on ICT in education practices	6%	5%	11%	15%	24%	18%	21%	4.84
engage in a virtual community of practice with teachers from different schools	7%	6%	11%	17%	25%	15%	20%	4.74

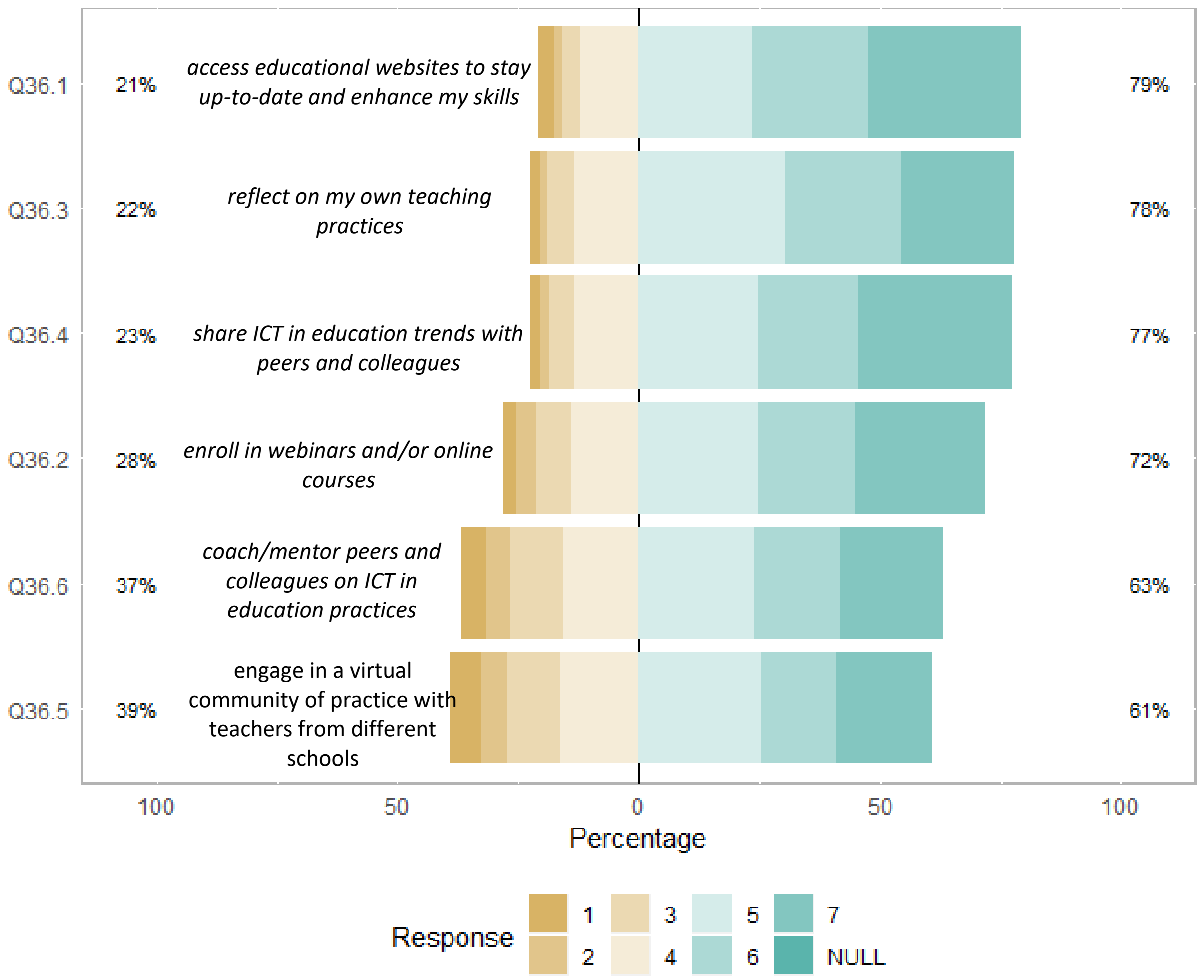
Question: How do you rate your level of competency in the following ICT-supported tasks?

Source: teachers questionnaire

Obviously, majority of the respondents assessed themselves as most competent in improving their skills by accessing educational websites (31%), sharing ICT trends with peers and colleagues (31%) and enrolling in online activities like webinars and courses (26%). The rest of the ICT skills were evaluated by teachers as being above average. All item mean values are above the middle value of the scale.

It is possible to notice that among all 36 items on self-assessment there is no single item indicating major proportion of responses below category 5. In terms of the item mean values there is no single item with the mean value below the middle value of the scale. Thinking about these results, one might wonder whether they are close to the real picture, or they are biased due to the social desirability. In this respect the following two questions are becoming relevant. How objective are these results? Does social-desirability exert influence on teachers' self-assessment?

Figure 9. Self-assessment: ICT skills used for professional learning



Note: Not all items are shown, see Appendix D for coding information

Question: How do you rate your level of competency in the following ICT-supported tasks?

Source: teachers questionnaire

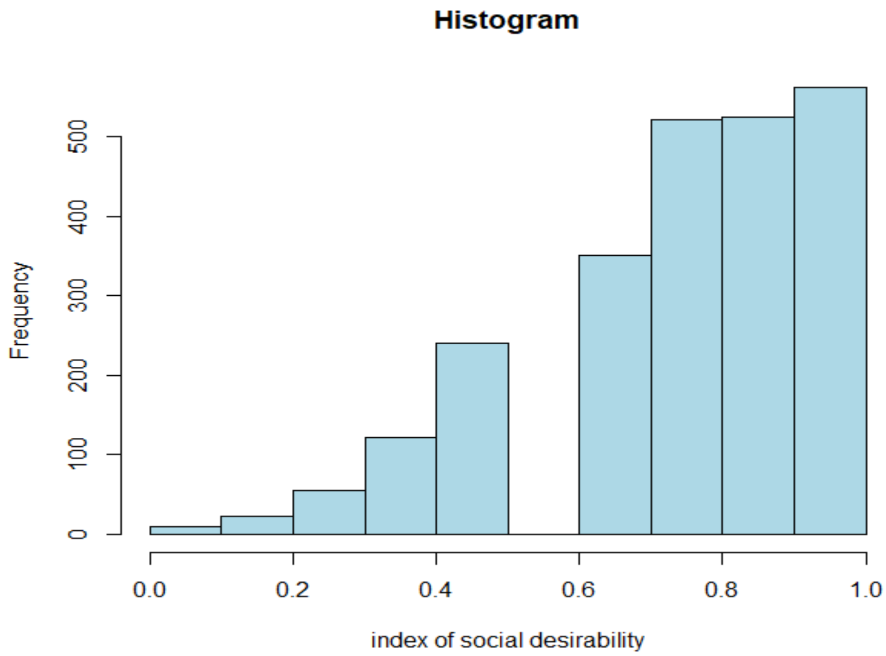
Social desirability

Generally, "…social desirability as a response determinant refers to the tendency of people to deny socially undesirable traits or qualities and to admit to socially desirable ones" (Philips & Clancy, 1972; p. 923). This phenomenon, detrimentally impacts results of questions on self-assessment, behavior, relationship, and attitude. As was written in the methodology, in order to decrease burden on respondents a short version of famous Marlow-Crowne social desirability scale (Crowne & Marlowe, 1960; Reynolds, 1982) was used. The form consists of 13 binary questions asking respondents sensitive questions on attitude and behavior[11]. Despite the previous findings, the short from showed inconsistent results. Scaling procedure revealed 1 factor structure with 8 out of 13 items[12]. Based on the results of the scaling, an index of social desirability was created, with maximum value of 1 and minimum value of 0.

[11] See Appendix E
[12] See Appendix E for full information on technical details of scaling

Overall, 23.3% or 562 out of 2407 teachers have highest index value of 1.0 (or 100%). Because the threshold of what can be counted as socially desirable is somewhat arbitrary, only the highest value of the scale was reported. However, from the histogram below one can evaluate the extent of social desirability in the survey answers.

Figure 10. Histogram of social desirability



Source: teachers questionnaire

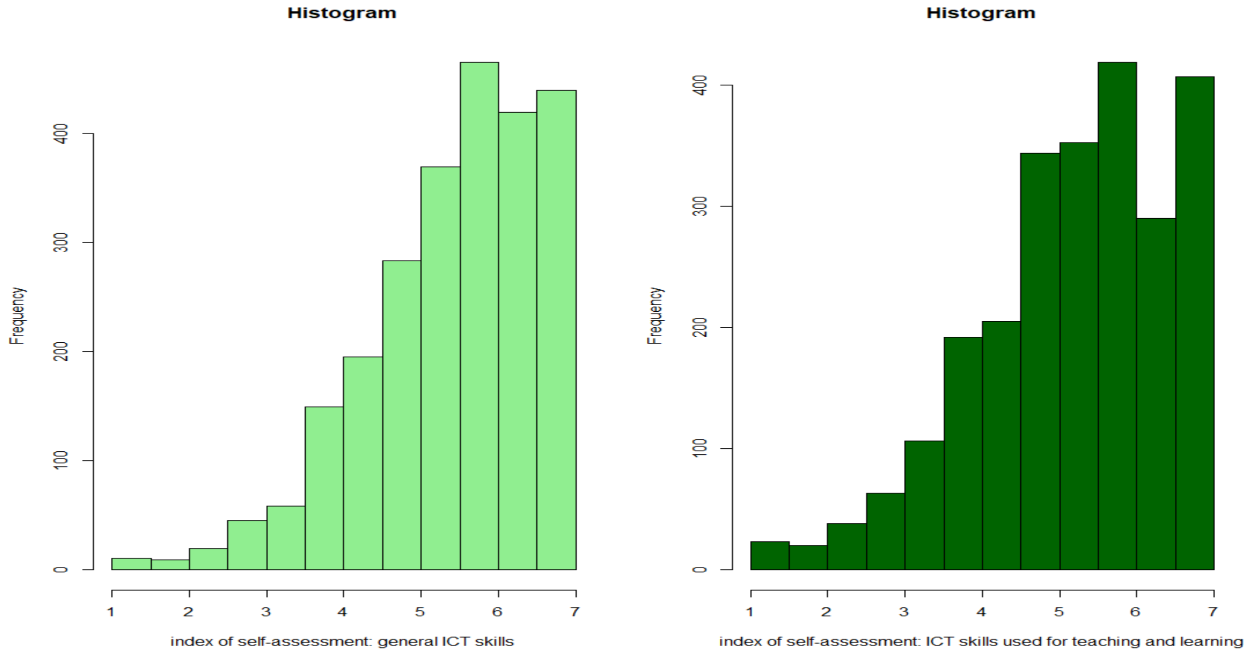
The mean value is 75.3%, however, one can notice that the distribution of the index is highly skewed to the right, where the biggest density of answers is located. From these results alone it is very difficult to evaluate the effect of social desirability on the self-assessment; however, it is possible to get an understanding of the scope of socially-desirable responses in the survey. The picture below shows histograms of calculated indices of self-assessment[13]. It can be clearly seen that both, show patterns of skewness toward high score. Ideally, one would expect normally distributed values of indices of social desirability and self-assessment, however on the picture they are both significantly biased to the right.

In order to estimate an effect of social desirability on the self-assessment one needs to use techniques of statistical modeling. Thus, teachers' self-assessment was used as dependent variable whereas vector of independent variables included age, education, teachers' category, rural-urban status, social desirability index, and experience. The main independent variable of interest was the index of social desirability[14], whereas the rest were the control covariates. For dependent variable, because of high correlation (r=0.82) between the indices of general ICT skills and ICT skills used for teaching and learning a single index was constructed by adding two indices and dividing by 2.

[13] General ICT skills, ICT skills used for teaching and learning

[14] (max index value – 1.0, min index value - 0)

Figure 11. Histogram of self-assessment: general ICT skills and ICT skills used for teaching and learning



Source: teachers questionnaire

The results of the modeling are presented in the table 5 below. Statistical model used for the analysis was multiple logistic regression. Since logistic regression requires binary dependent variable, the pooled index of self-assessment was transformed into binary variable. Values above the mean level received 1 whereas values below the mean level received 0.

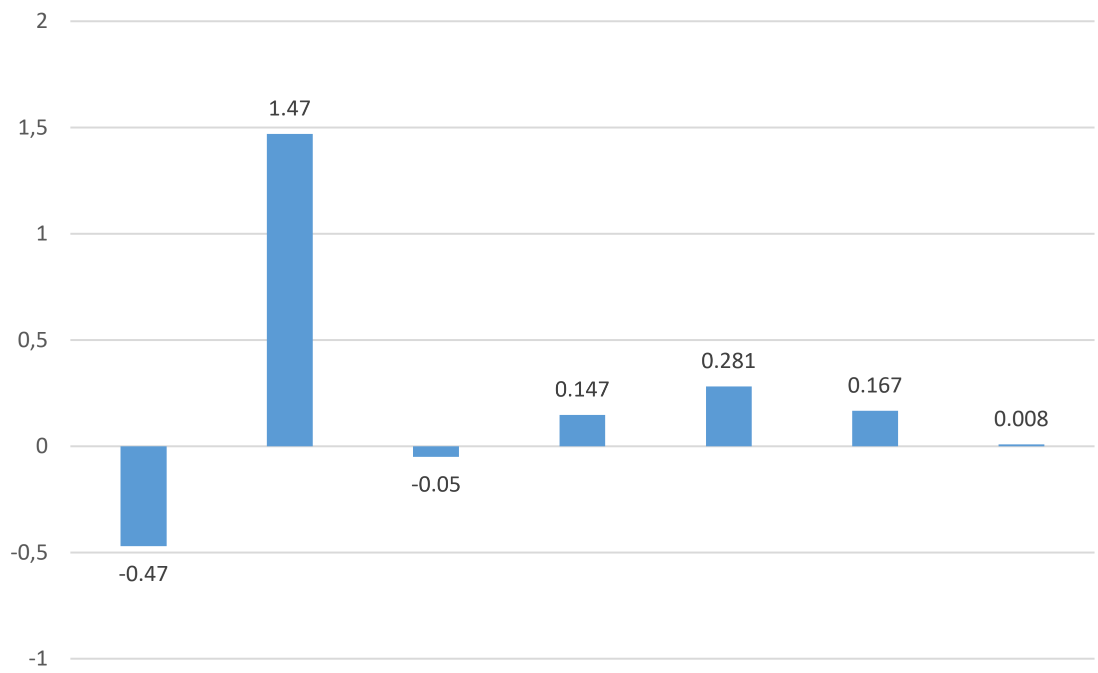
Table 5. Results of logistic regression

coefficients	*estimate*	*std.error*	*z value*	*Pr(>|z|)*
intercept	-0.47	0.32	0.29	0.767
isd	1.47	0.20	7.25	4.8e-13***
age	-0.05	0.006	-7.70	1.27e-14***
education	0.147	0.072	2.03	0.04205*
rural-urban	0.281	0.087	3.22	0.00126**
category	0.167	0.052	3.21	0.00131**
experience	0.008	0.006	1.30	0.19303

Null deviance: 3376.5 on 2459 degrees of freedom
Residual deviance: 3213.0 on 2453 degrees of freedom
AIC: 3227

The results suggest that index of social desirability (isd), age, education, rural-urban and teachers professional category have statistically significant effect on probability of being in the group with self-assessment higher than the mean value. More technically, one unit increase in the index of social desirability leads to the increase of log odds of being in the group with self-assessment score higher than the mean value (versus lower than the mean value) by 1.47. Moreover, by looking at the regression coefficients one can notice that in comparison with other covariates social desirability has the largest effect on the self-assessment. The effect size is presented visually in figure 12 below.

Figure 12. Comparison of effect size between social desirability and socio-biographic factors



Source: teachers questionnaire

The model above was not intended to account for all potential effects on the self-assessment, neither it was pretended to have a strong predictive power. Its main purpose was to look for statistical effect of social desirability and compare it with other potentially useful variables. The model showed expected results and thus, answering the question above it is possible to say that social desirability does exert influence on teachers' self-assessment. Because social desirability brings a certain amount bias, it is also safe to claim that the results of at least questions asking teachers to rate their competencies on ICT related skills are not completely objective.

There are several options to cope with the presence of social desirability (Nederhof, 1985). First, reject data of high scoring respondents. Second, correct the data of high scoring respondents by replacing their scores of self-assessment by the data of low and middle scoring respondents. The first variant assumes deletion of at least 22.8% of data but leads to a negligible decrease in the mean level of aggregate weighted scale score from 5.26 to 5.33 or in raw sum scores from 80.23 to 79.23. In other words, only 1 index unit. The second variant proposes to replace data of 1958 respondents by the data of 449 teachers who scored less than 60% on the index of social desirability. Table 6 below presents the mean level difference for each item in question on general ICT skills between the group of teachers with social desirability index value below 60% and group of teachers with social desirability index value above 60%.

Table 6. Comparison of item means between two groups of teachers.

Item	Code	Below 60%	Above 60%
use a word processor	Q30.1	5.90	6.09
produce presentation slides	Q30.2	5.50	5.87
use a spreadsheet	Q30.3	5.05	5.36
store and organize files into folders	Q30.4	5.84	6.15
use the prescribed school administrative system NEDB	Q30.5	4.66	5.05
use electronic journal	Q30.6	6.19	6.40
read, write, and send emails	Q30.7	5.95	6.15
use chat applications and other social media applications	Q30.8	5.72	5.88
search for and access educational resources and tools online	Q30.9	5.41	5.71
evaluate the credibility of information on the web	Q30.10	5.09	5.37
evaluate the relevance of a digital application or content for a learning activity	Q30.11	4.70	5.05
download/install programmes and software	Q30.12	4.71	5.11
use videoconferencing applications	Q30.13	5.47	5.76
use collaborative online applications and folders	Q30.14	4.26	4.67
edit digital photographs or other graphics	Q30.15	4.69	5.10
create audio-visual materials	Q30.16	4.15	4.62
learn new ICT applications and tools on your own	Q30.17	5.01	5.34

Source: teachers questionnaire

Obviously, item means of teachers who scored less than 60% on the index of social desirability have only negligible difference with the item means of teachers, who scored more than 60% on the index. Moreover, the difference is not statistically significant with p-value 0.118[15].

Thus, reiterating the above written, social desirability does exert influence on the self-assessment, however it would be right to claim that according to the results the influence is not crucial. Other factors influence teachers' self-assessment and unfortunately not all of these factors can be determined in this survey. It is also necessary to say that the short form of the Marlowe-Crown scale does not ideally measure social desirability and is not unidimensional. In this respect, in order to establish more thorough results further research of social desirability in Kazakhstan is needed. In this particular survey, the best possible decision is to indicate and

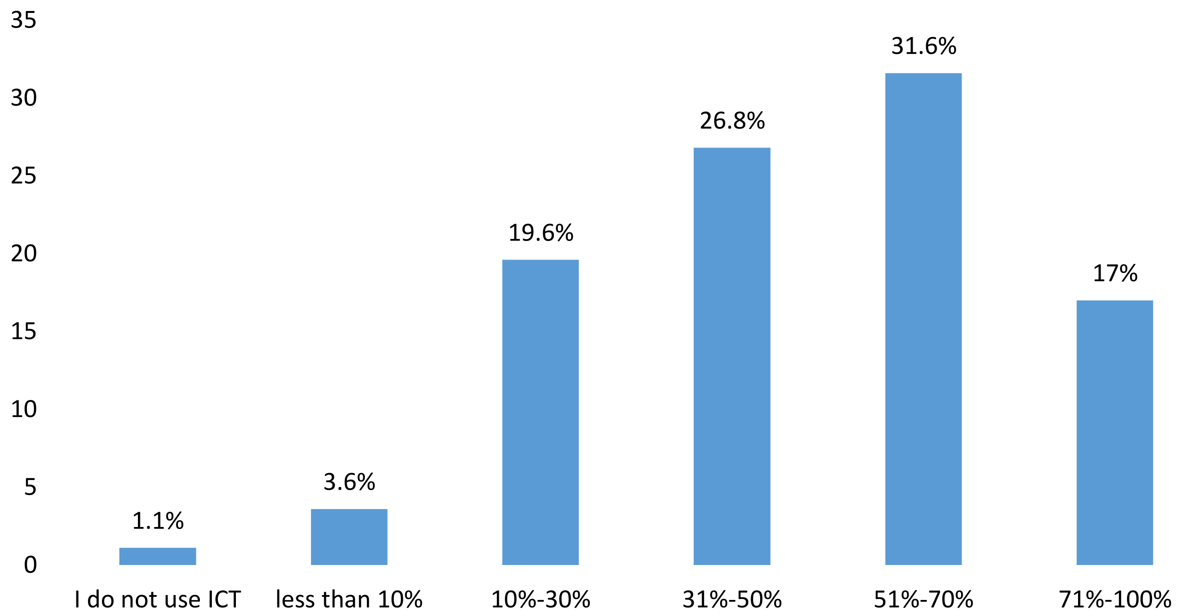
[15] Two sample paired t-test with equal variances

report the measure of social desirability and do not try to adjust its effect on the self-assessment.

Use of ICT in teaching

Since the questions on self-assessment cannot be regarded as fully free of social desirability bias, a potential question which can be used for the analysis asked teachers about average time of using ICT in teaching during lesson. Figure 13 below shows the percentages of the answers in each category.

Figure 13. Average lesson time of teaching using ICT



Question: On average, what percent of lesson time do you teach using ICT?

Source: teachers questionnaire

Approximately 48.2% of teachers use ICT more than half of the lesson time. Among them 31.6% use ICT 51%-70% of the lesson time and 17% use ICT almost full lesson time. Among 50.8% of teachers who use ICT less than a half of their lesson only 3.6% use ICT less than 10% and 1.1% do not use ICT at all. Apparently, it also depends on digital divide between urban and rural teachers. In particular among those who use ICT 71%-100% of the lesson time there are less rural teachers (13.2%) than urban (22%)

A natural question here is what factors contribute to use of ICT during teaching? How professional learning influence use of ICT? Do national and school consultations for policy development increase use of ICT by teachers?

In order to answer these questions logistic regression was conducted[16]. Participation in national and school consultations, participation in national and school ICT trainings, were used as the main covariates. Age, experience, education, category, rural-urban area and index of social-desirability were used as control covariates. Again, the main purpose here was not to build the best fitting model, but to study the effect of participation and ICT training on the average lesson time of ICT use in teaching. Table 7 provides the results of the analysis.

Table 7. Results of logistic regression

	variable	effect	stat. signific.
socio-demographic	age	-	***
	experience		*
	education		
	category		
area	urban	+	***
social-desirability	sdb	+	*
ICT policy development	particip. national level[17]	-	**
	particip. school level		
ICT training	national ICT training	+	**
	school ICT training		

According to table 7 teachers tend to use ICT less if they were not given an opportunity of participation in ICT policy development consultations at the national level. Older teachers use ICT in teaching on average less time than younger. The analysis supports the results of digital divide by indicating statistically significant effect of urban area. In addition, there is a statistically significant effect of ICT training. The more teachers received ICT training for the past 24 months at the national level the more they use ICT in teaching. Unfortunately, the results are affected by statistically significant effect of social desirability.

More research is needed in this area, especially influence of ICT training and inclusive policy development on ICT use in teaching. However, the findings above are particularly important to keep in mind then developing ICT strategy.

Professional learning

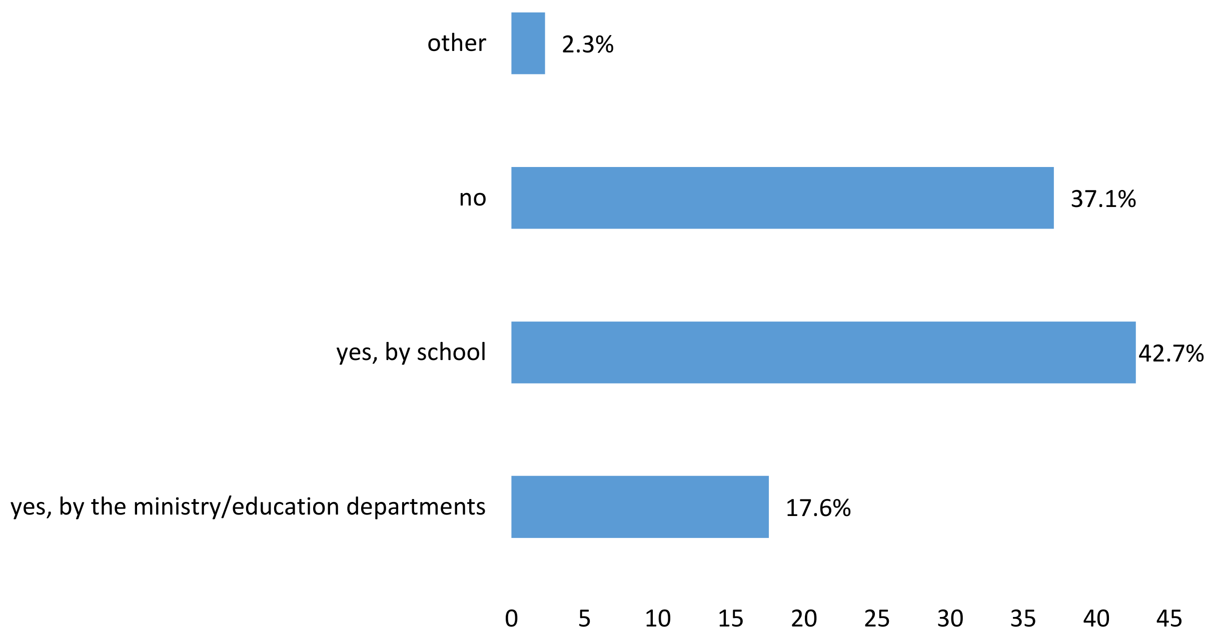
In Kazakhstan 47.2% of teachers are aware of professional development requirements on the use of ICT, 15.4% are not aware of such requirements and 37.3% are not sure.

Moreover 37.1% of teachers were never asked to identify their training needs in ICT nor by the ministry and local education departments, neither by the school (figure 14 below).

Figure 14. Survey of identification of teachers ICT needs

[16] Technical details of modeling are presented in the appendix D

[17] 1 – yes, 2 – no, 3 – do not know. The item coding was not reversed

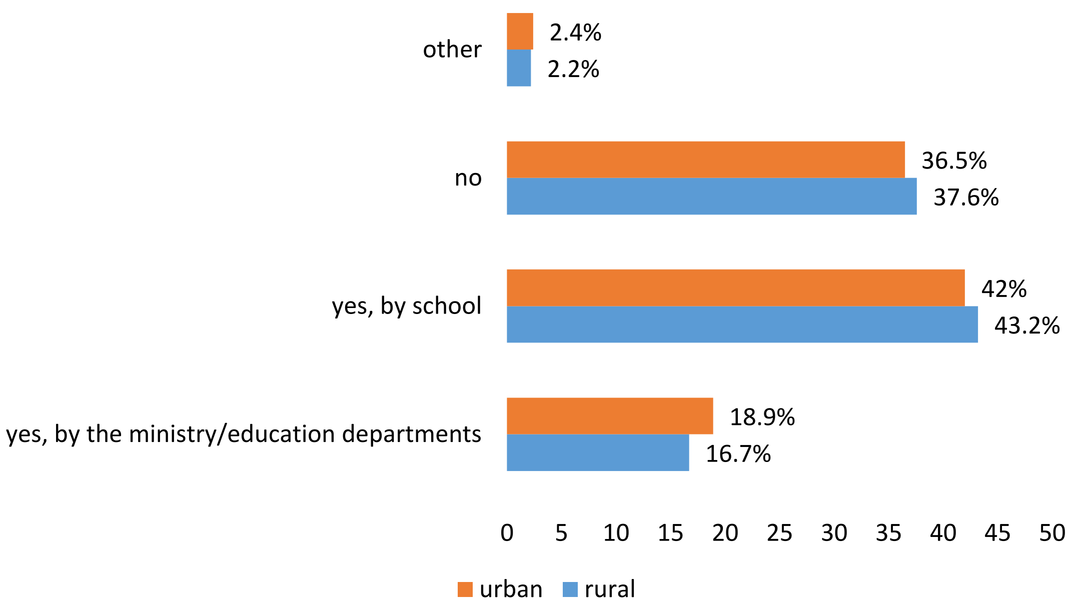


Question: Have you been surveyed or participated in identifying your training needs on ICT?

Source: teachers questionnaire

Rural-urban division shows the same picture, 37.6% of rural teachers and 36.5% of urban teachers were never asked about their professional needs in ICT. (Figure 15, below). As for the gender aspect, 38% of women were never surveyed on their professional ICT need which is roughly 5% bigger than that of men (figure 16). Overall, school serves as the main actor who surveys and provides participation of teachers in order to identify their professional needs (42.7%). Only 17.6% of teachers pointed to the ministry/education departments as those actors who ask them about their ICT needs.

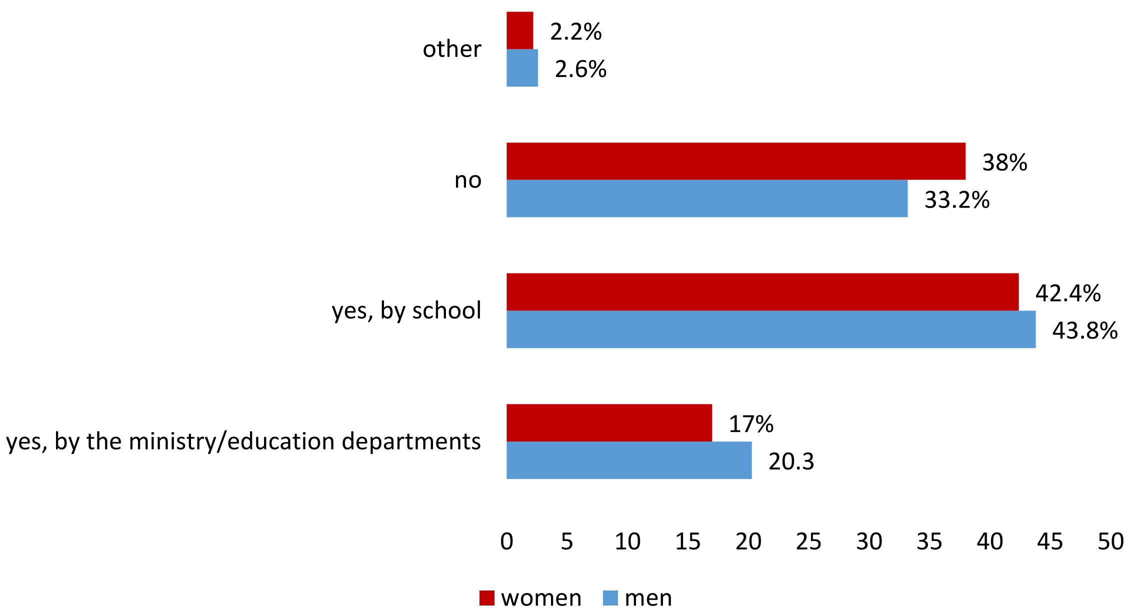
Figure 15. Survey of identification of teachers ICT needs: rural-urban division



Question: Have you been surveyed or participated in identifying your training needs on ICT?

Source: teachers questionnaire

Figure 16. Survey of identification of teachers ICT needs: women-men



Question: Have you been surveyed or participated in identifying your training needs on ICT?

Source: teachers questionnaire

Regarding the ICT training (Figure 17), the survey contains questions asking how many hours of ICT related training teachers attended at the national level and at the school level in the past 24 months. Strikingly, 43.4% of teachers attended no training at the national level. With regards to rural urban areas, they are more rural teachers (47%) than urban (38.5%) in the category of teachers who never attended ICT related training in the past 24 months. In addition, gender division suggests that women (44.9%) percentage of those who did not attend a single hour is more than that of men (36.8%).

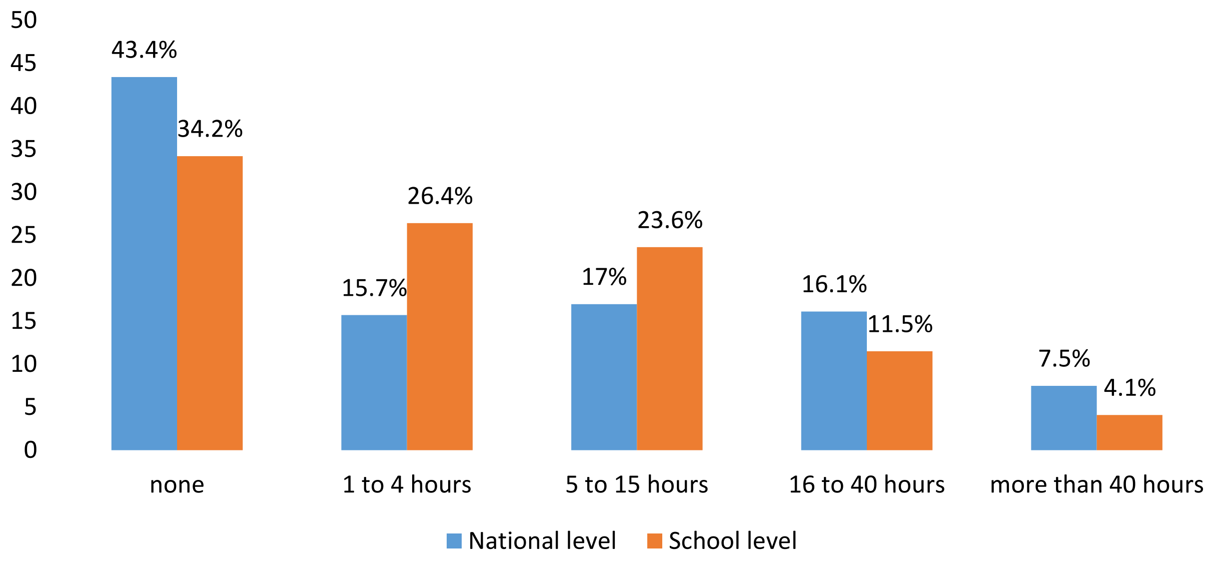
At the school level the overall number of teachers who did not attend ICT related courses in the past 24 months is 34.2%. However, in contrast to the national level here rural teachers have 35.7% and the urban teachers have 32%. Furthermore, difference between men (25.2%) and women (36.2%) among those teachers who did not attend courses is about 11%. Thus, at the school level gender divide is 3% more than at the national level. Only 7.5% of teachers attended 40 hours of ICT related training at the national level and 4.1% at the school level.

Box 4.
Development of ICT competencies stands at the center of national ICT strategies in education among OECD countries. For instance, to support development of digital competencies of school education and higher education Canadian Quebec created “Digital Competency Framework” (Quebec, Ministry of Education, 2019). The document offers detailed framework of digital competencies necessary for confident, creative and critical use of digital technologies. Moreover, the document offers concrete examples for teachers of how to use certain competency in teaching. The UK government explicitly defined in the official document a set of digital skills necessary for the adults to understand and apply digital technologies (Government of UK, 2018). Germany’s “Digital strategy 2025” includes a section on digital education throughout the life, from school to professional continuing education (Federal Ministry of Economic Affairs and Energy, 2015).

From figure 17 below it is obvious that at the school level teachers attended a small amount (1-15 hours) of ICT related courses more than at the national level. The difference is 10,7% in category “1 to 4 hours” and 6.6% in category “5 to 15 hours”.

Another question on professional development asks respondents to rank their professional development needs from 1 (highest priority) to 10 (lowest priority). It is necessary to mention, that this question presented the most difficult part of the questionnaire for respondents. In many cases respondents did not understand how to rank alternatives. Majority of those who encountered problems in this question did not rank, but put the same number in several items, which restricted them from proceeding further. The project team had to explain each teacher how to answer items and rank the priorities. For further use it is advisable to reformulate the question, or at least find online solution which offers user friendly way of ranking the priorities. If online solution is problematic, then the best way to handle this question is to conduct personal interviews. Though such step switches the mode of data collection, never the less it brings more control over the respondents’ answers by providing them the help from the side of the interviewer.

Figure 17. Professional learning: attendance of ICT related courses at the national and school level



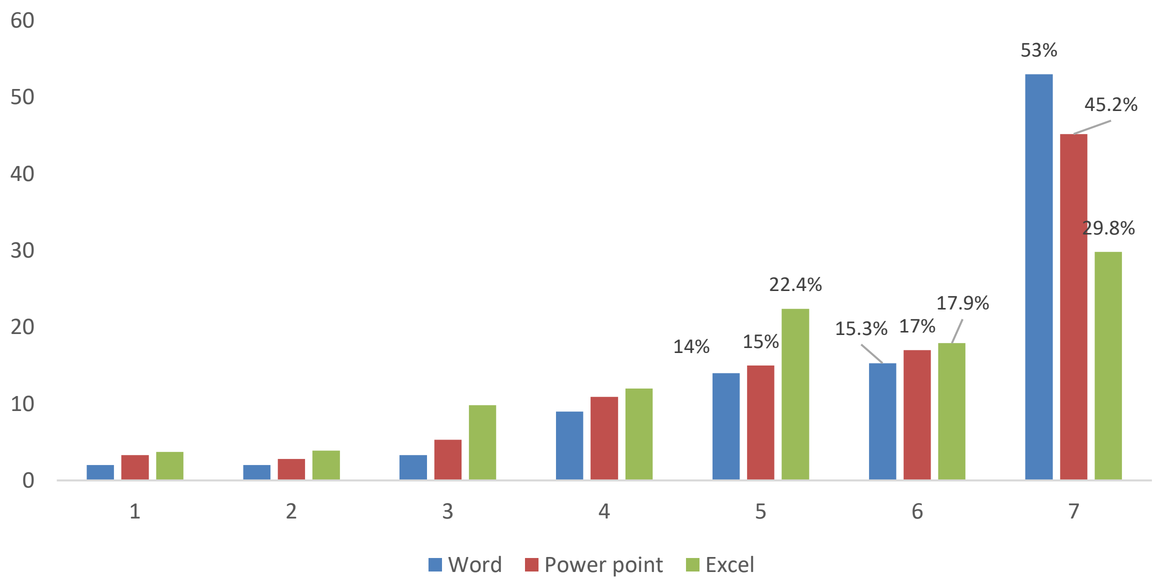
Question: How many hours of ICT-related training at the national level (provided by the MOE) have you attended in the past 24 months?

Question: How many hours of ICT-related training at the school level have you attended in the past 24 months?

Source: teachers questionnaire

Returning to the results, 44.9% of teachers ranked Basic ICT Literacy (e.g. productivity tools such as word processing, slide presentation, spreadsheet) as the main priority of professional development. With the help of the self-assessment, it is possible to look closely at this particular group. Among teachers who require training in basic ICT needs majority reported high level of competencies in using such applications as Word, Excel and Power point (Figure 18).

Figure 18. Teachers' self-assessment – group of basic ICT needs



Question: How do you rate your level of competency in the following ICT-supported tasks?

Source: teachers questionnaire

Apart from social desirability and issues with ranking, several reasons might have contributed to these contradicting results. First, lack of definition of ICT competencies, teachers simply do not know what is to be competent in certain ICT areas. Second, insufficient provision of ICT training as can be seen in figure 17. Third, lack of national policy and/or strategy of ICT use in teaching.

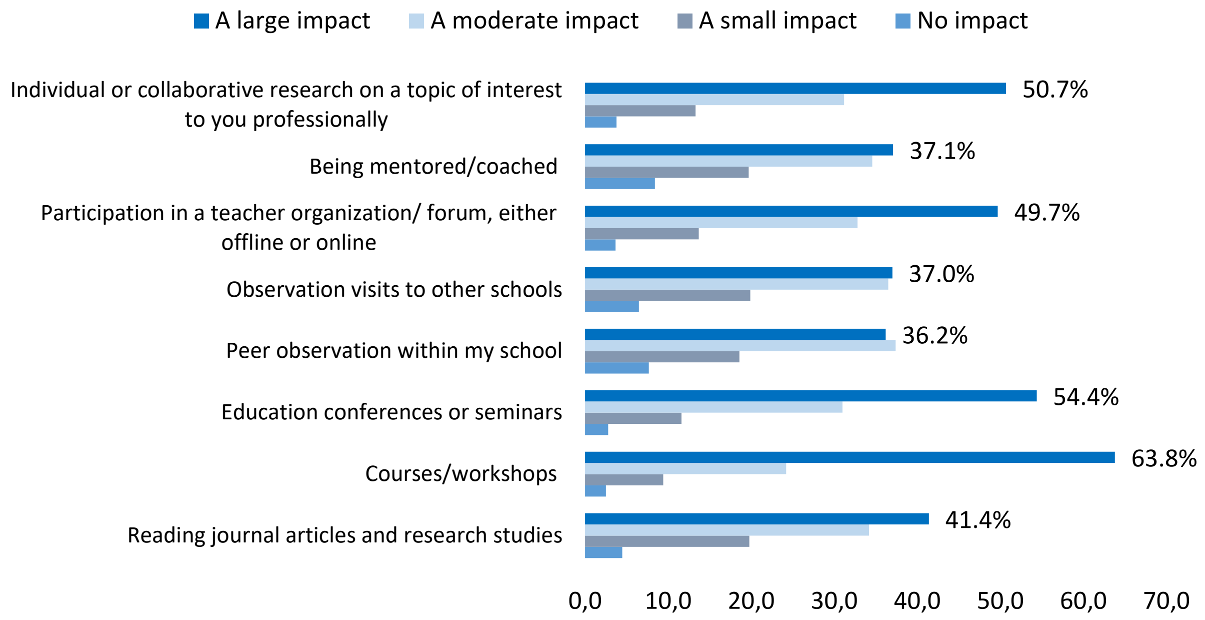
Even though the self-assessment suggests vice versa, high requirement of basic ICT needs is an evident signal of overall level of ICT competencies. The results of basic ICT needs can be supported by the next question on professional development activities. 63,8% of teachers rated courses and workshops and 54,4% rated education conferences and seminars as having the largest potential impact on their teaching practices. Furthermore, courses and workshops as well as education conferences and seminars almost equally important for rural (65,5% and 55,6%) and urban (61,4% and 52,9%) teachers. Results on professional development as well as potential impact of professional development activities on teaching practices are given in table 8 and figure 19 below.

Table 8. Professional development needs

	1	2	3	4	5	6	7	8	9
Basic ICT Literacy (e.g. productivity tools such as word processing, slide presentation, spreadsheet)	44.90%								
Teaching ICT as a subject		37.80%							
Integrating ICT into your specific subject area			39.80%						
Finding, adapting and evaluating resources from the Internet				39.40%					
Developing own multimedia learning resources					38.29%				
ICT-enhanced innovative pedagogy (eg. project based learning, computer-supported collaborative learning, etc.)						39.18%			
Using social network for teaching and learning							39.08%		
Using ICT for student assessment								38.22%	
School administrative systems (EMIS)									39.89%

Source: teachers questionnaire

Figure 19. Potential impact of professional development activities



Note: Not all data are shown

Question: rate the level of potential impact of the following professional development activities on your teaching practices

Source: teachers questionnaire

In addition, along with the top priorities which received more than half of the answers there is individual or collaborative research with 50.7% of answered respondents. Here rural teachers showed 51.3% whereas urban indicated 49.9% .

Conclusions

National context

- Over the past years, Kazakhstan has made significant progress in the development of ICT in education. An analysis of the regulatory framework shows that the development of ICT in education has ceased from being regarded as the goal of state development programs, and at this stage it viewed as a means of achieving such goals. This allows concluding that, in general, the level of ICT development has improved sufficiently to be removed from the policy agenda.
- In general, the analysis of the national context also allows us to conclude that in the development of ICT in education over the previous period the emphasis was put primarily on the infrastructural development: mostly the provision of broadband Internet connections, equipment and devices. And according to NEDB data, the provision of computer equipment increased significantly in 2020 as a response to the pandemic.
- Currently, the strategic focus is shifted towards ensuring the quality of ICT infrastructure, as well as developing ICT skills in teachers and students. This reorientation, according to experts, is also largely related to the impact of the pandemic, and targeted allocation of significant funds for these two areas can be named among the manifestations of this trend.
- Content of education is also a compelling issue on the strategic agenda. The completed transition to the updated content of education, which provides for the development of higher-order skills in students, requires developed ICT skills in both students and teachers. Methodological guidelines for teachers in this area are currently under revision. Currently, the ICT component covered insufficiently within them.
- The ICT component is also emphasized in the context of teaching and professional development of teachers. For example, teacher training programs provide for the development of ICT skills as a mandatory component of education in teacher training colleges and universities. In addition, advanced training courses include modules aimed at developing teachers' ICT/digital skills.
- ICT-enhanced pedagogy remains one of the challenges that Kazakhstan will have to address in the future, as this area requires more attention. Despite such initiatives as teacher competitions, the given opportunity to place self-developed digital educational content and resources on national educational portals and the acting teacher qualification system, the wider dissemination of innovative pedagogical methods will require additional efforts.
- The development of ICT in education is associated with various formats of partnerships between the stakeholders of the educational process and is actively developing within the framework of not only government initiatives, but also PPPs, commercial contracts and donor relationships. The most prominent examples of such interaction are the implementation of electronic journals, digital educational resources development, the provision of Internet connection, the equipment and information and

telecommunication products procurements, revision of educational content with the support of international organizations.

- Also, the analysis of the national context allows us to conclude that the COVID-19 pandemic has identified problem areas in the development of ICT in education, and at the same time has become an effective stimulus for their development. Thus, in 2020, the equipment provision indicators at schools significantly increased, substantial measures were taken to ensure the quality of the Internet connection, training on ICT-using skills was conducted, the quality of digital educational content improved significantly, ICT tools were implemented into teachers' daily practices both for educational and for administrative purposes.

Main Study

Infrastructure

- In Kazakhstan, there is digital divide between rural and urban schools with regards to speed of the Internet connection. Digital divide is a serious issue, it can aggravate inequality between rural and urban population, limit teachers and students access to online content and as a result lead to gap in ICT skills
- Though majority of teachers use computers and smartphones on a daily basis, nevertheless only 13% of teachers use tablets. International experience show that tablets can have a valuable impact on development of students' ICT skills. Students can quickly learn how to use tablets, tablets are more mobile than even laptops and have a quick access to the Internet

ICT policy

- In Kazakhstan there is no specific policy of ICT use in education. ICT policy and/or strategy are very important as they show teachers and students how to use ICT, what skills and competencies they need to develop, and what steps must be undertaken for country to stimulate technological changes through the use of ICT.
- Only small part (8%) of teachers knows that formally Kazakhstan does not have a policy of ICT use in education.
- Approximately 20% of subject teachers in Kazakhstan were never given an opportunity to participate at the national and school levels discussions for policy development.

Self-assessment

- Teachers' self-assessment showed overall high level of competencies in all ICT related tasks. However, the self-assessment is biased because of the statistically significant effect of social desirability. In other words, teachers tend to give responses that would show them in a favorable light which led to inflated values of the self-assessment.
- There is no statistically significant difference between the item mean values of those who have scored less than 60% on the index of social desirability and those who have

scored more than 60%. Therefore, no measures apart from informing about the scope of presence of social desirability in the survey were undertaken.

- Obviously, in order to avoid inflated results of the self-assessment, one needs to switch from the direct to indirect questions, or ideally, construct a standardized instrument which could properly assess teachers' ICT competencies.
- Participation in discussion of ICT policy development at the national level, participation in ICT courses at the national level have statistically significant positive effect on the use of ICT in teaching
- Age has statistically significant negative impact on the average time of ICT use during lesson.

Professional learning

- While schools, Ministry of Education and local executive departments work on identification of teachers' professional requirements, about one third of subject teachers in Kazakhstan were never asked to formulate their professional needs.
- More than one third of teachers in Kazakhstan did not attend a single hour of ICT-related courses for the past 24 months at the national level. At the school level such number is smaller but still represents around one third of all population.
- When asked about professional development needs, about 45% of teachers pointed to basic ICT training such as word processing, making presentations, working in Excel spreadsheets. These basic ICT needs stand at the level of knowledge acquisition according to UNESCO framework of competencies. Despite some difficulties that arose with this question, this result shows a picture that runs counter to the answers on self-assessment of ICT competencies.
- About two third of teacher population in Kazakhstan pointed to courses and workshops as activities that can have largest potential impact on their professional development. Education conferences and seminars were marked as the second top option and individual or collaborative research as the third. These results confirm the need in provision of teachers with ICT courses as well as show that besides their primary duty teachers are interested in research.

In Table 9, results of the survey were summarized and broad in accordance with UNESCO ICT Competencies Framework. Colors from light green to green confirm the achievement of certain aspect by majority of teachers. White color indicates areas where there is no conclusion due to insufficient amount of information and contradictory results.

Table 9. Survey results and UNESCO ICT Competencies framework

	Level «Knowledge Acquisition»	**Level «Knowledge Deepening»**	**Level «Knowledge Creation»**

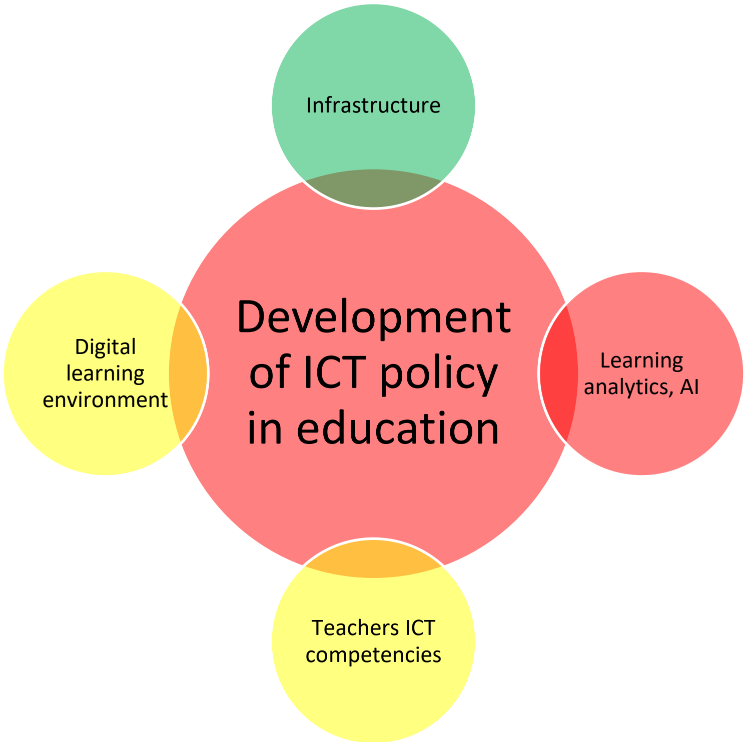
ASPECT 1 Understanding ICT in Education policy	**Education Policy Understanding**	**Education Policy Application**	**Policy Innovation**
ASPECT 2 Curriculum and Assessment	**Basic Knowledge**	**Knowledge Application**	**Knowledge Society Skills**
ASPECT 3 Pedagogy	**ICT-enhanced Teaching**	**Complex Problem-solving**	**Self-management**
ASPECT 4 Digital Skills	**Application**	**Infusion**	**Transformation**
ASPECT 5 Educational Process Organization and Administration	**Standard Classroom**	**Collaboration Groups**	**Learning Organizations**
ASPECT 6 Professional Learning	**Digital Literacy**	**Networking**	**The teacher as an Innovator**

Based on the survey results one can state achievement of all 3 levels in aspects 1 to 6 (figures 7-9). However, by accounting for social desirability bias, questions on basic ICT needs, participation in ICT courses and activities with the largest potential impact on professional career, it is not possible to safely state that majority of teachers achieved the third level. It is more probable to assume that the true level of competencies, especially for the level of "Knowledge creation" is far from being mastered in aspects 2-6. The most difficult part of evaluation is aspect 1, since the country does not have separate policy of ICT use in education. The existing policy documents either include ICT in their content as an integral part, or are too fragmented and aimed at using specific applications (NEDB, Kundelik) for specific tasks. Survey showed that teachers know and understand importance of ICT in educational policy; however they lack a common vision. For aspects 2-6 as was mentioned previously, it is important to change the approach to assessment of teachers' competencies (replace direct questions by indirect) or abandon survey in favor of a standardized assessment.

Recommendations

UNESCO's Teacher Readiness Survey revealed several key areas where Kazakhstan needs to develop policy measures to support the use of ICT in education. These key areas are depicted in figure 20 below. The green color represents the area where Kazakhstan made certain progress, the yellow colors are the areas where the country needs to strengthen its efforts and the red colors show completely or almost completely lacking areas. While majority of recommendations are based on the survey findings, some of them were developed on the basis of international experience[18].

Figure 20. Key areas for the development of ICT in education



Policy of ICT use in education

First, it is necessary to start from the largest red area which points to development of ICT policy in education. The program "Digital Kazakhstan" though accentuates importance of digitalization and defines certain steps for digitalization of education, nonetheless does not solely concentrate on ICT in education. It is important to have a common vision of how to use, develop and deliver ICT in education. Without such vision use of ICT use can become techno-centric and partial and probably, will lead neither to technological changes, nor to development of necessary skills.

Recommendation 1: Kazakhstan needs to elaborate a comprehensive policy of ICT use in education with clear objectives, delivery strategy and outcomes. The policy should cover such areas of ICT use in education as infrastructure, ICT competencies, digital learning environment and learning analytics.

Suggested measures:

[18] Recommendations 5,6 and the area of learning analytics

1.1 Create an inclusive working group to develop the policy

1.2 Stimulate national and school level consultations for policy development with active participation of school teachers

1.3 Create the policy implementation strategy for schools, higher education institutions and local authorities

1.4 Promote and clarify policy objectives and outcomes at the national and school levels

Infrastructure

According to the survey, most of teachers have access to computers and laptops that allow them to conduct lessons using ICT technologies. Furthermore, majority of teachers have access to the Internet connection. To some extent the NEDB data confirm these results, the ratio of students to computers is on average 1 to 6 and roughly more than 70% of schools have speed of Internet higher than 4 Mbits p/s. It is possible to safely claim that among other areas of ICT in education infrastructural aspect is the most well developed. However, despite the results at the national level, there is evident digital divide between rural and urban speed of school Internet connection.

Recommendation 2: Decrease digital divide between rural and urban schools

Suggested measures:

2.1 Ensure the quality and speed of the internet connection in rural schools

2.2 Ensure provision of rural schools with technical devices (tablets, interactive whiteboards, projectors)

Digital learning environment

Digital learning environment is an integral and important part of any educational process. In Kazakhstan, the use of digital resources showed that majority of teachers prefer to use open educational resources (73,6%) and various educational websites (51,6%). Digital educational resources are well represented by open educational websites such as Bilimland and Imektep. These websites provide open access to textual and video educational materials, instructional videos for teachers. However existing learning environment is aimed at individual use and study of digital resources, whereas OECD countries strongly encourage embedding collaborative learning into the digital learning environment. Chong & Kong (2012) describe that collaborative learning "… involve teachers meeting on a regular basis to develop shared responsibility for their students' school success" (p. 264). Moreover experience of OECD countries assumes development of collaborative learning not only for teachers, but for students as well.

Recommendation 3. Stimulate teachers and students to use digital learning environment

Suggested measures:

3.1 Encourage collaborative learning of teachers and students in digital learning environment

3.2 Provide teachers with necessary training on using digital learning environment

Teachers ICT competencies

Teachers ICT competencies cannot be developed without clear definition of what are the ICT competencies. A clear definition will help to elaborate assessment of ICT competencies, identify missing competencies and as a result come up with effective targeted professional courses and seminars.

Recommendation 4: Develop national ICT competencies framework.

Suggested measures:

4.1 Elaborate a detailed definition of ICT competencies

4.2 Develop hierarchy and levels of ICT competencies

Survey results show that Kazakhstan needs to work on determination and provision of ICT training and courses, both at the national and at the school level.

Recommendation 5: Determination of the current state of ICT competencies of school teachers and the need for their development

Suggested measures:

5.1 Conduct a survey among teachers to determine their ICT needs and define directions of development of their ICT competencies

5.2 Develop a standardized instrument to assess teacher ICT competencies

5.3 Conduct country-scale assessment of teacher ICT competencies

5.4 Revise teacher retraining programs based on the assessment results and national ICT skills development strategy

5.5 Conduct monitoring of the level of teachers ICT competencies on a regular basis

One of the elements of OECD countries state policies is professional training of teachers who are able to apply technologies to ensure the educational process. In Sweden and Norway at the national level, pedagogical universities are required to integrate ICT into the educational process with subsequent assessment of ICT skills during certification of university graduates

(Enochsson, 2010; Toemte, et al., 2010). In Netherlands students sometimes undertake ICT related projects during their internship (Brummelhuis, et al., 2010)

Recommendation 6: Conduct modernization of training and higher institution pedagogical programs with a focus on ICT competences

Suggested measures:
6.1 Elaborate a framework for the development of ICT competencies of teachers in university and college pedagogical educational programs

6.2 Adapt training programs in universities and colleges based on the results of the regular monitoring

Learning analytics and AI

NEDB and Kundelik provide huge amount of administrative data. However, these data are not properly employed for the analysis. Digitalization and learning analytics go hand in hand and thus, advantages of one cannot be used without the other. Learning analytics help to improve decision making process, track the progress of students and predict their potential results. On international level countries have taken the course on the development of learning analytics as well as implementation of AI algorithms. For instance, Turkey in its official document "Turkey's Education Vision 2023" dedicated subsection to development of data-based management with learning analytic tools (Ministry of National Education, 2019). According to the document, Turkey plans to integrate existing educational data sources and develop a platform of learning analytics, and transform decision making by data based approach. The platform will evaluate the academic data and personal data of students such as their interests, talents and temperament. Kazakhstan has a good potential to create own tools of learning analytics, moreover the abundance of data allows to use not only simple analytical methods, but AI algorithms as well. However, currently learning analytics is one of the most underdeveloped areas in country's education system.

Recommendation 7: Create instruments of learning analytics that can analyze data from the existing data with the help of complex tools of data analysis and AI algorithms

Suggested measures:

7.1 Integrate NEDB, Kundelik and Bilimland data sources

7.2 Revise data indicators with emphasis on quality of data

7.3 Create instruments of predictive analytics

7.4 Stimulate implementation of AI algorithms

References:

1. Alberta Government (2013). Learning and Technology Policy Framework. Retrieved from, Learning and technology policy framework, 2013 - Open Government. https://education.alberta.ca/media/1046/learning-and-technology-policy-framework-web.pdf

2. Brummelhius, A., Wijngaards, G., Swager, P., & van Goozen, B. (2010). *ICT in Initial Teachers Training: The Netherlands. Country Report.* Retrieved from, 45063786.pdf (oecd.org)

3. Collechia, A., & Shreyer, P. (2002). ICT Investment and Economic Growth in the 1990s: Is the United States a Unique Case. A Comparative Study of Nine OECD Countries. Review of Economic Dynamic, 5, 408-442.

4. Crowne, D., & Marlowe, D., (1960). A New Scale of Social Desirability Independent of Psychopathology. Journal of Consulting Psychology, 24(4), 349-354.

5. Cullen, R. (2001). Addressing the Digital Divide. *Online Information Review, 25(5)*, 311-320

6. Enochsson, A. B. (2010). *ICT in Initial Teachers Training: Sweden. Country Report.* Retrieved from, 45046846.pdf (oecd.org)

7. Federal Ministry of Economic Affairs and Energy (2015), Digital Strategy 2025. Retrieved from, https://www.de.digital/DIGITAL/Redaktion/EN/Publikation/digital-strategy-2025.pdf?__blob=publicationFile&v=9

8. Hassler, B., Major, L., & Hennessy S. (2015). Tablet Use in Schools: a Critical Review of the Evidence for Learning Outcomes. Journal of Computer Assisted Learning, 32, 139-156

9. Kozma, B. R. (2008). Comparative Analysis of Policies for ICT in Education. In J. Voogt & G. Knezek (Eds.), International Handbook of Information Technology in Primary and Secondary Education (pp. 1083-1096). Springer.

10. Looker, E. D., & Thiessen, V. (2003). Beyond the Digital Divide in Canadian Schools: From Access to Competency in the Use of Information Technology. *Social Science Computer Review, 21(4)*, 475-490

11. Montrieux, H., Vanderlinde, R., Schellens, T., & De Marez, L. (2015). Teaching and Learning with Mobile Technology: A Qualitative Explorative Study about the Introduction of Tablet Devices in Secondary Education. PLoS ONE, 10(12), 1-17.

12. Nederhof, A. J. (1985). Methods of Coping with Social Desirability Bias: A Review. European Journal of Social Psychology, 15, 263-280.

13. Niebel, T. (2018). ICT and Economic Growth – Comparing Developing, Emerging and Developed Countries. World Development, 104, 197-211

14. OECD (2017), OECD Digital Economy Outlook 2017, OECD Publishing, Paris. http://dx.doi.org/10.1787/9789264276284-en

15. Phillips, L. D., & Clancy, J. K. (1972). Some Effects of "Social Desirability" in Survey Studies. American Journal of Sociology, 77(5), 921-940

16. Quebec, Ministry of Education. (2019). Digital Competency Framework. Retrieved from, http://www.education.gouv.qc.ca/en/references/tx-solrtyperecherchepublicationtx-solrpublicationnouveaute/results/detail/article/digital-competency-framework-1/?a=a&cHash=2f4087f0a706e2c970404d73cee9719d

17. Queensland Government, Department of Education (2019). Digital Strategy 2019-2023. Retrieved from, Digital Strategy 2019–2023 (qed.qld.gov.au)

18. Reynolds, W. M. (1982). Development of Reliable and Valid Short Forms of the Marlowe-Crowne Social Desirability Scale. Journal of Clinical Psychology, 38(1), 119-125.

19. Toemte, C., Hovdhaugen, E., & Solum, N. H. (2010). *ICT in Initial Teachers Training: Norway. Country Report.* Retrieved from, 45128319.pdf (oecd.org)

20. The Program "Digital Kazakhstan", retrieved from, https://digitalkz.kz/en

21. Turkey's Ministry of National Education (2019). Turkey's Education Vision. Retrieved from, 2023_vizyon_eng.pdf (meb.gov.tr)

22. UK Government (2018). Essential Digital Skills Framework. Retrieved from, https://www.gov.uk/government/publications/essential-digital-skills-framework

23. Valadez, R. J., & Duran, R. (2007). Redefining the Digital Divide: Beyond Access to Computers and the Internet. *University of North Carolina Press, 90(3)*, 31-44

24. Valliant, R., Dever, J., A., & Kreuter, F. (2013). Practical Tools for Designing and Weighting Survey Samples. Springer

25. van der Viles, R. (2020). "Digital Strategies in Education Across OECD Countries: Exploring Education Policies on Digital Technologies". OECD Education Working Papers, No. 226, OECD Publishing, Paris, https://doi.org/10.1787/33dd4c26-en.

26. Venezky, L. R. (2000). The Digital Divide Within Formal School Education: Causes and Consequences. In OECD (2000), *Learning to Bridge the Digital Divide*, Schooling for Tomorrow (pp. 63-76), OECD Publishing, Paris

27. Vu, M. K. (2011). ICT as a Source of Economic Growth in the Information Age: Empirical Evidence from the 1996-2005 Period. Telecommunication Policy, 35, 357-372

Appendix A

Level of formation of ICT skills upon completion of secondary education

Education levels Learning outcomes	Primary education	Basic secondary education	General secondary education
Knowledge	knows the meaning of the concepts: "information", "object", "file", "folder", "shortcut", "model", "computer network", "Internet"; the purpose of operating system objects; types of presentation and units of measurement of information; the main parts of the computer; input and output devices; the purpose of application, service programs and the operating system, safety rules when working at a computer	Knows the algorithm for using a mathematical model to solve an applied problem; fundamentals of scientific ideas about information, information processes, technologies and models; the role of information technology in modern society and the life of every person; the basics of building computer systems and networks, as well as their interaction with software; ways of solving problems through modelling, algorithmization and programming; rules for correct and safe work with various digital devices	knows the purpose and basic functions of system and application software; basics of working with database management systems; life cycle models for software development; the basics of web programming, database theory for creating websites; programs for the development of mobile applications; network protocols and principles of the Internet; security measures designed to keep data and computer systems safe
Understanding	understands the purpose of the main parts of the computer, input and output devices, elements of the operating system interface; the impact of computer technology on human health; the importance of protecting information and devices from malware; the need to accompany information with links to authors	understands the interaction of the main devices of the computer; the need for software for the user to work with the system; computer use of binary code to represent all data and instructions; the relationship between units of measurement of information; economic, legal and ethical aspects of the use of information and means of information and communication technologies	understands the principles of organization of relational databases; basic principles of the functioning of network technologies; principles of audio and video information processing; main trends in the development of information technology
Application and use	uses information and communication technologies for collecting, storing, processing and transmitting information; application programs for working with various types of information, for creating models; Internet services for solving assigned tasks; rules for working at the computer	uses modern software tools for information and communication technologies to collect, present, process, store and transmit the necessary information; computer models of objects and processes (physical, biological, economic and informational) for their visualization and research; basic rules for writing algorithms and the possibilities of programming languages for solving practical	applies information and communication technologies to create information objects and formalize the results of their work; rules for composing queries in databases; cloud technologies for editing and storing documents; programming elements in the development of websites and mobile applications; rules of personal safety in the network and netiquette; audio and video processing software

		problems; local and global network capabilities for collaborative work on creating, viewing and editing documents	
Analysis	analyzes the consequences of violation of ethical and legal norms in the network; information from various sources, selected in accordance with the stated requirements	analyzes computer models to study real and imaginary objects and processes; various ways of solving a problem on a computer to determine the most rational; program code in a programming language to identify existing errors and their subsequent correction	analyzes queries using multiple criteria and relation operators to find information; a task to determine the appropriate methods and approaches to its solution through modelling, algorithmization and programming; the results of processing and computer calculations for compliance with the task; ways of solving the problem in various ways to determine the most effective
Synthesis (generalization)	synthesizes, classifies models of objects and situations for solving practical problems using information and communication technologies; knowledge about the capabilities of applications and network services for solving various problems	synthesizes information in the form of texts, tables, databases, graphics and multimedia to present and implement their ideas; models of objects and processes (physical, biological, economic) in spreadsheets, 3D editors, as well as programming environments	synthesizes information in various forms to express own ideas and thoughts; synthesizes databases information using forms and controls; websites information for solving user problems
Evaluation	evaluates data presented in the form of a graph, table, diagram; compliance of the model with the specified criteria; the ability to use application programs and network services to solve problems	evaluates the quality, importance, usefulness and effectiveness of information; choice of computer configuration and software depending on the needs of the user; computer model for compliance with real objects; the effectiveness of the algorithm and the results of its execution; negative impact of information and communication technologies on human health	assesses the results of its activities in accordance with the goals set in the modelling and development of the project (specificity, measurability, attainability, realism, relativity); advantages and disadvantages of the software used, including programming tools

Source: State Compulsory Standard for Primary, Basic Secondary and General Secondary Education, Order of the MoES of the RK No. 604 dated October 31, 2018 (with amendments No. 182 as of May 5, 2020)

Appendix B

Performance Assessment Criteria for Information and Communication Technologies, Informatics subjects

Education levels Learning outcomes	Primary education	Basic secondary education	General secondary education
Knowledge	knows the meaning of the concepts: "information", "object", "file", "folder", "shortcut", "model", "computer network", "Internet", the value of the digit units in the decimal number system, flat and spatial geometric shapes and their elements, formulas for calculating the perimeter, area of a square and rectangle, rules for adding and subtracting fractions with the same denominators, the purpose of operating system objects, types of representation and measurement units of information, the main parts of a computer, input and output devices, the purpose of application, service programs and operating system, safety rules when working at a computer	knows the meaning of the concepts "algorithm", "information processes", "information security", "online security", "plagiarism", "licensing", "copyright", "web page", "web server", "web site "," web browser "," URL-address "," http-protocol "," IP-address "," domain name ", methods of presentation and measurement of information, components (characteristics) of modern personal computers (hereinafter - PC) , the main technical means of storing, processing and transmitting information in PC and computer networks, the purpose and principles of the organization and functioning of computer networks, the purpose and classification of PC software, methods and means of computer implementation of information models, the basics of algorithmization and programming, stages of development of computer technology, types of information threats, also means of information protection	knows logical operations and their conventions, rules for calculating logical equations, rules for translating numbers from one number system to another, the concept and purpose of information systems, the concept of geoinformation systems, the basic concepts of object-oriented programming, the purpose and functions of information and communication technologies used, methods and means of computer implementation of information models, norms of information ethics and law, information security, principles of information security, the concept of "database", "database management system", "data normalization", classification of databases, the main elements of the relational database model, principles of creating single-table and multi-table databases, commands for searching and sorting information in databases, basic HTML tags and CSS commands for developing websites, basic principles of working with Web editors, basic tools for editing Web pages, typical structure of the Web - pages and principles of site design,

			basic principles of Web design, concepts of "server", "provider", "hosting", concepts of "data integrity", "file system", hierarchy and basic characteristics of computer memory, the purpose of virtual memory and cache; memory, the main components of the motherboard, the purpose and capabilities of graphics and animation packages
Understanding	understands the purpose of the main parts of a computer, input and output devices, elements of the operating system interface, the impact of computer technology on human health, the importance of protecting information and devices from malicious programs, the need to accompany information with links to authors	understands the role of graphical presentation of statistical data in quantitative and qualitative analysis, the role of information processes in society, wildlife, technology, the use of a binary alphabet by a computer to represent all data, the relationship between information measurement units, the programmatic principle of a computer, the need for software, economic, legal and ethical aspects of the use of information and communication technologies (hereinafter - ICT), the importance of observing safety rules when working at a computer	understands the principle of operation of logical elements of a computer, the difference between positional and non-positional number systems, the principles of an object-oriented approach to the compilation of algorithms and programs, the principles of organizing relational databases, the principles of functioning of network technologies, the advantages and disadvantages of the client-server model, the basic principles of the formation of animation clips , the possibilities and scope of use of the artificial intelligence system, the possibilities of cloud technologies, the purpose of virtual memory and cache memory
Application and use	uses means of information and communication technology for collecting, storing, processing and transmitting information, application programs for working with various types of information, for creating models, Internet services for solving tasks, rules for working at a computer	applies computing equipment and software for solving practical problems, coding rules for representing information in binary code, information security techniques, basic technologies for creating, editing, designing, storing, transferring information objects of various types using modern software, application program	applies the rules for translating numbers from one number system to another, the laws of logic for calculating the meaning of a complex statement, the editor's capabilities for graphically representing a real object, methods of processing digital images, applied programs and applications for conducting computer experiments, information

		capabilities, capabilities local and global networks for joint work on information, computer models of objects of physical, biological, economic and information processes for their visualization and research work, basic rules for recording algorithms, the possibilities of programming languages for solving practical problems, safety rules, ergonomics and resource conservation in work with ICT devices, norms of information ethics and copyright	and communication technologies for creating information objects, and registration of the results of educational work, a database management system for creating your own databases, macros for automating repetitive actions, rules for searching (building queries) in databases, computer networks when performing tasks and projects in various academic disciplines, rules of information security, information ethics and rights, file exchanger for publishing and distributing project results, object-oriented programming capabilities for creating applications, principles of creating WEB-sites, various ways of creating animation, rules of technology safety, hygiene, ergonomics and resource saving when working with information and communication technologies
Analysis	analyzes data and results related to counting, metering, application capabilities, consequences of violation of ethical and legal norms on the network, information from various sources, selected in accordance with the stated requirements	analyzes information on the selection of appropriate hardware and software for its presentation, processing and transmission, tables, graphs, diagrams, schemes for interpreting data and results, computer models for studying real and imaginary objects and processes, various ways of solving a problem on a computer to determine more rational, program code in a programming language to identify existing errors, information resources of global networks	analyzes logical expressions and schemes, queries using several criteria and relation operators to search for information, security measures to protect computer systems, errors in developed programs, methods for creating websites, the possibility and efficiency of computer modelling, information required to solve a given problem, the capabilities of geographic information systems in modelling and design, documents of various types in the shared access mode, computer models, security measures when working on the network, ready-made animation,

			videos, websites, the consequences of violation of ethical and legal norms on the network, the results of design work, information necessary to solve the problem, properties of objects, phenomena and processes
Synthesis (generalization)	synthesizes the simplest models of real objects and processes of the real world in the form of images and drawings, models of objects and situations for solving practical problems using information and communication technologies, knowledge about the capabilities of application programs and network services for solving various problems	synthesizes text, tabular, graphic, multimedia, as well as combined objects for the presentation and implementation of their ideas, the configuration of the computer and software depending on the needs of the user, algorithms for solving problems in the form of step-by-step instructions, flowcharts	synthesizes information about objects, processes and phenomena, information systems and presents it in a new form, information about the prospects for the development of computing technology, software, conclusions drawn from the analysis of data necessary for the development of a computer model, logical circuits based on logical expressions, computer model in accordance with the set goal, information about the capabilities of the software used, about the processing of animation, video, the creation of web pages and sites
Evaluation	evaluates data presented in the form of graphs, tables, diagrams, compliance of the model with specified criteria, the possibility of using application programs and network services to solve problems	evaluates information presented in tabular and graphical forms, the effectiveness of ICT tools depending on the application, accuracy, sufficiency, reliability, relevance, relevance of information by comparing various sources, the advantages of a computer model, the effectiveness of the algorithm and the results of its implementation, the negative impact of ICT tools on health a person, the influence of computer technologies on the development of society, the possibilities of modern means of ensuring information security	evaluates the performance of the program, the quality of information (accuracy, sufficiency, reliability, relevance, relevance) used for the project, the compliance of information models with the goals of modelling, the results of its activities in accordance with the goals in modelling and project development (specificity, measurability, attainability, realism, relativity) , the advantages and disadvantages of the software used, the prospects for the development of network technologies, the consequences of violation of ethical and legal norms

			on the network, when using the software, the possible dangers of the introduction of electronic devices for reading information about the object, the quality of the design of web pages, compliance with safety regulations, laws of ergonomics

Source: Order of the Minister of Education and Science of the Republic of Kazakhstan "On approval of criteria for assessing students' knowledge" No. 52 dated January 21, 2016

Appendix C

Sampling design and weighting

Sampling

According to the design described in the methodology, explicit stratified selection with proportional allocation of units was conducted. Effective sample size of 2851 respondents was allocated according to regional distribution of subject teachers with subsequent simple random selection in each explicit strata. Table 1. presents the results of the selection procedure and respective proportions of target population by regions.

Table 1. Sample and population distributions of subject teachers by regions

region	population	sample
Akmolinskaya	13867 (4.4%)	127 (4.4%)
Aktubinskaya	16047 (5.1%)	147 (5.1%)
Almatinskaya	39222 (12.6%)	360 (12.6%)
Atyrayuskay	10445 (3.3%)	96 (3.3%)
VKO	20248 (6.5%)	186 (6.5%)
Almaty	17132 (5.5%)	157 (5.5%)
Nur-Sultan	9433 (3%)	87 (3%)
Shymkent	14851 (4.7%)	136 (4.7%)
Zhambylskaya	23914 (7.6%)	219 (7.6%)
ZKO	12687 (4%)	116 (4%)
Karagandinskaya	17933 (5.7%)	165 (5.7%)
Kostanayskaya	11812 (3.8%)	108 (3.7%)
Kyzylordinskaya	18469 (5.9%)	169 (5.9%)
Mangistauskaya	11966 (3.8%)	110 (3.8%)
Pavlodarskaya	11677 (3.7%)	107 (3.7%)
SKO	9862 (3.1%)	91 (3.1%)
Turkestanskaya	51104 (16.4%)	469 (16.4%)

Source: NEDB, 2020

The table above shows equal regional proportions of subject teachers in the sample and in the population. As was mentioned in the methodology stratified selection with proportional allocation leads to *epsem* design, where each respondent has equal probability of selection. In the sample above, each respondent has inclusion probability of 0.009. The base weight calculated as inverse of inclusion probability equals 109.18, or in other words, each subject teacher represents approximately 109 subject teachers in the population. The formula for calculating the base weight is the following:

$$w_b = \frac{1}{Pr_{incl}}$$

Fieldwork release contained 100% of the selected sample, thus, the base weights were not inflated. It should be noted, that though selection was conducted within each explicit stratum, nonetheless due to effective sample size calculation the precise analysis can be done only on rural urban level.

Weighting

No matter how carefully constructed each survey to some extent suffers from problems associated with non-response. Another problem may arise with assigning known eligibility status in cases where eligibility cannot be determined. One needs an elaborated strategy of multi-stage weighting in order to account for all potential sample deficiencies. In addition, a proper weighting strategy helps to turn results of the sample representative of the target population. For this particular survey a 4-step weighting strategy included adjustment for unknown eligibility, adjustment for non-response, post-stratification and extreme weights trimming.

Adjustment for unknown eligibility

Despite the scope of National Educational Data Base, so far there was no quantitative assessment of quality of NEDB indicators. For this reason, the IAC project team proposed to use the table of disposition codes[19]. According to the results disposition codes 12, 13, 14, 15 showed 260 cases with unknown eligibility. They included technical problems, no answer, other, maximum number of calls, maximum number of WhatsApp messages, and notification from local executive authorities. In order to handle these cases, total base weights of respondents with unknown eligibility were distributed among cases with known eligibility according to the following formula.

$$w_{ue} = w_b * \frac{KNE + NE + UE}{KNE}$$

Where KNE – known eligibility. NE – non-eligible and UE – unknown eligibility. Thus, the base weight of each respondent was multiplied by unknown eligibility adjustment factor.

Adjustment for non-response

---

[19] The American Association for Public Opinion Research. 2016. Standard Definitions: Final Dispositions of Case Codes and Outcome Rates for Surveys. 9th edition. AAPOR. (Disposition codes for online and telephone modes of survey). Retrieved from, https://www.aapor.org/AAPOR_Main/media/publications/Standard-Definitions20169theditionfinal.pdf

Disposition codes 02-11 showed 114 cases marked as non-response. The adjustment procedure included creation of non-response classes using information for respondents and non-respondents and cell weighing within each created class. Age and rural-urban were used to form non-response classes, with age being collapsed into 5 categories[20]. Thus, 10 classes were used for the non-response adjustment procedure and the weights were calculated according to the following formula

$$w_{nr} = w_{ue} * \frac{R + NR}{R}$$

Where R – respondents, NR – non-respondents. The weights adjusted for unknown eligibility were multiplied by non-response adjusted factor.

Apart from the cell weighting one can alternatively use propensity score adjustment[21] to model non-response. Instead of creating classes one must use auxiliary information available for both, respondents and non-respondents to model the response status. This can be done via logistic regression or classification tree algorithm, where dependent variable is the response status of the respondent and independent variables are vector of auxiliary information.

Auxiliary information used for propensity score modeling included age collapsed into five categories, rural urban and experience in years. Due to direct modeling of probabilities of response logistic regression with logit link function was used and the regression equation took the following form:

$$y(response) = \beta_0 + \beta_1(age) + \beta_2(rural_{urban}) + \beta_3(exp)$$

The results of modeling (table 2) indicated statistically significant negative impact of age on response status. More technically one category change of teachers age leads to -0.2911 coefficient of log odds of response status. Coefficients of rural-urban, teachers' category and experience did not show statistical significance.

Table 2. Results of the logistic regression model

```
Deviance Residuals:
    Min      1Q  Median      3Q     Max
-2.6810  0.2620  0.2842  0.3225  0.4872

Coefficients:
                              Estimate  Std. Error z value  Pr(>|z|)
(Intercept)                   3.676169  0.345561  10.638  <2e-16 ***
pool_phase_one$rural_urban2  -0.213535  0.194482  -1.098  0.2722
pool_phase_one$age_group     -0.291153  0.125692  -2.316  0.0205 *
pool_phase_one$category_num   0.165776  0.111392   1.488  0.1367
pool_phase_one$exp       -    0.002533  0.012293  -0.206  0.8368
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

(Dispersion parameter for binomial family taken to be 1)

    Null deviance: 933.65  on 2574  degrees of freedom
Residual deviance: 923.57  on 2570  degrees of freedom
```

[20] (1) – 18:25, (2) – 26:35, (3) – 36:45, (4) – 46:55, (5) – 56+

[21] For more detail on propensity score adjustment see, Valliant et al, 2013.

```
AIC: 933.57

Number of Fisher Scoring iterations: 6
```

Turning log odds into predicted probabilities and taking inverse, one obtains the actual non-response adjustment scores. Table 3 presents summary statistics of the cell weighting and propensity scores of the logistics regression. One can clearly observe that the difference in summary statistics between both approaches is negligible, though propensity scores have bigger maximum than the scores obtained vial cell weighting.

Table 3. Summary statistics of cell weighting scores and propensity scores

procedure	summary statistics
cell weighting scores	Min. 1st Qu. Median Mean 3rd Qu. Max. 1.017 1.034 1.048 1.048 1.058 1.079
propensity scores	Min. 1st Qu. Median Mean 3rd Qu. Max. 1.021 1.036 1.044 1.047 1.054 1.126

In order to continue weighting procedures both approaches are appropriate. However, presented with two equal alternatives the decision was made to continue with the simplest one. Thus, multiplying weights adjusted for unknown eligibility with the non-response factors calculated via cell weighting one obtains weights adjusted for non-response.

Post-stratification

The third stage of weighting contained calibration of sample totals to the population totals via post-stratification. Region crossed with age categories were used to form post-stratification classes. In order to reduce unnecessary variability and avoid empty cells, instead of five categories, age was collapsed into three categories[22]. This step reduced number of postsrtata classes from 85 to 51. In each poststrata population totals were divided by sample totals and then multiplied by weights adjusted for non-response.

$$w_{pstr} = w_{nr} * \frac{N}{n}$$

Table 4 presents summary statistics of the resulting calibrated weights. Obviously post-stratification introduces some variability into the weights and produces extreme values (maximum – 228.2)

Table 4. Summary statistics of calibrated weights

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
97.83	109.03	123.23	126.24	134.89	228.02

Weight trimming

[22] (1) – 18:35, (2) – 36:50, (3) – 51+

Extreme weights resulting from the phase of calibration can lead to biased estimates. In order to reduce their influence it is important to consider the phase of extreme weights trimming. In this particular case all weights larger than threshold of 2.5 standard deviation from the mean were trimmed to the threshold and their excessive values distributed among the respondents. Overall 24 respondents from Atyrau and Karaganda regions had their calibrated weights larger than the threshold value. Excessive amount of weights were distributed among the remainders.

Appendix D

Self-assessment: items coding

How do you rate your level of competency in the following ICT-supported tasks?

item	code
use a word processor	Q30.1
produce presentation slides	Q30.2
use a spreadsheet	Q30.3
store and organize files into folders	Q30.4
use the prescribed school administrative system NEDB	Q30.5
use electronic journal	Q30.6
read, write, and send emails	Q30.7
use chat applications and other social media applications	Q30.8
search for and access educational resources and tools online	Q30.9
evaluate the credibility of information on the web	Q30.10
evaluate the relevance of a digital application or content for a learning activity	Q30.11
download/install programmes and software	Q30.12
use videoconferencing applications	Q30.13
use collaborative online applications and folders	Q30.14
edit digital photographs or other graphics	Q30.15
create audio-visual materials	Q30.16
learn new ICT applications and tools on your own	Q30.17

Source: teachers questionnaire

How do you rate your level of competency in the following ICT-supported tasks?

item	code
incorporate multimedia elements (e.g. video, animation, or simulation) to support learning of concepts	Q31.1
conduct student practice drills through digital tools	Q31.2
use digital tools/games to engage student participation	Q31.3
engage students to share opinions through online polls, surveys, forums, blogs, and other social media	Q31.4
engage external experts via electronic means (emails, forums, videoconference, etc)	Q31.5
guide students in conducting online research	Q31.6
integrate ICT into teaching strategies that stimulate students' critical thinking, problem-solving skills, and creativity	Q31.7

organize collaborative activities/projects among students using various ICT tools	Q31.8
use online assessment strategies and tools	Q31.9
conduct peer or self-evaluation among students using online forms	Q31.10
discuss with students their online rights, safety, privacy, and ethical behaviour	Q31.11
use appropriate social networking sites for teaching purposes	Q31.12
use a variety of ICT applications/tools to communicate with parents, caregivers/guardians, and peers	Q31.13

Source: teachers questionnaire

How do you rate your level of competency in the following ICT-supported tasks?

item	**code**
access educational websites to stay up-to-date and enhance my skills	Q31.1
enroll in webinars and/or online courses	Q31.2
reflect on my own teaching practices	Q31.3
share ICT in education trends with peers and colleagues in your school	Q31.4
engage in a virtual community of practice with teachers from different schools	Q31.5
coach/mentor peers and colleagues on ICT in education practices	Q31.6

Source: teachers questionnaire

Appendix E

Scaling: social-desirability

Short form of Marlowe-Crowne social desirability scale consists of 13 binary questions presented below.

Item		
1. It is sometimes hard for me to go on with my work if I am not encouraged	Yes	No
2. I sometimes feel resentful when I do not get my way	Yes	No
3. On a few occasions, I have given up doing something because I thought too little of my ability	Yes	No
4. There have been times when I felt like rebelling against people in authority even though I knew they were right	Yes	No
5. No matter who I'm talking to, I'm always a good listener	Yes	No
6. There have been occasions when I took advantage of someone	Yes	No
7. I'm always willing to admit it when I make mistake	Yes	No
8. I sometimes try to get even rather than forgive and forget	Yes	No
9. I am always courteous, even to	Yes	No

people who are disagreeable.		
10. I have never been irked when people expressed ideas very different from my own	Yes	No
11. There have been times when I was quite jealous of the good fortune of others	Yes	No
12. I am sometimes irritated by people who ask favors of me	Yes	No
13. I have never deliberately said something that hurt someone's feelings	Yes	No

The scale was placed at the end of the questionnaire in the consecutive order. Because all questions were in binary form, polychoric correlation of items was used. R package *polycor*[23] provides a convenient way of calculating correlation matrix between binary items. Calculated matrix was used to test reliability and validity of the social desirability scale with further calculation of index values.

First step of establishing validity consisted of exploratory factor analysis. The analysis showed 1 factor with each factor loading larger than 0.5. Only 8 items out of 13 showed factor loadings higher than 0.5. The findings are presented in the table below.

Table 1. EFA results

items	factor 1	h2	uniqueness
It is sometimes hard for me to go on with my work if I am not encouraged	0.56	0.32	0.68
I sometimes feel resentful when I do not get my way	0.64	0.41	0.59
On a few occasions, I have given up doing something because I thought too little of my ability	0.55	0.30	0.70
There have been times when I felt like rebelling against people in authority even though I knew they were right	0.64	0.40	0.60
There have been occasions when I took advantage of someone	0.57	0.33	0.67
I sometimes try to get even rather than forgive and forget	0.51	0.26	0.74
There have been times when I was quite jealous of the good fortune of others	0.54	0.29	0.71
I am sometimes irritated by people who ask favors of me	0.54	0.30	0.70

[23] https://cran.r-project.org/web/packages/polycor/polycor.pdf

rotation – varimax estimator – minres proportion of variance – 0.33

Second step was conducted to check the results of EFA. Confirmatory factor analysis was used on the 8 items that constituted one factor structure presented in the table above. The standardized results of the CFA are presented in table 2 below.

Table 2. CFA results

items	factor 1	Std.err
It is sometimes hard for me to go on with my work if I am not encouraged	0.601	0.026
I sometimes feel resentful when I do not get my way	0.688	0.026
On a few occasions, I have given up doing something because I thought too little of my ability	0.566	0.028
There have been times when I felt like rebelling against people in authority even though I knew they were right	0.629	0.032
There have been occasions when I took advantage of someone	0.558	0.039
I sometimes try to get even rather than forgive and forget	0.492	0.037
There have been times when I was quite jealous of the good fortune of others	0.522	0.034
I am sometimes irritated by people who ask favors of me	0.525	0.032
CFI – 0.971 TLI – 0.960 RMSEA – 0.037 (upper – 0.045, lower – 0.029)		

Results confirm the factor structure with RMSEA equaling to 0.037, CFI – 0.971 and TLI – 0.960. All indicators show the results are sufficient to claim that the factor structure with 8 items can be used to report the phenomenon of social desirability.

The final step to check reliability is to calculate score of composite reliability. Unlike Cronbach Alpha, composite reliability is based on the factor loadings extracted from the confirmatory factor analysis. The resulting reliability score of the scale with 8 items with two correlated factors equals 0.797, which is considered to be an acceptable score.

Based on the results of the reliability and validity it became possible to properly calculate the index of social desirability as the mean value of teachers response scores.

Appendix F

Logistic regression: average time of ICT use during lesson (DV)

Table 1. Results of ordinal logistic regression

	variable	coefficient	p-value
socio-demographic	age	-0.020 (0.007)	0.014
	experience	-0.010 (0.007)	0.159
	education	0.125 (0.088)	0.157
	category	0.067 (0.063)	0.288
area	urban	0.359 (0.106)	7.38e-03
social-desirability	sdb	7.432 (0.320)	<2e-16
ICT policy development	particip. national level	-0.218 (0.082)	0.008
	particip. school level	0.080 (0.082)	0.325
ICT training	ICT training	0.139 (0.049)	0.004
	school ICT training	0.107 (0.057)	0.064
	intercept	-9.10	<2e-16

Null deviance: 3336.5 on 2406 degrees of freedom

Residual deviance: 2267.5 on 2396 degrees of freedom

AIC: 2289.5

Figure 1. ROC curve (upper left corner indicates better fit)