Data Collection Survey on Possibilities of Educational Support with ICT and Japanese Companies Promotion in Mongolia

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Japan International Cooperation Agency

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List of Abbreviations

ADB	Asian Development Bank
CDIO	Conceive, Design, Implement, Operate
CITA	Communications and Information Technology Authority
COMECON	Council for Mutual Economic Assistance
CRC	Communications Regulatory Commissions of Mongolia
ECD	Education Culture Department
EDIX	EDIX Educational IT Solution Expo
EFF	Extended Fund Facility
ERP	Enterprise Resources Planning
ESIS	Education Sector Information System
FDI	Foreign Direct Investment
GNI	Gross National Income
HDI	Human Development Index
HEMIS	Higher Education Management Information System
ICT	Information and Communication Technology
IITE	UNESCO Institute for Information Technologies in Education
IMF	International Monetary Fund
IT	Information Technology
ITPD	Institute of Teacher's Professional Development
JICA	Japan International Cooperation Agency
JOCV	JOCV Japan Overseas Cooperation Volunteers
JPY	Japanese Yen
KOICA	Korean International Cooperation Agency
MEA	NGO Mongolian Education Alliance
MECSS	Ministry of Education, Culture, Science and Sports
MIER	Mongolian Institute for Educational Research
MIT	Massachusetts Institute of Technology
MNT	Mongolian Tugrik
MNUE	Mongolian National University of Education
MOOC	Massive Open Online Course
MOSS	Mongolian Online Studying System LLC
MUST	Mongolian University of Science Technology
NGO	Non-Governmental Organization
NSO	National Statistical Office of Mongolia
NUM	National University of Mongolia

PISA	Programme for International Student Assessment
RGDP	Gross Domestic Products
RTT	Round Trip Time
TVET	Technical and Vocational Education and Training
UB	Ulaanbaatar
UNESCO	United Nations Education, Scientific and Cultural Organization
USD	United States Dollar
WB	World Bank

This survey uses JICA' monthly exchange rate as of March 2019.

1MNT＝0.04236JPY

Chapter 1 Overview of the Survey

1.1 Background and objectives of the survey

In education sector of Mongolia, many problems such as the lack of educational administrative capacity and undeveloped educational infrastructure came up following termination of the Soviet Union's aid as well as economic transition from socialist economy to capitalistic economy following the disintegration of the Soviet Union in 1991. Under such circumstances, 'New Education Law' (1993, 2003) was implemented with the aim of decentralization of power to shift managerial roles from central government to local government, which enlarged discretion and responsibility of teachers. Meanwhile, in 'Global Education Monitoring Report 2019' (2018) , United Nations Education, Scientific and Cultural Organization (UNESCO), it is pointed out that there is a gap of student academic abilities between urban areas and rural areas.

In 'Master Plan to Develop Education of Mongolia in 2006-2015' (2006), the government encourages active utilization of ICT in learning methods and pedagogy; 'Active Plan of Education in Mongolia' (2008) aimed to promote development of teacher training system and school facilities. In 2014, many international conferences that were organized by UNESCO Institute for Information Technologies in Education (IITE), Mongolian University of Science and Technology (MUST), Mongolia National University of Education (MNUE) and other institutes proposed facilitation of ICT such as application of ICT into teaching methods including collection of educational data and adoption of mobile learning. Introduction of ICT to education sector has been considered as one of the most effective methods to improve education quality. JICA Partnership Program 'Sustainable use of ICT for improving the quality of primary education in rural Mongolia' (we call shortly hereafter, TIT-JICA Partnership Program), which has been conducted in cooperation between JICA and Tokyo Institute of Technology from 2012, is coming to fruition. In recent years, with spread of smartphones, the internet penetration rate of Mongolia has exceeded 90%[1]. It is remarkable that a high school student in Ulaanbaatar achieved excellent results at edX[2] and entered Massachusetts Institute of Technology (MIT). In addition, a project about the internet infrastructure that started in 2013 by World Bank (WB) resulted in improvement of internet access in rural areas, which enables teachers in rural areas to receive training and to share teaching materials through telecommunication. Given recent startling development of ICT, analysis of big data accumulated through pupil/student learning activities is expected to lead to innovation of pedagogy or curriculum.

In this survey, based on the above-mentioned trends, we will report possible aid to

[1] Referred to White Paper 2017, Communications Regulatory Commissions of Mongolia

[2] A massive open online course (MOOC) provider created by MIT and Harvard University, which hosts a large variety of courses at no charge. https://www.edx.org/

Mongolian education sector using ICT, including prospective projects by Japanese academic-industrial-government cooperation focusing on the following three aspects.

i. online teacher training for remote areas
ii. improvement of teaching skills for science (teaching skills for experiment) as well as mathematics
iii. possibility of collection and analysis of big data towards curriculum development

1.2 Survey guidelines

For conducting this survey, the following three basic guidelines are adopted.

Table 1. Survey guidelines

Guideline 1	To study feasible support plans through investigation of Mongolia's development plans and policies on utilization of ICT and problems around the plans and policies.
Guideline 2	To gather fundamental and supportive information for business expansion of Japanese ICT enterprises in Mongolia so that the enterprises can draw new business plans in Mongolia.
Guideline 3	To accomplish high quality survey by taking full advantage of Asia SEED's resources and networks in Mongolia.

We aim at proposing viable and feasible support plan to solve problems in education sector in Mongolia taking account of Mongolian geographical features and current situation of infrastructure. First of all, in pursuit of this aim, it is necessary to grasp current situation of Mongolia. We scrutinize the latest documents and data published by the Mongolian government and international organizations to review Mongolian government policies, infrastructure development and situation of education sector. Then, we investigate feasible ICT services applicable to the situation of Mongolia via close examination of 'seeds' of educational services which are supplied by Japanese IT enterprises and via analyzing ICT policies in Mongolia. Meanwhile, we check aid plans of other donors to avoid overlapping and search a way of collaboration on aid with the donors. Regarding the part of information that is unclear, we confirm the information through the interview sessions in Mongolia.

Recently Japanese IT-related enterprises have started their business overseas: for example, in Indonesia, 'Recruit Marketing Partners Co., Ltd.', a Japanese company, has begun its business of online learning material 'Quipper'. We survey fundamental information about Japanese IT enterprises through interviews and questionnaires, study feasibilities of their business development overseas and clarify problems which the companies will face if they expand their

business to Mongolia hoping that our survey will be useful for Japanese ICT enterprises.

Since we have to conduct survey from many different angles with time restrictions, we consider the possible support measures of JICA as working hypothesis in preparatory activities in Japan, which we utilize the working hypothesis during our activities in Mongolia. We conduct our survey by utilizing information on Mongolian educational policy and by using contact network among Ministry of Education Culture, Science and Sports (MECSS) and educational institutions that Asia SEED has obtained through long experience of projects in Mongolia. Meanwhile, we ask for advices from Professor Shinobu YAMAGUCHI, Tokyo Institute of Technology, who has been conducting ICT educational development project in Mongolia and Associate Professors Yasuo TSUCHIMOTO, Yokohama College of Commerce, who is engaged in development of 'School on Internet Asia Project (SOI Asia Project)' with broad knowledge on educational application of IT.

Chapter 2 Current Outlook of Mongolia

2.1 Basic information

There are 3 million and 170 thousand people living in Mongolia of which area is 1 million 560 thousand km2, around 4 times of that of Japan. Mongolia, with population density 2 persons in 1 km2, is one of the most sparsely populated countries. In 2011, the increasing rate of the real gross domestic product (RGDP) is over 17% because of boost by foreign investment into mining development such as Oyu Tolgoi mine. Since that, the economic growth has slowed down. In 2015, the increasing rate of RGDP decreased to 2.4%. Main reasons for the economic turndown are sluggishness of foreign direct investment (FDI), low prices of natural resources in mining sector, shrinking export due to economic slowdown in China, which is the biggest importer from Mongolia, decrease of agricultural production owing to the inclemency of the weather3. In 2016, RGDP fell into 1.2% based on these serious situations, Mongolian government agreed to accept Extended Fund Facility (EFF) with International Monetary Fund (IMF), to tackle the reform on fiscal policies and banking policies. Mongolian economy has been elevated. Growth rate of RGDP became 6.9% in 2018.

Table 2. Basic information

Area	about 1,564,100km^2	Capital City	Ulaanbaatar
Population	3,177,899 (2017)	Population Density	2/km^2
Ethnic Groups	Mongols (95%) Kazakhs	Languages	Mongolian (official language)
Religions	Tibetan Buddhism	Mean Air Temperature	winter: -23℃, summer: ＋25℃
Government System	republican form (combination of presidential system and parliamentary cabinet system)	GDP	3,779USD (2017)
Main Industries	agriculture and mining	Mineral Resources	copper, coal, molybdenum

(Made by the survey team)

Mongolia consists of Ulaanbaatar, capital, and 21 provinces. The province is called ‘aimag’

[3] JICA Mongolia Business Environment Guide 2017
https://www.jica.go.jp/mongolia/office/activities/environment_guide/index.html

in Mongolian. A subdivision of aimag is 'sum' (district), and a subdivision of sum is 'bag' (village).

The Mongolian population is increasing. The population was about 2,620,000 in 2007: about 2,810,000 in 2011. In 2017 the population reached about 3,170,000. Especially, the population of the generation of 5~24 years, which is the main target of educational service, has been floating over 1 million from 2013 to 2017 (Table 3).

Table 3. Population of 5~24 years (2013～2017)

Age	2013	2014	2015	2016	2017
5-24	1,034,712	1,018,029	1,025,894	1,034,548	1,051,893

(Made by the survey team referring to National Statistical Office of Mongolia)

2.2 Educational situation

2.2.1 Development policy in Mongolia

'Mongolian Sustainable Development Vision in 2030' published in 2016 which shows the long term development plan decides 10 targets; 1) to improve per capita GNI to 17,500USD to become a middle income country, 2) to maintain annual economic growth rate more than 6.6%, 3) to eradicate poverty, 4) to improve inequality of income, 5) to rise enrollment rate of primary education and job training to 100% and to promote lifelong learning, 6) to improve living environment and life expectancy, 7) to place more than 70 in Human Development Index (HDI), 8) to place more than 30 in Global Green Economy Index, 9) to place more than 40 in 'Doing Business Index' within Global Competitiveness Index, 10) to improve governance of government. These goals become development guidelines of Mongolia until 2030. Development plan for each sector is divided in 5 years from first phase to third phase and more detailed target is set.

According to the "Mongolia Sustainable Development Vision in 2030", five items; 1) improvement of pre-school education, 2) introduction of Programme for International Student Assessment (PISA) [4] and improvement of educational environment, 3) improvement of vocational schools, 4) ranking in top universities in Asia, 5) increase of investment in science and technology field; are set as goals from 2016 to 2030. The details are as follow.

1) Improvement of pre-school education: To enable all children to enter pre-schools and make an environment to learn culture and language of Mongolia is the first goal and 3 stages of development policy are formulated. In the first phase from 2016 to 2020, it is targeted to expand the pre-school, maintain the infrastructure, and improve education which enables 70% of children to enter the pre-school. During the second phase from 2021 to 2025, it is targeted to continue the improvement of quality and quantity of pre-schools and arrange one teacher for 25 children which enables 80% of children to learn at pre-school. Arrangement of one teacher out of 20 children and

[4] PISA: an international evaluation of learning achievement studied by OECD testing 15-year-old school students on performance of reading, mathematics and science. 36 countries with OECD membership and more than 50 counties without the membership are expected to join the test in 2021.

90% of children to enter pre-schools is the target for 2026-2030. Improvement of environment for pre-schools is one of the important plans in education sector.

2) Introduction of PISA: In the first phase from 2016 to 2020, it is targeted to prepare for the introduction of PISA, to construct the educational environment for two-shift system (from three-shift system at present), to change three-shift system schools into two-shift system schools, to develop the appropriate educational system for nomadic life, and to offer high school education by excellent teachers. During the second phase from 2021 to 2025, it is targeted to implement PISA, to reduce two-shift system down to overall 50%, and to decrease number of student to 25 in one class. In the last third phase, improvement of PISA score, installation of laboratory and experimental equipment in school, reduction of two-shift system down to 30%, and decreasing students number to 20 in one class are presented. The important point for the second goal is the introduction of PISA, reduction of schools which apply three-shift system, decreasing students number in a class, and installation of laboratory and experimental equipment.

3) Improvement of vocational schools: In order to satisfy the human resource needs from industrial sector, from 2026 until 2030, it is targeted to improve the education system as well as ability of teachers and to increase the number of students in the first and second phase.

4) Ranking in top universities in Asia: The vision aims at raising the higher education to international level from 2016 until 2020, and setting three pillars of higher educational institutions as i) education, ii) research, iii) industry. During the second phase from 2021 to 2025, it targets establishment of the cluster or park of science and technology in development area of Mongolia and achieve 4 universities of Mongolia to become top universities in Asia. Construction of educational system to cultivate students who have sufficient knowledge and skills to be competitive in the world is planned from 2026 to 2030.

5) Increase of investment in science and technology field: In pursuit of facilitation of cooperation with industrial enterprises, in the first phase, it targets enlargement of the industry-university collaboration and innovation and to pump 2% of GDP as investment into science and technology. The investment into science and technology is targeted to increase to 2.5% of GDP in the second phase, and it is targeted to increase 3% of GDP in the third phase.

Next, this report refers to the “Action Program of the Government of Mongolia 2016-2020”. Action Program is the mid-term development plan formulated along with Sustainable Development Vision in 2030 and it indicates detailed policies to achieve Sustainable Development Vision in 2030:

- development of system to allow enrollment to primary school from 6 to 8 year old depending on living conditions
- improvement of dormitory for primary education
- implementation of “Every Child in a Kindergarten” to improve enrollment rate of pre-school

- transition from three-shift system to two-shift system
- provision of free public transportation for secondary school students
- improvement of method and criterion for educational evaluation
- establishment of educational standard along with international standard and tradition, culture, and history of Mongolia
- implementation of career support education for pre-university students
- introduction of policy for high quality evaluation of university education
- promotion of university to focus on research
- improvement of private investment for research activity at university
- increase of bachelor's degree, master's degree, and doctor's degree graduates through study abroad
- promotion of system for lifelong education utilizing information technology

Various policies have been implemented for ICT utilization in education. "ICT Vision 2010" issued by Mongolian government in 2000 aims the construction of Knowledge-based society and encourages the utilization of ICT in education sector; specifically, 1) introduction of ICT education in curriculum of every education level in order to improve the basic ability of ICT, 2) provision of equipment, 3) teacher training to utilize ICT for development of self-ability, 4) construction of educational information database. 'The ICT Vision 2015 in Education Sector of Mongolia' published by Ministry of Education in 2006 indicates to introduce the ICT in the secondary school curriculum, to increase number of computer per students from 2010 to 2015, and to implement teacher training to adopt ICT in class. Introduction of ICT in schools in rural area, arrangement of internet connection in schools, utilization of ICT for capacity building of teachers, provision of teacher training to utilize television and internet in the class, and utilization of software for students' evaluation and analysis are indicated in the 'Master Plan to Develop Education of Mongolia in 2006-2015' published by Mongolia government in the same year 2006.

In addition, according to the interview of Communications and Information Technology Authority (CITA), "National Program" was approved by cabinet meeting on 20 February, 2019 and provision of education to everyone through ICT was clearly indicated as future policy. To be specific, ICT will be utilized in education in rural area, lifelong education, programming, and training. National Program is planned to be implemented for 4 years. [5]

Utilization of ICT in education sector of Mongolia is consistently encouraged by government as explained above.

[5] Detailed action plan is expected to be drawn up before long

2.2.2 Education system in Mongolia

The basis of current education system in Mongolia was developed over 70 years of the Socialist era since the independence from Chinese Qing Dynasty until the 1990s, under the strong influence of the former Soviet Union. In the era, Mongolia successfully developed modern education system due to the support from the former Soviet Union despite the postwar chaos. As a result of the government's ownership of the whole education sector, schools and school dormitories were developed at places where children could commute from any place in the vast land of Mongolia. In addition, education was provided free of charge from primary to higher education, which is an unimaginable system from current educational situation in Mongolia. These have very important meaning as a legacy of socialism and have produced a very high literacy rate of 97% in Mongolia.

At the peak of relations between Mongolia and the Soviet Union in the Socialist era, the Soviet Union subsidized a third of Mongolia's GDP and such huge financial assistance made it possible for the Mongolian Government to invest in public sectors including the education sector. It was reported that the government had spent 17.6% of its budget for education, which was 11.3% of GDP, until the late 1980s.

However, the education system of Mongolia was exposed to a sudden change with the collapse of the former Soviet Union in the early 1990s. Financial assistance from the Soviet Union was suspended and the trade was stopped due to the abolishment of Council for Mutual Economic Assistance (COMECON) which pushed Mongolia down to one of the poorest countries in the world. The expenditure on education in 2003 was reduced down to 3.8% of GDP. As a result, various problems occurred including shortage of teachers, lack of facilities, and increase of dropouts from schools due to poverty. But it is noteworthy that, even in such situation, Mongolia managed to minimize the decrease in literacy and school enrollment rates.

Upon entering the second half of the 1990s, GDP growth had turned positive, and the new government had made educational reforms one after another. Especially after 1996, the government accelerated the educational reform mainly by getting assistance from Asian Development Bank (ADB).

Reform of primary and secondary education in Mongolia was launched in the early 1990s. Due to collapse of the centralized administration, it was directed toward more decentralization and strengthening of school autonomy, accompanied by renewal of curriculum and establishment of private schools. The concept of the new Education Law of 1991 was confirmed in the new Constitution of 1992 where human rights, freedom, an open market system, pluralism of political parties, and participation were proclaimed. The first 'Education Sector Master Plan (1994)' was developed with the technical assistance of ADB to enhance basic and general education, strengthens the administration of the central government, and provides education for eradication

of poverty. In 1995 the Education Law was differentiated into Fundamental Law of Education, Primary and Secondary Education Law, and the Higher Education Law. In 1996, the 'Education Sector Development Program' was formulated with the support of ADB. Based on this development program, the 'Government Basic Instructions' was issued in 1997 and this led to the establishment of goals along the framework of sustainable development and education for all. In addition, with the 'Mongolia Education Sector Strategy (2000-2005)' in 1999, donor countries and international agencies provided assistance for education sector by sector-wide approach: revision of the school curriculum and methodology was focused on shifting from an academic-focused instruction to practical-oriented one, and change to a student-centered teaching.

While Mongolia had adopted a 5-3-2 year system or a 10-year system following Soviet Union's education system, it changed the system to a 5-4-2 type or an 11-year system in 1999 and then shifted it to a 5-4-3 type or a 12-year system from 2015. The school year starts in September.

Secondary education in the 12-year system is divided into two respective programs: Compulsory Lower Secondary Education and Upper Secondary Education. In secondary education, at the primary and secondary education, it is still commonly seen that the Soviet-style ordinary school, which is a combination of primary school, junior high school and senior high school. From 2010, measures to alter curriculum of primary and secondary education to meet international standards have been employed and core curriculum designed after several countries' curriculum is introduced. The subjects delivered in primary and secondary education is shown below (Table.4~6).

Higher education has been provided at universities, institutes and colleges. The colleges can offer diploma programs of three years or bachelor degree programs. The bachelor degree programs at the universities require four to five years, the master programs require one to two years and the doctoral programs require three to four years. (Note that medical courses require six years.)

Table 4. Subjects in Primary school

No	Subject	No	Subject
1	Preparation Course	8	Music
2	Mongolian Language	9	Physical Education
3	Mathematics	10	Health
4	Human and Environment	11	English
5	Human and Society	The period of integrated study[6]	
6	Human and Nature	12	Civic education (Moral Education)
7	Art, Technology	13	Extracurricular Activities

(Made by the survey team referring to MECSS, annex1 of Minister decree №A/ 453 2018.07.09)

[6] 総合的な学習の時間

Table 5. Subjects taught in junior high school

No	Subject	No	Subject
1	Mongolian Language	12	Art
2	Traditional Writing	13	Music
3	Literature	14	Drawing
4	Mathematics	15	Technology
5	IT	16	Physical Education
6	Physics	17	Health
7	Biology	18	English
8	Chemistry	19	Russian
9	Geography	The period of integrated study	
10	History	20	Civic education (Moral Education)
11	Society	21	Extracurricular Activities

(Made by the survey team referring to MECSS, annex1 of Minister decree №A/ 453 2018.07.09)

Table 6. Subjects taught in high school

No	Subject	No	Subject	
1	Mongolian Language	Compulsory Elective subject		
2	Traditional Writing	19	Language	Mongolian Language and Traditional Writing
3	Literature	20		Literature
4	Mathematics	21		English
5	IT	22		Russian
6	Physics	23	Math	Mathematics
7	Chemistry	24	Natural Science	Biology
8	Biology	25		Physics
12	Mongolian History	26		Chemistry
13	Social Science	27	Social Science	Mongolian History
14	Geography	28		Social Science
15	English/Russian	29		Geography
16	Physical Education	30		Business
17	Health	31	The period of integrated study	
18	Design, Drawing, Technology	32	Design Technology	Civic Education (Moral Education)
		33		Extracurricular activities

(Made by the survey team referring to MECSS, annex1 of Minister decree №A/ 453 2018.07.09)

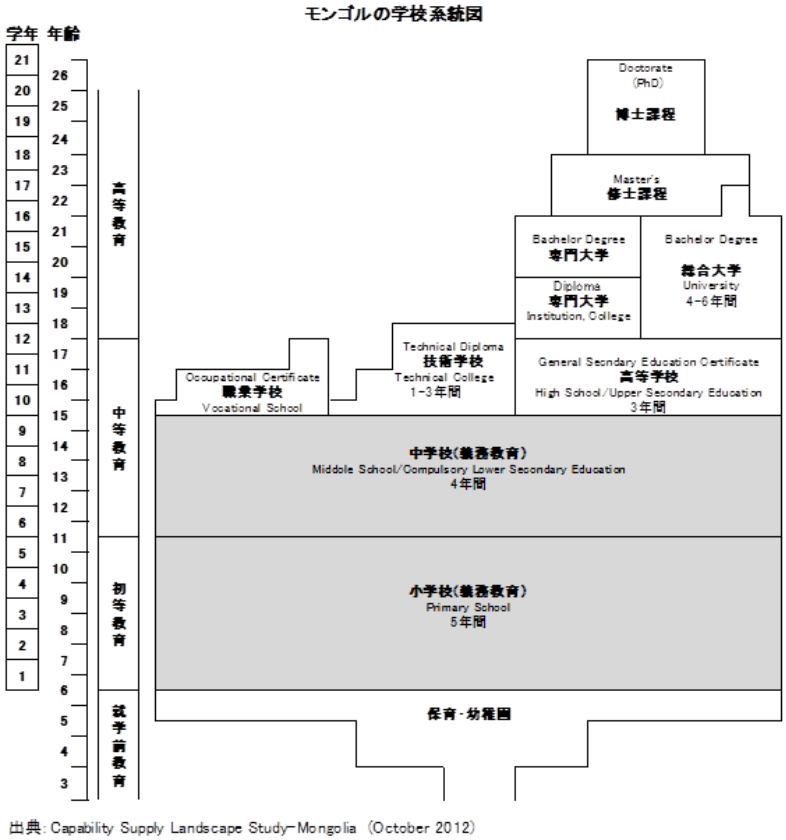


Figure 1. Mongolian school system diagram for 12-year system

2.2.3 Educational administration system in Mongolia

Article 16 of the Constitution of Mongolia (1992) assures the right to education of the public and provision of free basic education. In addition, the Education Law 2002 stipulates that the goal of education is to develop the people's ability to learn, work and live on their own by providing proper intellectual, moral and realistic skills based on the principles of humanism. As basis of educational administration, five acts for education were enacted in 2002: the Education Law, the Higher Education Law, the Primary and Secondary Education Law, Technical and Vocational Education and Training Law, and Pre-school Education Law.

MECSS administers education and roles of MECSS are regulated by laws. Basically, all public education is under the jurisdiction of MECSS and its roles are as follows:

- to ensure to organize the implementation of legal service of the whole country on education
- to develop a comprehensive and appropriate system of education for all (including non-formal education)
- to coordinate activities of organizations in accordance with the provision of training and support for various programs

- to provide training to all personnel of the organization relating to education, and move forward issues related to social benefits of teachers

Therefore, the administrative guidance and financial support to the public and private educational institutions of the country, related policy formulation, approval of curricula and textbooks, and control of schools and national universities are executed by MECSS. We note that the expenses for schools are borne by MECSS, including budgets that can be within discretion of school principals.

2.2.4 Statistics in education

According to Mongolian Statistical Yearbook 2017 published by National Statistics Office of Mongolia (NSO) in 2017, there are 798 schools established including all public and private primary schools, junior high schools and senior high schools in Mongolia now (652 are public whereas 146 private). The number of higher educational institutions categorized into universities, technical colleges or vocational schools is 179. There are 1,416 pre-schools.

The latest statistics as of 1st February, 2019 says that the number of all public and private primary schools, junior high schools and senior high schools is 803.

Table 7. Number of educational institutions

Level	2015	2016	2017
Pre-schools	1,288	1,354	1,416
Primary and secondary (primary, junior high and senior high)	768	778	798
Higher education	181	181	179

(Made by the survey team referring to NSO, Mongolian Statistical Yearbook 2017)

Especially, the transition of school number of primary and secondary school is shown in the following table. It is found that school number is slightly increased with student number is increased.

Table 8. Number of primary and secondary school by area/type

Indicator		School year						
		2012-2013	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018	2018-2019
School		**755**	**756**	**762**	**768**	**778**	**798**	**803**
Type of ownership	Public	621	628	628	636	645	652	656
	Private	134	128	134	132	133	146	147
Location	Urban	207	203	214	215	226	241	245
	Rural	548	553	548	553	552	557	558

(Made by the survey team based on public data of MECSS)

Detailed information of school and student number in each province is shown in Table. 9.

Table 9. Number of school, student, teacher, dormitory by education system in each province (2018-2019)

№	Prefecture center, UB	General education school																												
		School			School /public and private/					Number of pupils									Teachers /public, private/	Of which		Number of Public school			Dormitories	Of which		Pupils live in dormitory
			Үүнээс:							In public school		In Private school		Total		Of which												
		Total	Public	Private	Total	Primary	Middle	High	Complex school	Total	female	Total	female	Total	female	Primary	Middle	High		Primary	Middle	Total	Primary	Middle		Public	Private	
Total		**803**	**656**	**147**	**803**	**80**	**115**	**563**	**45**	**553562**	**276238**	**39588**	**19320**	**593150**	**295558**	**327019**	**184017**	**82114**	**30411**	**10736**	**19675**	**27615**	**9697**	**17918**	**522**	**511**	**11**	**34706**
1	Arkhangai	33	30	3	33	5	5	23		17,078	8,671	113	54	**17191**	**8725**	9,086	5,436	2,669	**988**	328	660	**967**	325	642	31	31		2,255
2	Bayan-Ulgii	43	37	6	43	16	3	23	1	20,674	10,564	2,518	1,167	**23192**	**11731**	11,025	7,887	4,280	**1537**	538	999	**1395**	511	884	48	45	3	4,247
3	Bayankhongor	30	29	1	30	5	11	13	1	16,109	8,168	113	49	**16222**	**8217**	9,126	5,196	1,900	**886**	313	573	**880**	307	573	27	27		1,663
4	Bulgan	22	22		22	2	5	14	1	10,006	4,923			**10006**	**4923**	5,407	3,133	1,466	**582**	213	369	**582**	213	369	26	26		1,775
5	Govi-Altai	28	27	1	28	4	3	20	1	11,279	5,590	112	58	**11391**	**5648**	5,735	3,744	1,912	**715**	256	459	**711**	252	459	29	29		1,383
6	Dornogovi	22	21	1	22	1	10	11		12,805	6,424	204	94	**13009**	**6518**	7,279	4,202	1,528	**629**	228	401	**618**	225	393	17	17		785
7	Dornod	26	23	3	26	1	7	16	2	14,936	7,409	438	222	**15374**	**7631**	8,664	4,738	1,972	**798**	280	518	**761**	261	500	24	24		915
8	Dundgovi	19	19		19		11	6	2	7,984	3,978			**7984**	**3978**	4,182	2,689	1,113	**505**	166	339	**505**	166	339	17	17		921
9	Zavkhan	30	30		30		9	19	2	14,532	7,220			**14532**	**7220**	7,488	4,751	2,293	**900**	278	622	**900**	278	622	26	26		1,358
10	Uvurkhangai	30	29	1	30	4		24	2	21,508	10,882			**21508**	**10882**	11,333	7,092	3,083	**1136**	400	736	**1136**	400	736	34	34		2,022
11	Umnugovi	21	21		21		9	12		12,109	6,087			**12109**	**6087**	6,982	3,682	1,445	**634**	220	414	**634**	220	414	19	19		881
12	Sukhbaatar	16	16		16		7	9		11,565	5,770			**11565**	**5770**	6,380	3,565	1,620	**576**	209	367	**576**	209	367	16	16		953
13	Selenge	34	33	1	34	1		33		18,659	9,165	395	209	**19054**	**9374**	10,536	5,919	2,599	**1028**	369	659	**1007**	363	644	20	20		1,197
14	Tuv	31	30	1	31	1	9	20	1	15,213	7,399	43	19	**15256**	**7418**	8,646	4,830	1,780	**821**	325	496	**816**	320	496	33	33		2,089
15	Uvs	30	28	2	30	6	7	15	2	17,478	8,894	172	72	**17650**	**8966**	9,230	5,506	2,914	**1028**	364	664	**1017**	354	663	37	37		3,074
16	Khovd	25	25		25			23	2	18,590	9,172			**18590**	**9172**	9,628	5,911	3,051	**1029**	329	700	**1029**	329	700	22	22		1,859
17	Khuvsgul	36	35	1	36	4		29	3	26,157	13,138	131	65	**26288**	**13203**	13,991	8,390	3,907	**1456**	474	982	**1435**	469	966	39	39		3,549
18	Khentii	26	25	1	26	1	15	7	3	14,265	7,106	119	64	**14384**	**7170**	7,674	4,617	2,093	**757**	286	471	**751**	280	471	26	26		1,337
19	Darkhan-Uul	26	17	9	26	1		23	2	18,104	8,955	1,922	1,017	**20026**	**9972**	10,850	6,430	2,746	**1055**	332	723	**885**	288	597	7	6	1	627
20	Ulaanbaatar	242	134	108	242	27	3	192	20	232,104	115,620	31,308	15,228	**263412**	**130848**	150,949	78,565	33,898	**12051**	4,455	7,596	**9842**	3,585	6,257	16	12	4	1,455
21	Orkhon	24	17	7	24	1		23		18,133	8,980	1,708	850	**19841**	**9830**	10,806	6,068	2,967	**1035**	304	731	**916**	278	638	3	2	1	204
22	Govisumber	5	5		5		1	4		3,446	1,735			**3446**	**1735**	1,889	1,109	448	**186**	64	122	**186**	64	122	3	3		132
23	Other	4	3	1	4			4		828	388	292	152	**1120**	**540**	133	557	430	**79**	5	74	**66**		66	2		2	25
Of which	**Urban**	**246**	**137**	**109**	**246**	**27**	**3**	**196**	**20**	**232,932**	**116,008**	**31,600**	**15,380**	**264532**	**131388**	**151,082**	**79,122**	**34,328**	**12130**	**4,460**	**7,670**	**9908**	**3,585**	**6,323**	**18**	**12**	**6**	**1,480**
Of which	**Rural**	**557**	**519**	**38**	**557**	**53**	**112**	**367**	**25**	**320630**	**160230**	**7988**	**3940**	**328618**	**164170**	**175937**	**104895**	**47786**	**18281**	**6276**	**12005**	**17707**	**6112**	**11595**	**504**	**499**	**5**	**33226**

Other* means Mongolian schools in Korea, the schools which implemented Cambridge curriculum. Urban* includes the indicator other*

(Made by the survey team based on public data of MECSS)

As of 2017, the number of students in primary and secondary education is about 760,000; the number of students at higher educational institutes such as universities is 190,000. There are about 250,000 children going to pre-schools.

Table 10. Number of learners belonging to each educational institution

Level	2015	2016	2017
Pre-schools	225,388	243,432	256,720
Primary and secondary (primary, junior high and senior high)	535,100	552,000	572,000
Higher education	206,400	198,600	192,400

(Made by the survey team referring to NSO, Mongolian Statistical Yearbook 2017)

Especially, the statistics of student number of primary and secondary education by sex, new entrant and school

Table 11. Student number of primary and secondary education (new entrant, sex, school)

Indicator		School year						
		2012-2013	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018	2018-2019
Pupils		**496,123**	**497,022**	**505,816**	**535,055**	**551,953**	**572,752**	**593,150**
Sex	female	248,974	248,960	253,505	269,384	277,047	286,014	295,558
	male	247,149	248,062	252,311	265,671	274,906	286,738	297,592
Total number of pupils	New entrants to general education school	48,092	55,972	62,366	66,048	62,245	68,238	72,247
	number of disabled child	16,373	16,197	11,072	9,143	8,362	7,279	6,518
	herder's children	118,145	112,097	109,599	96,810	104,530	109,618	114,198
Public school		467,918	468,370	476,676	504,070	520,201	537,740	553,562
Sex	female	235,183	235,040	239,235	254,223	261,552	268,972	276,238
	male	232,735	233,330	237,441	249,847	258,649	268,768	277,324
Private school		28,205	28,652	29,140	30,985	31,752	35,012	39,588
Sex	female	13,791	13,920	14,270	15,161	15,495	17,042	19,320
	male	14,414	14,732	14,870	15,824	16,257	17,970	20,268

(Made by the survey team based on public date of MECSS)

Following pie chart shows age distribution of teacher. 80% of teacher is female, and 63% of teacher is age of up to 39 years old after graduating university.

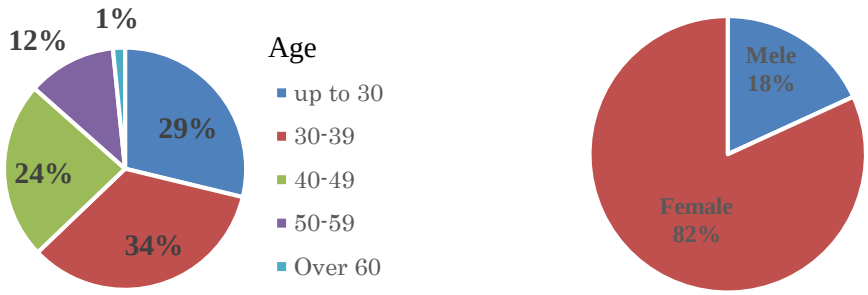


Figure 2. Age distribution and percentage of male and female of teacher in 2018
(Made by the survey team based on public data of MECSS)

The number of children/students has been increasing year by year: the increment from 1990 to 2017 is about 250,000. In primary and secondary education, the teacher-student number ratio (average of the number of students taught by one teacher) is 19.6 in 2017 but the ratio comes to 30.2 if we look into only primary schools. According to 'Statistical Abstract (Education, Culture, Sports, Science and Technology)' published by Ministry of Education, Culture, Sports, Science and Technology, Japan, the teacher-student number ratio in Japanese primary schools is 15.4, which means a teacher in Mongolian primary schools teaches double number of pupils compared with a teacher in Japan. Less number of teachers to students in Mongolia is supposed to be one of the reasons of heavy burden of Mongolian teacher's work. We hear from an NGO, Mongolian Education Alliance for Education that one teacher teaches around 40~60 pupils/students at some schools in Ulaanbaatar and other cities. Indeed, the number of schools falls short of necessity in city areas, and most of the schools adopt two-shift or three-shift system.

Table 12. The number of pupils for one teacher at primary schools in each province

Area/Province	2015	2016	2017
National Average	27.5	28.9	30.2
Western region	22.0	22.8	23.8
Bayan-Ulgii	18.9	19.3	19.9
Govi-Altai	21.8	21.4	21.8
Zavkhan	25.1	25.4	26.5
Uvs	21.6	23.7	25.2
Khovd	25.3	26.5	28.2
Khangai Region	26.5	27.5	28.8
Arkhangai	24.5	26.1	27.0
Bayankhongor	25.6	26.6	28.6
Bulgan	24.0	24.7	25.6

Orkhon	31.4	31.6	33.7
Uvurkhangai	26.7	27.5	27.8
Khuvsgul	26.5	27.8	29.1
Central Region	26.7	28.4	29.1
Govisumber	28.3	29.0	31.1
Darkhan-Uul	30.2	31.2	31.7
Dornogovi	28.8	30.0	31.2
Dondgovi	23.0	23.5	24.4
Umnugovi	27.4	29.6	30.3
Selenge	25.8	28.1	28.0
Tuv	23.9	26.7	27.3
Eastern Region	25.6	28.1	29.0
Dornod	26.8	29.1	29.9
Sukhbaatar	27.4	29.7	30.4
Khentii	23.4	26.0	27.0
Ulaanbaatar	31.4	32.7	34.4

(Made by the survey team referring to NSO, Mongolian Statistical Yearbook 2017)

The following table shows time per day for a student at primary schools, junior high schools or senior high schools to spend for homework (Table. 13). Teaching materials which students use for their homework are mainly textbooks. We find through our survey conducted in Dundgovi Province that rural areas do not have educational environments for student self-teaching like after-school study centers: students in rural areas do their homework at school dormitory or home or study using teaching materials that their guardians buy for self-teaching. An online teaching material 'Suraad', which we will mention in Chapter 4, is such self-teaching. We confirmed that Mongolia is in a situation that digital teaching materials are suitable for home learning.

Table 13. Time for homework according to school stages

Time	Primary School	Junior High School	Senior High School
1～2 hours	63.6%	38.2%	33.5%
2～3 hours	19.5%	40%	39.5%
4 hours or more	15.2%	21.7%	26.6%

(Made by the survey team referring to Mongolian Institute for Educational Research (MIER)'s report[7])

The following table shows monthly income of guardians of students at each school stage.

Table 14. Percentage distribution of monthly income of a guardian for each school stage

[7] Survey was conducted for Primary, Junior High and Senior High School by MIER. This report is targeted Administrative Manager in Education of Ulaanbaatar, aimug center and sum, teacher, 598 persons of primary school students, 471 persons of junior high school students, 433 persons of high school students and their guardians.

Monthly Salary of a Guardian	Primary School	Junior High School[8]	Senior High School[9]
100,000MNT (4,236JPY)	6.3%	-	4.1%
100,000~300,000MNT (4,236~12,708JPY)	18.7%	17%	13.5%
300,000~500,000MNT (12,708~21,180JPY)	15.1%	19.7%	14.4%
500,000~800,000MNT (21,180~33,888JPY)	15.1%	20.6%	14.7%
800,000~1,000,000MNT (33,888~42,360JPY)	14.2%	8.3%	17%
1,000,000~2,000,000MNT (42,360~84,720JPY)	20.9%	15.7%	27.4%
2,000,000MNT or more (84,720JPY or more)	7.2%	5.3%	8.9%

(Made by the survey team referring to MIER's report)

The private tutoring services are also provided in Mongolia. Additionally, we researched several private tutoring services which are existing in Ulaanbaatar by telephone. Their target customers and monthly fee are listed below. "Day Care service" is providing pick-up service from school, homework supports, and providing meal. "Focused on specific subjects" is providing learning support on specific subjects such as Mathematics and Mongolian language. "Entrance Exam" is focusing on studying for entrance examination of the university. Moreover, there are also the private teacher services.

Table 15. Private Tutoring Services in Ulaanbaatar

[8] 6.4% of questionees responded no answer
[9] 3.5% of questionees responded no answer

No	Type	Name	Subject name	Target age	Frequency (per week)	Tuition (hour)	Tuition (month)	Location
1	**Day care service (Homework, lunch etc.)**	Erdem center	Math, Physics, Mongolian language	math:1-12th grade physics: 6-12 grade	every work days	-	180,000	Mongol 3r surguuli, Astra center 1149
2		Nomun center	Math, Mongolian+IQ	4-10 years old	every work days	-	300,000	Sukhbaatar district, 2nd khoroo, BLDG #44
3		Otgon day care center	Math, Mongolian language	1-5th grade	5 days	-	200000	Sukhbaatar district, 8th BLDG
4	**Focused on specific subjects**	Effort Az	Math, Geometric		2 times	-	200,000 (40 hours)	-
5		Flamingo center	Natural science	5-9th grade	3 times	-	130,000 (per subject) 200,000 (2 subjects)	Sukhbaatar district, 1st khoroo, DHL center 6F
6		Shine Ireedui center	Math, Physics	5-12th grade	3times	-	180,000 (per subject)	Sukhbaatar district, Erdem tower
7		Sod-Erdem	Mongolian language	1-12th grade	3 times	-	130,000	Bayangol district, 10th khoroolol, Sod center 413
8		Erdmiin khurd center	Math, Physics, Mongolian language		3times 5 times	-	120,000 180,000	Tsetsee gun office center #300
9		Mongol chanar center	All subjects	1-2th grade	3 times	-	250,000	Songinokhairhan district, 1st khoroolol, Tse center 2F
10	**Entrance exam**	Golden Ocean center	Natural science and Social science subject	mainly 12th grade	3-5 times	-	300,000	Bayanzurkh district, 13th khoroolol, Och center 504
11		Happy education center	All subjects for entrance exam	12th grade	3-6 times	-	100,000 (per subject)	Sukhbaatar district, Idet tower 8F
12		Ikh-Undraga Smart Edu	Mongolian language Math, Physics, English	mainly 12th grade	3 times(per subj)	-	200,000 (per subject)	Bayanzurkh district, 13th khoroolol, Channel center #410

(Made by the survey team)

2.2.5 Projects related to education by donors of other countries or NGOs in Mongolia

1) ADB

ADB started its aid to Mongolia in 1991 and set up Ulaanbaatar Office in 1994. The total amount that ADB spent in 2017 reached 330 million USD. There are 30 members of staff working at the office in Ulaanbaatar. Regarding educational areas, from 2006 ADB has been conducting support in making Education Sector Master Plan and now is drawing the latest Education Sector Master Plan.[10] Regarding ICT, ADB affords support to the Mongolian Government for improvement of ICT instruments and infrastructure of Mongolian Tax Authority, which is under a scheme 'Strengthening Information and Communication Technology Systems for Efficient and Transparent Public Investment and Tax Administration Project'[11]. Regarding educational sector, ADB conducts support activities for higher education: Higher Education Reform Project[12] from 2012. The main objective of the project is improvement of governance, finance and management in higher education areas. So far, 8,521 persons of administrators, managers, specialists in higher

[10] ADB: Mongolia: Supporting the Development of and Education Sector Master Plan
[11] Strengthening Information and Communication Technology Systems for Efficient and Transparent Public Investment and Tax Administration Project, https://www.adb.org/projects/51084-001/main
[12] Higher Education Reform Project: https://www.adb.org/projects/43007-023/main#project-pds

education, professors and staff members at MECSS, MCEA[13], or higher educational institutes have joined training sessions or workshops to develop their abilities. Introduction of CDIO[14] to MUST is also under this project: in 2016, instruments for distance learning were given to five higher educational institutes, e-learning.edu.mn[15] was developed, the distance learning center was set up at Mongolian State University of Education, and Higher Education Information System (HEMIS) was developed[16]. Moreover, ADB conducts a project for TVET development[17].

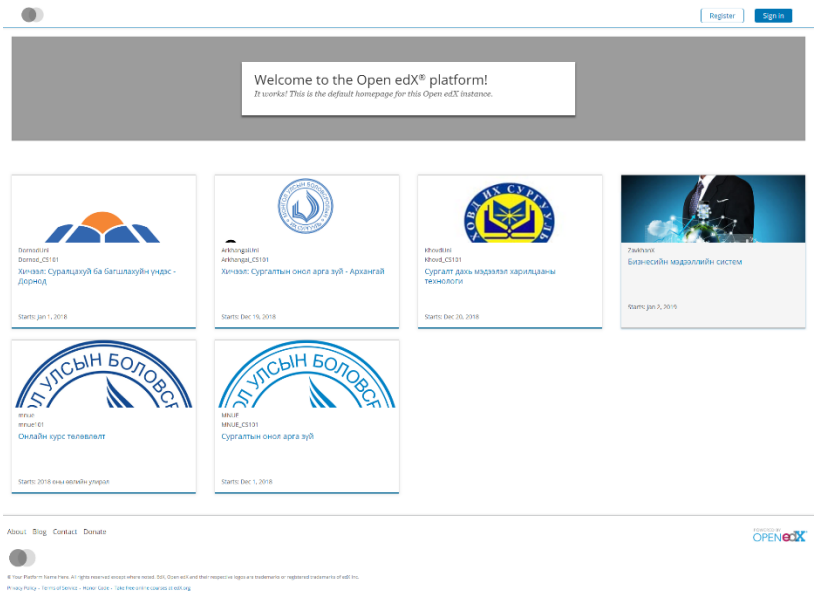


Figure 3. e-learning.edu.mn
(There are found some pages with no information and so this site is supposed under development now.)

2) World Bank

WB started its activities in Mongolia in 1991 and there are 21 members of staff working now. Regarding ICT related projects, WB is conducting a medical project from 2016 until 2020, E-Health Project18, aiming at improvement of medical sector including set-up of database to share medical data19. Regarding educational sector, Education Quality Reform is being implemented with primary schools targets aiming at ability improvement of Mongolian language and mathematics as well as school management development. The project consists of four

[13] Mongolia National Council for Education Accreditation
[14] CDIO: an educational framework created at the MIT and other universities, which stresses on Conceive, Design, Implement and Operate as fundamental ideas.
[15] A class delivery system using platform of edX. This delivery system is under developing and now six classes are released.
[16] Integrated into ESIS (Education Sector Information System) of MECSS as discussed in detail later.
[17] Skills for Employment Project: https://www.adb.org/projects/45010-002/main#project-overview
[18] E-Health Project, http://projects.worldbank.org/P131290/e-health-project?lang=en&tab=overview
[19] It is pointed out that to the optical fiber internet though the system is connected, there are problems on transfer of medical data of patients due to slowness of the internet speed.

components: 1) educational improvement through outcome-based learning, 2) teacher training, 3) financial support to primary schools, School Grant, 4) support for project implementation. Under scheme of School Grant, which grants maximally 2,000~3,000USD to each school which is accepted its application. By 2017, the scheme has accepted 650 applications from schools and educational facilities at many schools have already been improved. And WB, in collaboration with ADB and UNESCO, is planning of data collection survey on primary education curriculum and preschool education curriculum to draw Mongolia's Master Plan to Development Education. We note that this plan does not include survey on ICT. Until recently, WB had conducted The Rural Education and Development Project (2006~2013) having distributed books to primary schools in whole Mongolia, Global Partnership for Education Early Childhood Education Project (2012~2014) having built pre-schools, provided facilities and offered teacher training courses to cope with rapid growth of birthrate, Improving Primary Education Outcomes for Vulnerable Children in Rural Mongolia (2012~2016) having improved preschool education for children going to primary schools in rural areas and introduced extracurricular activities, and Education for All Fast Track Initiative (2007~2013) having given kitchens and furniture to pre-schools and renovated school dormitories.

3) UNESCO

UNESCO's works in Mongolia being within purview of its Beijing Office, Mongolian National Commission for UNESCO is set up as coordinator center for UNESCO projects. The chief of the office and the vice-chief are assumed by the Minister of Foreign Affairs and by the Senior Vice Minister of MECSS respectively. Using Korea Funds-in-Trust, UNESCO is conducting Enhancing National Capacity to Foster Digital Citizenship Education in Asia-Pacific from 2017 until 2021. The target countries are Mongolia, Myanmar, Nepal, Philippines, Sri Lanka and Uzbekistan. The project aims at 1) establishment of standard for ICT skills required to teachers of primary schools and secondary schools, and 2) curriculum development of teachers colleges for improvement of teachers' ICT skills. The project is now at the stage of submission of draft of the standard to MECSS. Regarding curriculum development of teachers colleges, the project will develop curriculum so that students can gain the standard ability targeting 40 higher educational institutes, such as MNUE, which conduct teacher training courses.

4) KOICA

It was in 1991 when Korean International Cooperation Agency (KOICA) set its office in Mongolia. There are 30 members of staff including 16 Mongolian working. It has no full-time staff in charge of ICT or education and so assigns personnel with project base. KOICA focuses on four areas: education, water quality management and public hygiene, administration, and

transportation. In the area of education, it supports on dispatch of volunteers (education in Korean language, preschool education, physical education, education in computers, and so on) and supports for TVET. For vocational education, Mongolia Korean Polytechnical College was established in 2000, which has trained human resources in accordance with industrial needs. Regarding education and ICT, it plans starting Capacity Building Project for School of Information and Communication Technology at Mongolian University of Science and Technology in Mongolia from 2019, which includes drawing of a master plan of School of ICT, curriculum development according to international standard, set-up of IT laboratories, procurement of equipment, and building renovation.

5) NGO Mongolian Education Alliance

Originally, Mongolian Education Alliance started its activities as Mongolian Foundation for Open Society in 1996 under support from international organizations and became an independent as MEA in 2004, whose targets of activities are preschool education and primary-secondary education. There are 10 members of staff working. It conducts 1) training for guardians and teachers on teaching methods to meet level of children's growth, 2) facilitation of extracurricular activities for students at junior high schools and senior high schools, 3) training on pedagogy to encourage students' will to learn and understanding at the stage of primary education.

2.2.6 School situation at ger area of Ulaanbaatar

No.62 School is a school[20] located at Songinokhairkhan district of Ulaanbaatar. The student number is the biggest in Mongolia. This school targets 1st to 12th grade. 960 students studied in the year of foundation in 1975, and student number was increased to 4,356 at present. There are 2,700 primary students, 963 junior high school students, and 693 senior high school students. Average student number of one class is 44 through 1st to 12th grade. If it is calculated in the average of primary school, the average student number is 43. The biggest student number in once class is 48. Primary school teachers are 63. A student number is increasing steadily in accordance with the apartment number is increasing. There are students who walk 5km from their house to school because there are not enough schools in ger area. Among this school, only primary school level adopts three-shift. Classes for the first-shift are conducted during 8:00 to 11:20, the second-shift is conducted during 12:00 to 15:20, and the third-shift is conducted during 15:40 to 19:20. 21 classes out of 63 classes of primary school provide the third-shift. Guardians have to accompany the three-shift students on the way to and from school. Newly entry student number is about 630 every year.

Classroom number is not enough nevertheless the principal's room and teachers' room are

[20] A new school building is expanded by JICA aid in 2002

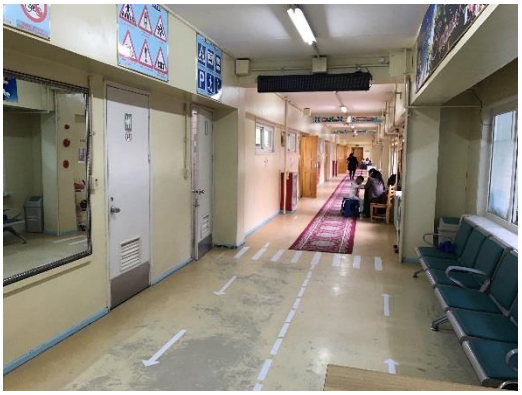
used as classrooms. Teacher works overtime about two hours every day. Teachers training is provided on Saturday, Sunday or after 20:00 in weekdays due to teacher's workload. Addition to this, teacher participates in club activities in weekends. They cannot spare time for preparation so they use the same teaching materials which are developed before. Teachers have no room to provide qualified classes. There is no science experiment room and experimental equipment, so that school facilitates experiment equipment from their budget bit by bit. Teachers and students bring necessary things from their homes sometimes.

158 teachers work in this school through 1st to 12th grade. 30 teachers out of 158 teachers are not provided computers for them. It has been about five years after computer distribution from MECSS and some of those computers are broken. Since ICT equipment such as projector, display, computer, and internet are not well installed, teachers cannot use ICT in the class.

47 students in the class (mathematics class)

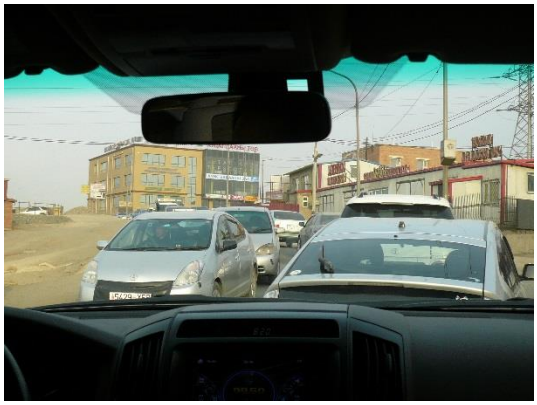
Principal's room is used as classroom (room is narrow)

Topic of 'Energy' of science at 5th grade. Students confirm warmth by striking a match



corridor

Appearance of ger district (gers and houses are mixed together. no water and electricity are available in ger)



Appearance of ger district (there is traffic jam to school)

Figure 4. No.62 School

No.57 School is a school located at Chingeltei district of Ulaanbaatar. The student number is the biggest in Mongolia. This school targets 1st to 12th grade. There are 2,320 students and 66 teachers, and the school adopts two-shift. Experiment cannot be conducted because of no science experiment equipment is a big problem. Originally, cost for experiment equipment is not included in the educational budget for Chingeltei district. Thus, the school purchases experiment equipment bit by bit by saving another budget. However, there is a limitation of school budget and ink and paper of printing machine is also inefficient. Teachers spend that cost personally. There are four projectors which are purchased by school to buy two, and other two are bought by guardians. There are many issues in schools of the ger district including No.57 School. However, an interviewee pointed out that there is no aid for ger district whereas international aid projects target schools in located central Ulaanbaatar or rural areas.

There is a computer room with 30 computers, although only 10 computers work without problem. The internet is not connected into the classroom. It is difficult to use ICT in the class because there is no computer and display.

Figure 5. No. 57 School

2.3 Outlook of ICT

2.3.1 Development Policy

In 1981, the first computer was imported to Mongolia from Bulgaria. 13 years later, computer was assembled in Mongolia in 1994.

Training of communication technology engineers was started at National University of Mongolia (NUM) in 1967, and the Polytechnic University was founded with communication department in 1972. MUST established Information Technology School in 1991. In 2001, Information Technology Training Center had started training in MUST.

In 1998, Mongolian government had advocated the ICT Vision 2010 and targeted to be in top 10 of ICT Sector in Asian countries. It promoted the 'National Program on Postal Services to Every Household' which was the long term plan to construct the postal network in all over Mongolia and 'National Program to Switchover Radio and Television Broadcasting to Digital Technology' which was to renew the television and radio by digital technology.

'E-Mongolia National Program' which was enforced in 2005 was important policy in ICT sector in Mongolia. It followed the e-Government Master Plan prepared by Korean Aid, set the various goals such as 1) arrangement of laws related to IT, 2) arrangement of infrastructure (construction of main network, spread of computer, so on), 3) training of human resource for IT, 4) information disclosure, 5) promotion of IT industry, and carried out 22 projects. This program mentioned the construction of e-Education Administration System. 'Low Cost PC Program' which introduced the cheap PC from 250 USD to market by ICTA[21] signing contract with Intel, and 'Affordable Internet Program' which provided internet connection for 1MNT from 20:00 to 8:00 by Mongolian Internet Service Provider Association as a part of E-Mongolia National Program.

As mentioned above, IT is positioned as one of the important development sectors in

[21] Abbreviation of Information and Communication Authority. Former of CITA

Mongolia from 1999 until present, and the ICT-related policy has been implemented as follow according to 'The State Policy on the Development of Information and Communications Technology 2017-2025'.

Table 16. ICT-related policies implemented in Mongolia

1999-2010	Concept of ICT Development of Mongolia by 2010
2002-2006	Mid-term Strategy Plan to Develop ICT
2005-2012	E-Mongolia National Program
2012-2016	E-Government National Program
2010-2015	National Program on Information Security
2011- 2015	Program on High-speed Broadband Network

(Made by the survey team from The State Policy on the Development of Information and Communications Technology 2017-2025)

As a result of these policies, IT sector reaches 2.4% of GDP and IT penetrates throughout the daily life. Still, development of software and hardware is necessary, and especially, utilization of IT in industry, research and development of IT, human resource development are important. The above State Policy analyses the present weakness of IT sector that 1) there is no company or factory to assemble the IT-related machine, 2) there is no specific organization to research ICT, 3) there are not enough engineers who have advanced knowledge of IT sector, 4) law related to e-commerce at domestic and international market is not maintained, 5) access to ICT service is not well maintained. Regarding this condition, future objectives are shown as follows. 1) arrangement of legislation related to IT, 2) arrangement of IT infrastructure in collaboration with companies, 3) promotion of advanced IT services, 4) promotion of innovation with IT, 5) cultivation of IT industries, 6) strengthen of IT security, and 7) strengthen of governance with IT. These policies has been regarded the middle term plan from 2017 to 2020, and the long term plan from 2021 to 2025. The middle term plan targets the cultivation of new market, products and services, maintenance of infrastructure and human resource development through arrangement of legislation related to IT whereas the long term plan targets the creation of industries based on high-technology and innovation, and improvement of IT environment.

For ICT sector, it is targeted to expand the high-speed internet to 70% of population and to connect high-speed internet with Asia and Europe in 2016 to 2020. In the next phase (2021-2025), it is stipulated to expand high-speed internet to 90% of population, to enable 70% of population in rural area to connect internet, and to digitize more than 50% public services. In 2026-2030, it is set to expand high-speed internet to 95% of population, to digitize 85% of public services, and to launch a domestic satellite. As long-term plan of ICT sector in Mongolia is explained above,

expansion of high-speed internet to nationwide, digitalization of public service, and launch of domestic satellite are the three main policies.

2.3.2 Government offices responsible for ICT

In Mongolia, ICT development policies come under CITA: Communications and Information Technology Authority, a body controlled directly by Prime Minister's Office. CITA, consisting of five departments, carries out 1) formulation of policies, 2) formulation of laws, 3) promotion of industry and research & development of ICT, 4) improvement of information security, 5) enhancement of ICT in rural areas.

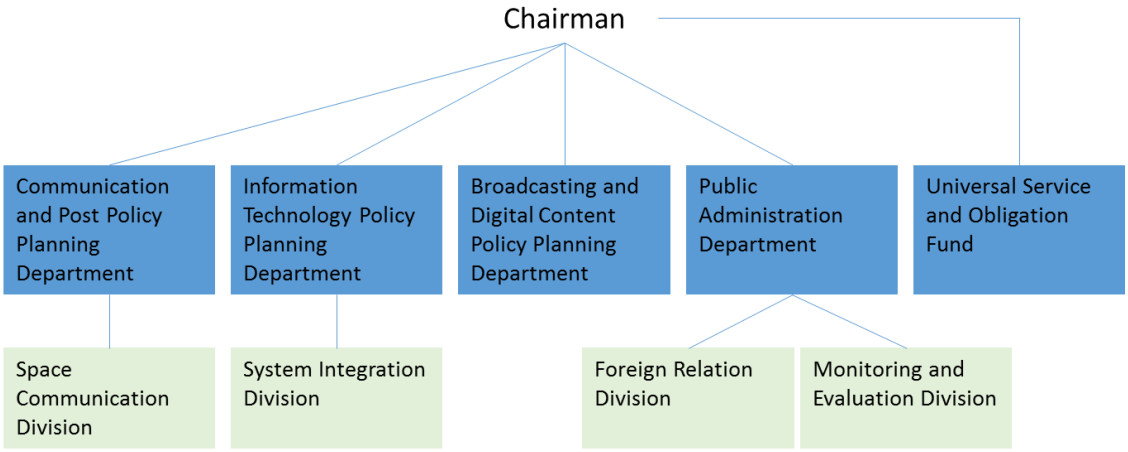


Figure 6. Organization chart of CITA
(Made by the survey team referring to CITA website)

'Communication Act revised in 2008' sets up and regulates 'Universal Service Fund' aiming at laying new communication networks/maintenance of communication networks, providing provinces with communication services. The fund is subsidized by the Mongolian government as well as financed by grant from foreign countries and by part of license fees paid to CRC: Communications Regulatory Commission.

2.3.3 Outlook of ICT infrastructure

According to Digital in 2018 in Eastern Asia[22], the world population has reached 7.5 billion, half of which access internet: 3.1 billion people enjoy social media. In East Asia (to which Digital in 2018 in Eastern Asia categorizes Mongolia), 57% of the population uses internet. Each of Central Asia, West Asia, South East Asia and East Asia has more 50% penetration rate for internet; penetration rate in South Asia being 36%.

[22] we are social, Digital in 2018 in Eastern Asia, https://www.slideshare.net/wearesocial/digital-in-2018-in-eastern-asia-86866557?from_action=save

As of 2018, Mongolia has more than 2 million internet users with internet penetration rate 65%, which is 25% increment from the rate in 2017. Statistics in 2017 tells us that Mongolia's penetration rate of mobile phone is 120%, which means a lot of people have more than one mobile phone to access internet through mobile phones, which means that for many people mobile phones are devices to get internet connection. In city areas penetration rate of mobile phones is very high. The number of smart phone users has gone up at 500,000 from 2015 to 2017: the number of the users reaches about 2,440,000. Each of banks in Mongolia has their own newly-developed applications for internet banking and customers enjoy services through smart phones such as account balance inquiry, remittance and bank transfer.

Among mobile phone users, most are the users of 3G (third generation of wireless mobile telecommunications technology) is the most, with the number of the users about 2,620,000, whereas the number of users of 4G/LTE, which is introduced around in 2016 and surpasses 3G in communication speed, is about 670,000. Especially in city areas many people use 4G/LTE.

The number of social media users is 2 million and many internet users enjoy social media also. The most popular social media is Facebook. The table below shows the websites Mongolian access frequently. Like many other countries, it indicates trend that Google, YouTube, Facebook are high ranked in Mongolia also (we are social, 2018). GOGO.mn is the only Mongolian site in the ranking list.

Table 17. Number of smart phone users

	2015	2016	2017
Number of Users	1,927,797	2,356,627	2,439,236

(Made by the survey team referring to CRC white Paper 2017)

Table 18. Websites accessed by users in Mongolia

Rank	Website
1	Google.mn
2	Youtube.com
3	Facebook.com
4	Google.com
5	GOGO.mn

(Made by the survey team referring to Digital in 2018 in Eastern Asia)

Due to geographical features and whether conditions, mobile communication has rapidly been spread leaving costly fixed internet lines behind. Four enterprises- Mobicom Corporation LLC, Skytel LLC, Unitel LLC and G-Mobile are vying inside the mobile communication market (Table. 19). Mobicom Corporation LLC is established in 1995 as a joint venture among KDDI,

Sumitomo Corporation (these two are Japanese companies) and Newcom LLC (a Mongolian investment company). Skytel was established as a joint venture between two Korean companies-SK Telecom and Taihan Electric Wire-but SK Telecom withdrew in 2011. Mobicom Corporation LLC and Unitel LLC occupy 70% of the market, that is, 70% of mobile communication users subscribe to these two companies. In 2017, the number of people who hold contract for 3G is about 2,620,000, which is about 82% of Mongolian population. In 2016, Mobicom Corporation LLC and Unitel LLC started services for 4G/LTE around city areas, which is the next-generation standard surpassing 3G in communication speed. As of 2017, the number of those who receive 4G/LTE service reaches about 670,000 (Table. 20).

Table 19. Percentage of Users of Providers

Name	2015	2016	2017
Mobicom Corporation LLC	41.81%	39.21%	38.64%
Skytel LLC	14.99%	16.00%	15.25%
Unitel LLC	30.87%	31.68%	35.16%
G-Mobile LLC	12.33%	13.11%	10.95%

(Made by the survey team referring to CRC White Paper 2017)

Table 20. Number of Internet Users in terms of Technology (Mongolia)

2017	
DSL	20,251
Fiber Optic	247,164
3G	2,625,685
LTE/4G	677,131
Wi-Fi	13,957
Wi-Max	1,469
Other	2,252

(Made by the survey team referring to CRC White Paper 2017)

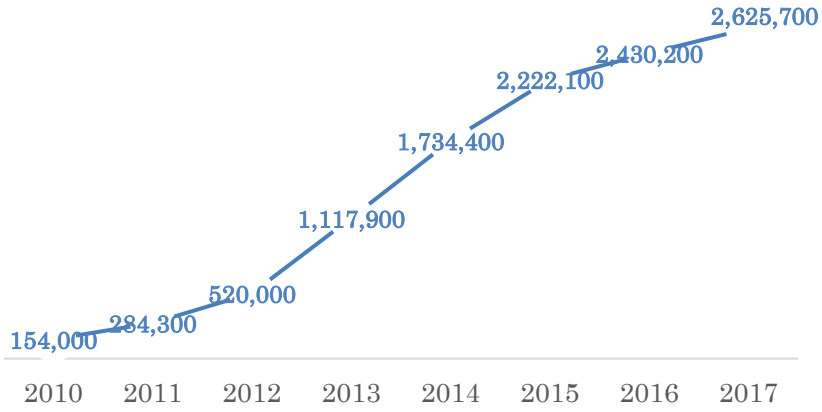


Figure 7. Numerical Transition of 3G subscribers
(Made by the survey team referring to CRC White Paper 2017)

Let us turn to computers for school teachers. Since MECSS afforded about 25,000 computers to schools from 2015 to 2016 or some teachers purchased computes at their expenses, sufficient number of computers has been distributed to schools step by step. A survey of Tokyo Institute of Technology in 2017[23]shows that 67% of teachers/staff at primary schools in Mongolia answered that they had enough ICT instruments at their schools, which imply that ICT instruments seem to have been equipped at schools.

Successive improvement of internet infrastructure for schools has been undergone. We find though interviews to CITA that optical fibers have been almost installed between Ulaanbaatar to many sums. 337 sums have optical fiber connections; 28 do not have yet. Each year, four or five sum get optical fiber connections installed and so all sums will have been furnished with optical fibers. Here we note that not all residents in sum will be able to use optical fibers.

We conducted a communication speed test at No.4 School in Dundgovi Province connecting the school to Ulaanbaatar and Japan respectively. Table 21 below shows the results of the test.

Table 21. Result of communication speed test at No.4 School, Dundgovi Province

[23] Report of Impact Survey, Tokyo Institute of Technology, et al., 'Quality improvement of Primary school teachers in rural areas in Mongolia-through teaching material development utilizing ICT in line with locality', 2017. This survey conducted research into 1161 Primary school teachers and 158 school managers in four provinces in Mongolia and one district in Ulaanbaatar.

Date of Test	25 February, 2019	
Place of Test	No.4 School, Dundgovi Province	
Test Method	We measured the following speed/time using a computer connected to wired Local Area Network (LAN) in the school: • upload speed and down speed using Speed test[24] • Round-Trip Time (RTT) of a message sent by PING to Ulaanbaatar or Tokyo respectively.	
When the test was conducted	Around 12:40 pm	
Results	UB	Download: 2.64Mbps / Upload: 8.86Mbps, RTT: 18ms
	Japan	Download: 0.28Mbps / Upload: 1.00Mbps, RTT: 115ms

Regarding connection to Ulaanbaatar, download speed was 2.64Mbps and upload speed was 8.86Mbps. We could watch YouTube video with medium image quality (720p) smoothly without waiting time for download of the data. However speed of connection to Japan was quite low for download and upload both; RTT[25] was 115ms. In general, more than 100ms RTT occurs in the connection between countries and so this RRT seems to be short enough. It is pointed out that if RTT comes to more than 600ms, quality of a television telephone using Skype suffers with falling quality of screen image[26]. Under the circumstances as we conducted the test, there seems to be no problems on usage of television telephones between Dundgovi and Ulaanbaatar or between Dundgovi and Japan. We note that in the case of communication between Dundgovi and Japan, since speed of download and upload is low, it might be difficult to make high-quality video callings (refer to the following Table. 22).

Table 22. Necessary speed to communicate with Skype

Type of Calling	Minimal required download/upload speed	Recommended download/upload speed
Video Calling/Shared Video	128kbps / 128kbps	300kbps / 300kbps
Video Calling (High Quality)	400kbps / 400kbps	500kbps / 500kbps
Group Video Calling (5 persons)	512kbps / 128kbps	2Mbps / 512kbps
Group Video Calling (more than or equal to 7 persons)	2Mbps / 128kbps	4Mbps / 512kbps

(Made by the survey team referring to 'Help' to Skype)

[24] Website to measure internet speed, https://www.speedtest.net/

[25] RTT: round-trip time. The length of time it takes for data to be sent from a sender to a receiver plus the length of time it takes for a reply to be return from the receiver to the sender. If RTT is longer, there is possibility of occurrence of wide timing gap between image and voice like satellite broadcasting in those days.

[26] Kaminaga, et al., 'Relation between network delay time and smoothness of conversation using video communication through Skype', 80th National Conference, Information Processing Society of Japan.

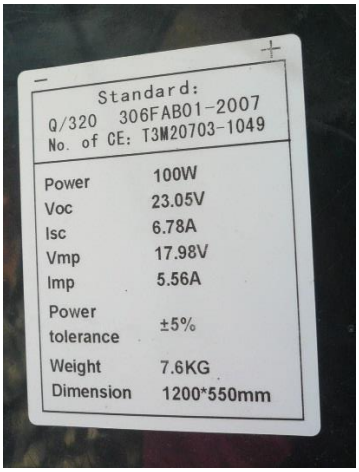
However we remark that the speed or time as above cannot be obtained at every school. For example, at a university in Ulaanbaatar, quality of Skype video calling is stabilized in the morning or night but during daytime there are delays of voices and so on-sometimes it is impossible to make a video calling because internet in the university is mixed up with wifi that students use. In addition, our interview sessions with schools in rural areas shows that internet speed is low even at schools which are connected with optical fibers. Current situation is that not all teachers can utilize internet connection with enough high speed: we find that some teachers are using mobile wifi that they themselves buy and so on. Further expansion and improvement of internet infrastructure is needed.

According to the hearing survey towards high schools students in No.4 School of Dundgovi Province, it is found that students usually use the application of Facebook, Instagram or TikTok via own smartphones or digital devices of their family. It shows that Mongolian high school students are familiar to use ICT tools even if they live in remote areas.

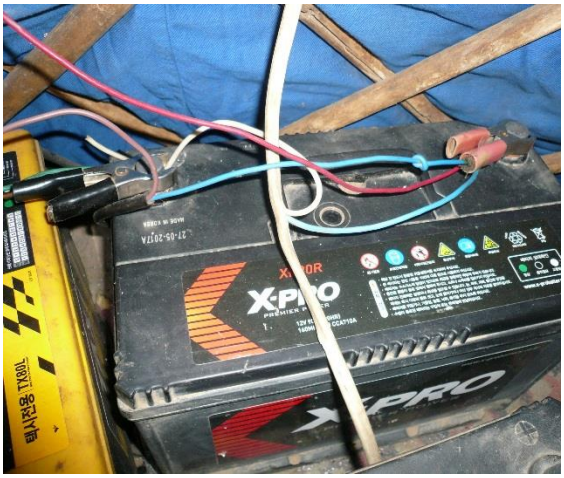
We also investigated situation of nomadic people living in a ger at the same time of our field survey in provinces. The gers are located in a steppe, 20km far from Mandalgovi, which the aimag center (province capital) of Dundgovi Province, about 200km far from Ulaanbaatar. Though a mobile phone with sim card of Mobicom caught a radio wave in aimag center, it could not around the gers.

Solar panels made in China (about 200,000 MNT) are installed outside the gers and generated electricity during day time is charged to storage batteries. People use lighting, televisions and freezers to which electricity produced by the solar panels is brought. A fully-charged battery can carry electricity to a television for 6 hours during night time. Regarding telephones, there are one fixed-line phone with an antenna and several smart phones. But people have to move to the place where they can catch a radio wave when they use smart phones because no radio wave is available in gers. Due to unavailability of radio waves, it is impossible to go on the internet through mobile phones from gers.

A solar panel installed near a ger



Rating of solar panels



A storage battery put in a ger

A freezer put in a ger

An antenna for satellite television

A television put in a ger

Figure 8. ICT instruments in a ger, Dundgovi Province

Chapter 3 Current Situation of Teacher Training and Science and Mathematics Education

3.1 Overview of teacher training in Mongolia

Institute of Teacher's Professional Development (ITPD) is responsible for teacher training in Mongolia mainly. Besides ITPD, District Education Bureau and international organizations provide teacher training; however, this survey focuses on ITPD which is the public agency of teacher training. ITPD provides four training as below.

Table 23. Delivered Training in ITPD

Basic training	The objective is capacity building of teachers. The target is teachers whose teaching careers are 1 year, 5 years, and 10 years.
Policies and principles dissemination training	Training about the policy and principle from government.
Training on the needs from educational field	Training is provided based on the needs from educational fields.
Free training	Training provides multiple topics. Teachers join the training of interested topic.

The most important training of ITPD is the basic training. This basic training is targeted all teachers in Mongolia and it is obligation for teachers whose teaching career is 1 year, 5 years, and 10 years. Training contains 5 topics, 1) capacity building, 2) educational activity and management, 3) teaching method, 4) utilization of ICT, 5) professional subjects, for 100 hours in total. 8,000 teachers take this training throughout the year. The training instructor is the educational experts of ITPD. Inconsideration of difficulties of providing 100 hours of training at ITPD headquarters and the burden of teachers, web browser based online learning system has been introduced to provide first half 50 hours of training since 2015.

3.2 Online learning system of ITPD

Participants are able to take online training system based on Moodle[27] by user registration on designated website of ITPD. The main materials are textbooks, but the video training materials are sometimes offered. ITPD does not have the own studio to record the materials; therefore the ITPD uploads the video materials recorded outside and edited by ITPD. Online bi-directional

[27] A sort of study management system on Website. Free open source software. Moodle includes distributing teaching materials, providing and scoring examination, managing attendance, making discussion forum.

training using the video telephone is not carried out considering the insufficient internet line speed and difficulties of gather busy teachers at one place. It is available to 1) distribute the tasks, 2) make and take the examination, 3) participate in the discussion, 4) introduce the reference materials, 5) browse the learning status in the online learning system. The texts are mainly used on the website while Power Point file, Word file and PDF file can be uploaded. Person in charge of ITPD manages the learning information of participants[28], and participants who have not completed first half of 50 hours basically can not participate in the latter half of 50 hours training at ITPD headquarters[29]. Online learning situation can be checked by ITPD educational experts, and the contents of training at headquarters will be changed according to the online learning status. The contents of online learning itself are updated once a year by ITPD educational experts.

3.3 Issues of ICT utilization on teacher training

ITPD recognizes that teachers' ICT utilization in education as essential in the view of world trends and have high motivation to utilize it. Law to support teachers enforced in June 2018 establishes the teacher development center at each school and encourages teachers to make efforts for self-ability development, and it has high expectation of ICT utilization in terms of self-learning and information gathering.

However, the survey by ITPD in 2017 implicates that only 30% of teachers utilize ICT and one of the reasons of it is teachers' insufficient proficiency to conduct lessons by utilizing ICT. The fact that teachers working before common ICT usage in education are not familiar to use ICT in education, and they cannot purchase computer or use internet due to financial reason seem to be reasons of the above low rate. Thus, ITPD plans to conduct teacher training to make this number double by 2022. To be more specific, it is necessary to develop the teaching ability to put ICT into practice such as know-how of using ICT effectively in class and preparation of class plan using ICT and the basic training also includes the topic on using ICT. As mentioned above, ICT utilization has been promoted by ITPD.

However, internet infrastructure issue should also be concerned in the consideration of teacher training improvement in the future. Currently, optical fibers are provided at aimag centers and more than 90% of sum; however, interview of several counterparts for this survey reveals the problem of communication speed. In addition to that, web browser based online learning is available at rural area, but the bi-direction online training by using video telephone is not conducted due to the limitation of internet speed. In the case of planning the bi-directional online training in future, it is necessary to investigate in the Education Bureau at aimag where the high speed and stable connection of internet is accessible and make it to the venue for the training.

[28] Managed by excel file.
[29] In practice, some teachers participate in the training at headquarters even not finishing the online learning because of the internet problem. In this case, teachers participate in the training at the same time proceeding the online learning.

And, investment for improving internet speed seems to be necessary.

3.4 Current situation and issues of science education

The interviews survey at MECSS, ITPD, Japan Overseas Cooperation Volunteers (JOCV) and local schools have revealed that the shortage of science experiment equipment is the big issue for the science and mathematics education. Concretely, the number of experiment equipment is overwhelmingly few regarding the number of students even though there is experiment equipment available. It became clear from the interview with MECSS that there is a plan to improve the experiment equipment according to the curriculum revised in 2013 to 2014, however, the budget will be considered from now on and it is not sure when the improvement plan will be conducted. Underdevelopment of experiment equipment is a big bottleneck of science education progress in Mongolia. According to the latest report of MIER, it pointed out that there are no experiment equipment in 40% of Ulaanbaatar, 20% of aimag centers, and 30% of sum[30]. And, safety management at science experiment rooms is another problem since many schools do not have user's manual of experiment equipment and 30% of all schools are not reached the certain safety level of experiment equipment usage. This report also indicated that teachers purchase photocopy paper or print documents by their own expenses due to lack of photocopy papers, and they spend 50,000MNT-78,000MNT (same as 2,118JPY- 3,304JPY) (equal to 10% of their salary) for teaching materials from their own pocket.

Under this situation, there are high needs to utilize ICT as a substitute of experiment equipment. Especially, there is a demand for video teaching materials, animation materials, and simulation materials which are alternative to experimental equipment. Some teachers have mentioned that they would like to use ICT instead of hazardous experiments. When visiting rural schools for this survey, physics teachers utilize science and mathematics simulation software named 'PhET[31]' in an offline environment which was developed by University of Colorado at Boulder. Besides it, measuring software such as protractor and constellation observation application which are free to use for Android and iOS is utilized in the class.

Since ICT is not the all-round solution, considering the above issues from various angles is necessary. For example, experimental methods using the items which can be easily obtained from supermarket or other accessible places is the effective means[32].

[30] In the report of MIER, the indicator of judging 'there is experiment equipment' is not described. We have to be careful to use this result since some interviewees pointed out the problem of shortage of experiment equipment compare with students number.
[31] It will be explained in details at another chapter.
[32] JOCV working at Dondogobi actually does this activity which receive high evaluation, It had been considered to upload its experiment procedures.

Chapter 4 Case Study on the Usage of ICT in the Field of Education in Mongolia

4.1 Case study on the usage of ICT in the field of education in Mongolia

4.1.1 PhET: Simulation software for science and mathematics

PhET (https://phet.colorado.edu/) is an interactive math and science simulation software developed by Nobel Laureate Carl Wieman together with the University of Colorado at Boulder. It provides user-friendly interface and game-like environment where students learn through exploration and discovery of math and science. Since PhET is free and can be run offline, it is highly recommended and has high demand among the teachers. It has also been introduced as digital educational materials in the teacher training seminar held by ITPD. The English interface of PhET makes it a bit difficult for the Mongolian teachers to use. Some teachers with high motivation solve this problem by looking up words before using PhET in class.

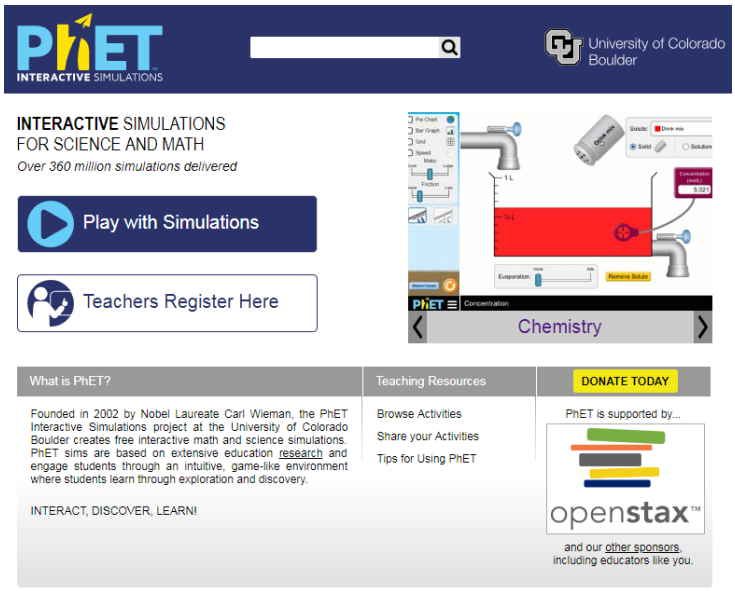


Figure 9. PhET's Homepage

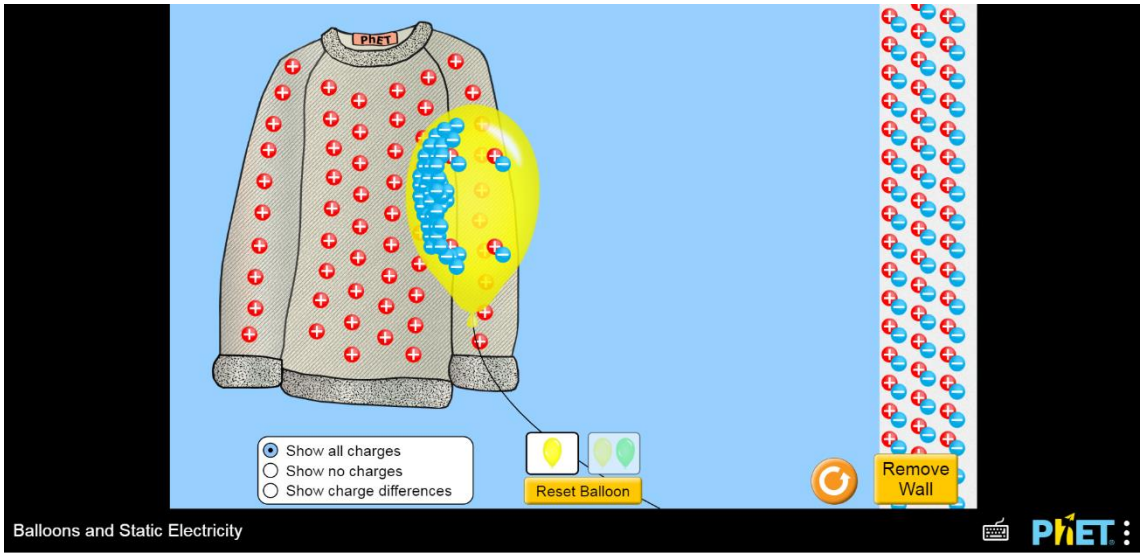


Figure 10. Balloon and Static Electricity

(Students can move balloons and learn how static electricity works while playing)

4.1.2 Mathshop: Educational materials for mathematics learning

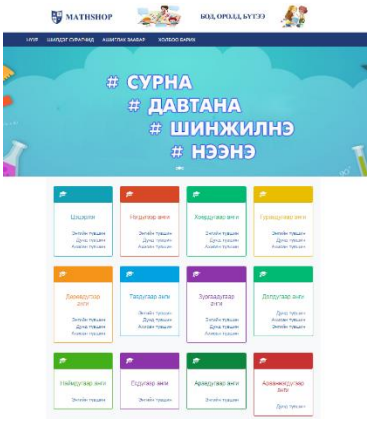
Mathshop is mathematics e-learning software in line with Mongolian curriculum for 1st to 12th grade students, developed by MIER in cooperation with ITPD and Ulaanbaatar Metropolitan Education Department and Mongolian Online Studying System LLC (MOSS) to improve mathematics ability of poor family and the whole of Mongolia. It is accessible from mathshop.mn. The features of this software are that: 1) it is possible to select online learning or offline learning according to the learning environment of the user, 2) it is compatible with Mongolian and English, and 3) it utilizes illustration, voice and the ranking function to increase children's interest. The current number of users is 160 and the annual fee is 88,000 MNT[33]. The payment methods include bank transfer and purchase of user registration card.

In 2018, the trial operation was carried out at several schools in Ulaanbaatar City and shown the result that one out of four students who used Mathshop has recognized their improvement of mathematics results. To enhance the content and to improve the software, MOSS also had a very positive attitude towards collaboration with Japanese companies.

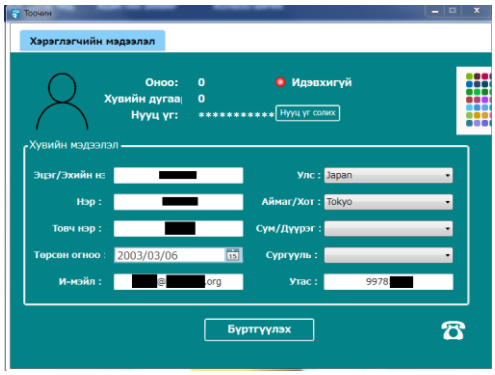
The first challenge for MOSS is that there is no enough explanation of understanding the unit (Figure 11). After reading explanation, no specific questions are indicated after one explanation was read so that learners cannot drill the questions and establish well understanding. Addition to this, there is no explanation towards mistake but another question comes out automatically.

[33] Annual fee for one course is 88,000 MNT (JPY3,727). For example, if students want to learn the content for both 1st and 2nd grade, they need to pay 176,000 MNT (JPY7,455).

Exploration of sales channels is a challenge for MOSS. MOSS is a company established for the development of Mathshop, but it does not have sales know-how and no effective sales channel has been established. As a result, monetization was not enabled, fund shortage occurred and the company disbanded. Currently, they continue to develop Mathshop on a voluntary basis.



Top Page of Mathshop.mn

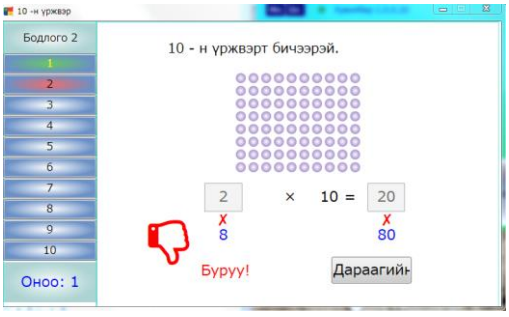


Registration page for learners

Launch page of the software

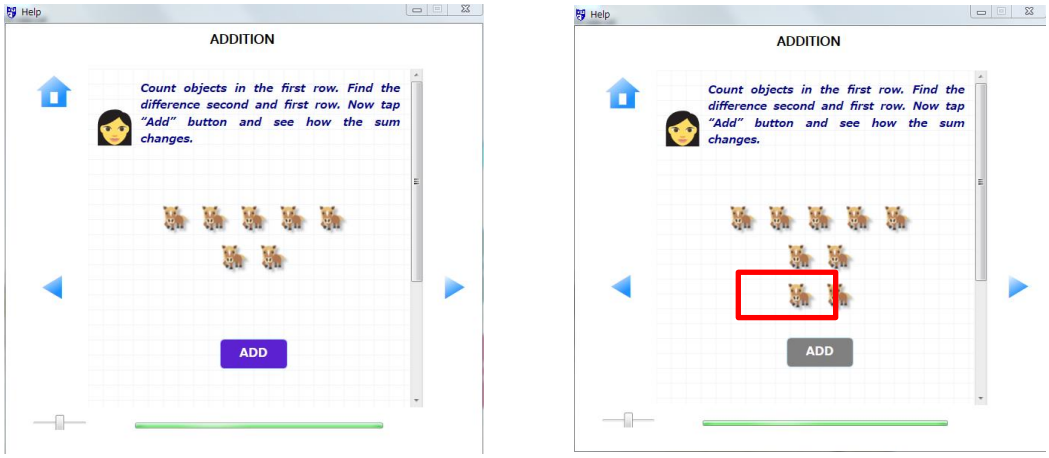
Selection page
to choose subject

Question example: to express the number of 67 by using blocks



Question example: Answer the total number of ○ by multiplication.

If learner's answer is incorrect, the correct answer will be shown with no particular explanation.



Example of explanation: Concept of "addition" is taught by animation. By clicking on "ADD" on the left chart, picture of two hourses are appreared on the right chart. However, it is hard to delivery the essential meaning of "addition" since there is no detailed exlanation of picture.

Figure 11. Mathshop's interface

4.1.3 Suraad.mn: Online educational materials for mathematics learning

Suraad is a browser-based mathematics exercise book, which contains 50,000 questions developed by the former director of the Education Research Institute. To use Suraad, it is necessary to have access to the Internet. Its interface does not have multi-device support, therefore Suraad can only be used via computer. The main target grade of Suraad is from 6th (1st grade in junior high school) to 12th grade (3rd grade in senior high school). Suraad is available for students, parents and teachers. The registration pages are also separated for students, parents and teachers. It is accessible from Suraad.mn and free trial is available for few days. The functions of Suraad include practicing exercises, saving learning history, browsing learning history by parents and teachers. When logging into Suraad, the subjects to be studied by students will be compiled as several sets of exercises, each exercise contains 15 to 20 questions. When students start using Suraad, they will be asked to challenge the exercise of their own level. Suraad is structured from simple exercises to progressive level step by step.

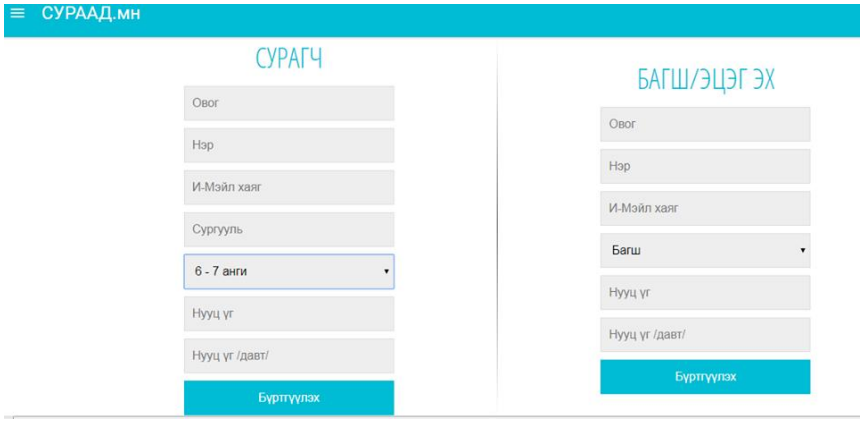


Figure 12. Suraad's registration pages

(students' page on the left, parents and teachers' page on the right)

Figure 13. Content page for 6th to 7th grade students

(Students can study by topics. The graph on the left is showing the degree of comprehension. At the bottom of the graph, there is a click button for 'Level Identification' test to identify students understanding)

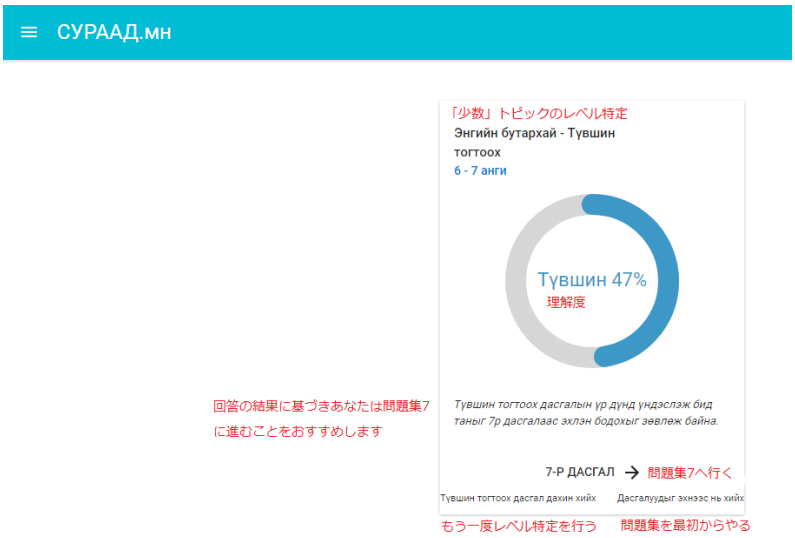


Figure 14. Result of level identification test
(The degree of comprehension and the advice on the next set of exercises are shown)

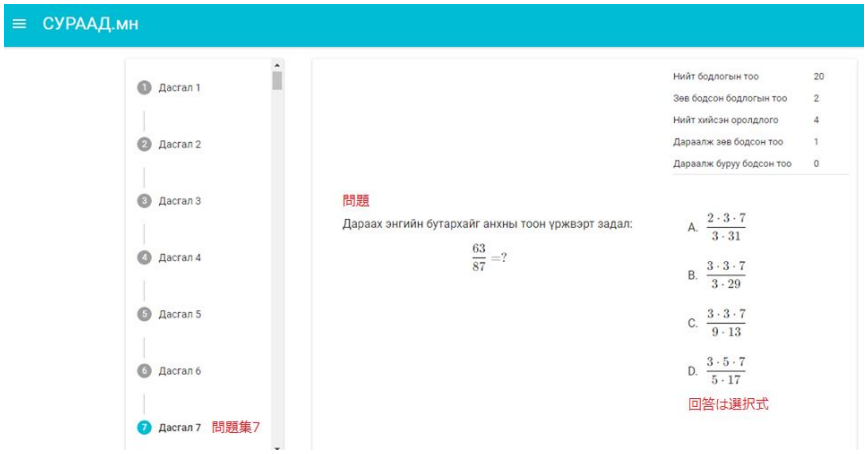


Figure 15. Example for problem page

As part of this survey, 287 students from 6th grade to 11th grade at the No. 4 School[34] in the Dontgobi province, were using Suraad as a trial to review their mathematics learning for two months from April 2018. Usually, the monthly fee is 30,000 MNT (JPY1,288) for each account for each student, with academic discount, the monthly fee was reduced to 10,000 MNT (JPY429) for each student. The total monthly fee in the amount of 2.87 million MNT for the first month was borne by the school from its own budget, and the remaining monthly fee for the second month was borne by each student. The subjects that students have studied include decimals, calculation

[34] A school specializing in mathematics from 6th grade (middle school student) to 12th grade (high school student). It is also called Tegsbilli School. There are 42 teachers and 376 students. Each teacher has one computer. The Internet is connected via fiber optic modem, and there is no particular problem in internet communication.

of formula, absolute value, solving equation and substitution for 6th grade students, inequality, polynomial, simultaneous equations for 7th and 8th grade students, square root, absolute value, quadratic equation and Viet's theorem for 9th to 11th grade students. The students answered 22 questions per day on average.

The report for trial use of Suraad from the No. 4 School analyzes the advantages and the challenges for the students and teachers as below.

Table 24. Suraad's advantages and challenges

	Students	Teachers
Advantages	• The positive attitude towards the class has been improved • The ability of problem solving has been improved • Self-learning ability has been improved dramatically. • Because each student is doing different exercise, cheating can be avoided.	• The individule differences among students has been considered. • Teachers' workload regarding teaching materials production, students' understanding level analysis have decreased • Teachers' work to share the level of students' understanding with guardians can ba saved
Challenges	• There is a shortage of PC which can connect to the interntet • There is a shortage of equipment and tools. Addition to this, there is not enough nubmer of PC in one classroom for the students number and students have to be separated in 2-3 classrooms. Thus, it is necessary for teachers to visit several classrooms to check	

Suraad's interface is so simple. Since there is no animation or typical elements of game to make study enjoyable and students have to focus on solving questions only, so it seems to be difficult to keep students motivated to continue studying. Furthermore, since Suraad requires online environment, it is difficult to utilize Suraad in places where connection to the Internet is unstable. Moreover, the explanations to correct wrong answers are not enough prepared and support for students who fail in understanding is limited.

4.1.4 MOODLE: educational management system

There are about 40 schools called Laboratory School which provide advanced education in accordance to the education policy in Mongolia. We visited one of the Laboratory Schools named Ulaanbaatar No.23 School which utilizes ICT in education. In particular, the school uses Moodle to manage educational data in the school and to deliver the teaching materials and to check study level. Some classrooms are arranged to equip tablet devices with introducing Moodle. It is found that some changes are brought by Moodle, such as reducing of teachers' workload, increasing of

lessons preparation, decreasing the volume of teaching materials. Other advantages for students can be counted that they find the examination result soon, and they can catch up by self-learning by referring teaching materials even if they absent the classes. Addition to this, students in this school prefer to digital teaching materials than paper one since they are familiar to digital devices. On the other hand, what are the listed as the issues of utilizing Moodle are massive date installation and contents preparation.

Figure 16. Demonstration class with Moodle
(teacher refers to students' tablet device screen from teacher's computer to check study condition always (back screen). Student on the left is reading the document with tablet device)

4.1.5 Online education delivery

The online education content of Massive Open Online Course (MOOC)[35] are used among several education institutions. That platform is the same as the system used in the world. It is not seems to be improved by outsiders.

Table 25. Example of MOOC

Name	URL	Administrator	Main objectives
E-OPEN Institute	emust.edu.mn/Home/Elearning	MUST	Online acquisition of Master's Degree
E-Learning System of MNUMS	elearning.mnums.edu.mn	Mongolian National University of Medical Sciences	Online Distribution of teaching materials

[35] MOOC is an abbreviation for Massive Open Online Course. It is an online learning platform aimed at unlimited participation and open access for free via the web. Representative MOOCs include Coursera founded by Stanford professors, edX run by a team of researchers at MIT and Harvard, JMOOC run by the Japan Massive Open Online Courses Promotion Council. Many MOOCs combine video-recorded lectures and tests.

4.1.6 ESIS： education database

Education Sector Information System (ESIS)[36] based on a system for collecting education information called OpenEMIS developed by UNESCO is a large-scale education database created by MECSS. The main users of ESIS are MECSS, Education Board of each region, schools and pre-schools, and all schools are obligated to enter the data on ESIS. ESIS (portal.esis.edu.mn) aims at improving education management, sharing information with educational institutions and other institutions, planning education plans effectively, and improving the quality of education[37].

The development of EMIS began in 2013. In 2014, it applied to the primary and secondary education, and gradually expanded the target scope. In 2015, it applied to the pre-primary education and in December 2018, it applied to the higher education. MECSS funded the system construction of primary and secondary education as well as of pre-primary education while ADB[38] provided financial assistance to the system construction of higher education. The development team was under the jurisdiction of MECSS. Since the development was terminated in 2018, the institution for system management will be established at MECSS.

The data which EMIS collected is large-scale, including student information, course subjects, attendance situation, students' grade, timetable, assignment information as well as nationwide test results[39], university entrance examination results, curriculum, educational environment, teachers' information. In addition, other than data collection and analysis, its functions also include distribution of assignments, distribution of digital textbooks[40] and interactive educational materials at the digital teaching material portal site (econtent.edu.mn), application of scholarships and parent-teacher communication via mobile application. On the digital teaching material portal site, video content for teacher training will have been released which was created under TIT-JICA Partnership Program.

However, the interview survey revealed that the analysis of the collected data has not been done yet due to the lack of human resources who are capable of analyzing collected data, although ESIS has gained popularity and the awareness of ESIS has been gradually improved. As pointed out, the following two types of human resources are necessary for ESIS.

i. Human resources who have the ability to analyze big data as well as a good knowledge of education that can put the analysis results into the idea of improvement of education.

ii. Teachers who can utilize data and tools to improve education

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[36] it was called EMIS (Education Management Information System), but in recent years the name has been changed to ESIS. Available on portal.esis.edu.mn

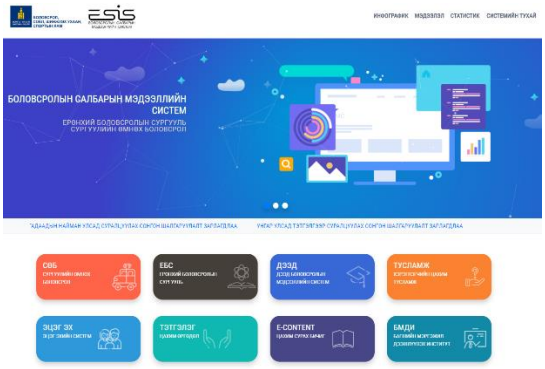
[37] MECSS, ICT Contributions to EMIS Sustainability and Data Quality

[38] ADB has been implementing the "Higher Education Reform Project" since 2012, with the aim of improving the capacity of higher education institutions in Mongolia and improving university entrance rate of students from poor and remote areas. As part of this project, the support to ESIS has also been provided.

[39] A national examination conducted by the Education Evaluation Center under the jurisdiction of MECSS. The examination is conducted for 5th grade, 9th grade and 12th grade students who are advancing to junior high school, senior high school and university. Education Research Institute is responsible for the analysis of collected data. However, it has not been done so far.

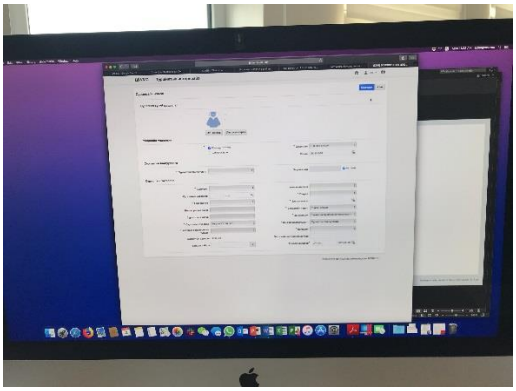
[40] Digital textbooks cannot be downloaded.

Addition to this, it is obligated to entry the result of university entrance examination with in the announcement date. However, it takes until next morning for entering examination result due to overmuch access. Management of study condition of students is overlapped in paper and ESIS is also problem at schools.

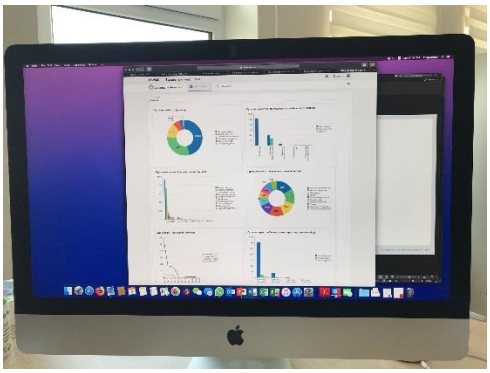


ESIS portal site
(portal.esis.edu.mn)

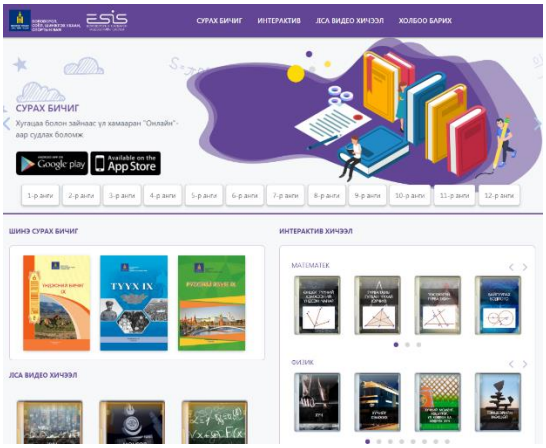
ESIS management page
Content divided into categories



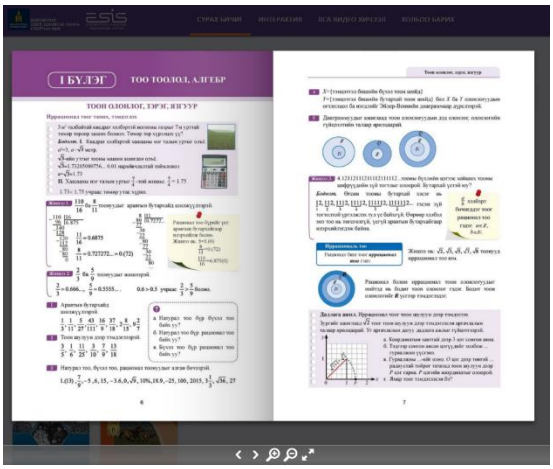
Student data input page



Data browsing page



ESIS digital teaching material portal site (http://econtent.edu.mn/)



Accessible textbooks on ESIS digital teaching material portal site, e.g. 9th grade mathematics

Figure 17. ESIS

Chapter 5 Survey on Companies in Japan and Mongolia, and Situation of Japanese IT Companies in Terms of Expanding Their Businesses to Developing Countries

5.1 Door-to-door survey on companies in Japan

5.1.1 Purpose of survey

The purpose of this survey is to consider possibilities of expanding Japanese companies to Mongolia, necessary information and support by analyzing the size of Japanese ICT and related companies, business contents, target sectors, intent of expanding overseas and related issues.

5.1.2 Door-to-door survey

Four companies which are providing ICT solutions in education are designated by JICA Mongolia to make the door-to-door survey (Table 26). The survey is implemented by interviewing about the summary of their product, advantage and issue of introducing ICT into education and their policies on expanding overseas for about one hour. Main questions are listed as follows. The survey is conducted in 14th February and 18th February.

A. Summary of products
B. Issue of introducing ICT in schools
C. Advantage of utilizing ICT in education
D. Foresight and issues on expanding overseas

Table 26. Summary of companies in Japan

Company	Founded in	Capital Fund(JPY)	Main business
A	2008	270 Million	Development and sales of digital teaching materials of mathematics
B	1910	5 Billion	Sales of ICT hardware for classes Development and sales of administrative supporting software
C	2014	980 Million	Development and management of educational platform
D	1986	190 Billion	Development of learning materials in robot programming for kids Development and management of e-learning system for sports

(Made by Survey Team)

5.1.3 Survey results

We see different situation on progress among companies on expansion of business overseas: one company has been implementing business several countries and another company is considering to proceed their business abroad; each company has positive attitude towards overseas expansion itself. Following points are the characteristics which are discovered by the interviews.

No.1 ICT may reduce teachers' overloaded work, and students can proceed their study by own pace.

According to the interviews, advantage of introducing ICT in education is indicated in two aspects. One is the effect towards teachers and the other is the effect towards students. Reduce of teachers' overloaded work is the most common opinions as an effect towards teachers. Although students numbers are getting smaller due to the low birthrate, the imposition of teachers are still hard because of various learning systems, and new subjects such as English and computer programming become compulsory subjects. Introduction ICT to education seems to be in progress to solve these issues. In concrete cases, grading students, attendance, absence and tardy arrival, study condition, contact to guardians, homework distribution and collection which were managed by printed materials are replaced into digital technology and those data are centralized making analysis and output easier. This is also in accordance with the purpose of introduction of ESIS which is mentioned in 4.1.6. A teacher is able to issue transcripts and to share students' information with other teachers much more effectively than the condition of work based on printed materials. And, collecting students' feedback of classes by writing on the piece of paper took time before. If teacher can use digital devices, those feedbacks can be shown on the display or projector without collecting time. Managing students' study condition by digital tools makes it easier to find students whose study progress is slow or who feel difficulties in study. Utilizing ICT in education will reduce teachers' daily overload. And, much more fruitful instruction by teachers will be expected by using ICT, which spares the teachers hours for class preparation, teaching research and communication with students.

ICT utilization also effect as a method of cultivating students' concentration, understanding and interest. One of the features of ICT is attraction in visual and auditory. For example, it is possible to explain about the moon wax and wane through continuous moon observation and verbal explanation. However, projected image would make students understand the phenomenon immediately. ICT tools has benefit when the verbal explanation is complicated.

In recent years, students are required to gain sequence skills of collecting information, solving problems and presenting the results. ICT tool is also utilized to support in learning such skills. Internet usage as information collection, data analysis and management, study record on

digital note, opinions sharing with friends, and presentation materials development are the examples of good use of ICT.

Existing teaching method is difficult to instruct depending on each student's understanding because a teacher teaches toward all students at once. Utilizing the ICT makes effective analysis of students' study progress and understanding easier, and much more proper instruction (Adaptive learning) can be provided to each student based on that analysis. The role of teacher is now shifting to facilitator to lead and promote study from teaching itself.

No2. Presentation of utilizing method and enhancement of support contents are important to introduce ICT.

All ICT companies which were interviewed in this survey mentioned the importance of support and follow-up services before/after introducing ICT contents. There are teachers who have negative impression on introduction of ICT to education. Companies explain about the advantage of utilizing ICT toward those teachers, schools and the board of education carefully. For example, companies construct support systems such as user's manual, show samples of teaching plans using sales products and set up a call center for supporting issue when using the products.

Motivation to use ICT is also necessary for teachers. Presentation and sharing good practices are effective to raise teachers' motivation of using ICT. Even teachers with nervous feeling to introduce ICT tend to be positive if they recognize that students' reaction or concentration are obviously changed. For that sake, sharing effective teaching method by ICT and workshops for teachers to enhance ICT skills are important and actively provided by companies.

No.3 Companies cannot access basic local information or needs even though they are positive to expand business overseas.

All companies that we interviewed during this survey are positive to expand their business overseas. One of the companies has launched promotion in several Asia countries and is planning to expand its business to other countries also. What companies pointed out about difficulties in terms of expanding business overseas are 1) they do not have knowledge about target countries, 2) difficulty in collecting and analyzing basic information and needs about local education, 3) lack of necessary information to manage business in developing countries. Necessary information for companies is shown in following lists. And, market survey or feasibility study to promote business in cooperation with outsourcing resources or consulting firms which have deep knowledge of target countries are effective if the companies do not have channel to expand overseas.

Table 27. Example of necessary information for companies

Basic information	About education sector	About business management
• Culture • Population • Impression towards Japan (whether they have affinity to Japan) • Life style • Social issues • Monthly income in average	• Policy in education • Policy in using ICT • Pedagogy (teaching guideline, syllabus, curriculum, etc.) • Statistics on education (number of schools, students, etc.) • Issues in education • ICT needs in education • ICT infrastructures in education	• Regulation with regard to establishment of foreign companies • Process to establish company • Whether there are prospective partner companies • Whether there are local human resources to work with • Channel to essential information about such as banks, auditors, etc. for business management.

No4. Local needs, market size, local human resources, affinity to Japan and so on are essential points to choose target countries.

Essential points for a company to choose target countries are 1) matching between the target countries' needs and company's own solution, 2) market size, 3) acquiring talented local human resources, 4) affinity to Japan. We find that 1) is the most important to solve local issues by the company's product or services through comparing and analyzing local needs and the company's capability. Market size should be taken into consideration in terms of company's intended product, but basic statistics such as population, the numbers of teachers, schools, classes, and students, and government budget for education would be the indicators. The small population of three million becomes the hurdle to expand their business into Mongolia. And, as described in the previous part, the introduction of ICT product is not a goal but follow-up support or improvement in line with local condition is so much needed. Moreover, local employment of IT human resources and prospective managers are also important elements to construct sustainable business systems to run and manage service in the country. In addition, people's affinity to Japan is preferable. If people in a country feel affinity to Japan and have reliability to Japan and Japanese education, companies expect that Japanese educational service

will win the trust of the local people.

5.2 Survey on web questionnaire for Japanese companies

5.2.1 Survey summary

We developed web questionnaire by using Google form on the website in free of charge. The questionnaire consists of the following contents with 24 questions. The questionnaire has been sent to main email address of target companies or sent to contact form together with the brief explanation of survey.

Table 28. Web questionnaire for Japanese companies

1	Purpose of questionnaire
2	Company profile
	Company name, division/position/name/contact of the person who answers the questionnaire, foundation year, capital fund, number of employees, type of providing services, main target customers.
3	Expansion overseas
	Interest towards expansion overseas and reason, target country, advantage and issues on expansion, recognition on JICA's scheme of partnership with the private sector: Support for Japanese SMEs Overseas Business Development, expansion to Mongolia (business contents, reason, prospective customers, issues)

We chose the companies that joined "Education IT Solution Expo (EDIX) 2018" by Reed Exhibitions Japan Ltd. EDIX is the biggest educational exhibition in Japan and presents business support systems, ICT tool, digital teaching materials, e-learning and various school services at the same time. This exhibition is held every year in Tokyo in June and in Osaka in September.

In this survey, the questionnaires have been distributed to 303 companies which attended EDIX at zone (1), (2), (3), (4), and (5)[41] as follows.

Table 29. EDIX zones and products

1	School administrative support zone	administrative support system, digital grading system, etc.
2	Teaching materials and educational contents zone	digital textbooks, digital teaching materials, educational software, academic repository database, etc.
3	e-learning zone	e-learning solution, Learning Management System

[41] A company which has no information of inquiry or email address is excluded.

		(LMS) [42] , class and lecture recording, distance education/class delivery, etc.
4	ICT devices zone	digital blackboards, tablet PC, projectors, educational digital devices, etc.
5	Future learning zone	programming teaching materials, materials for Science, Technology, Engineering and Mathematics (STEM), Virtual Reality (VR) Augmented Reality (AR), Artificial Intelligence (AI), etc.

(Made by the Survey Team based on Education IT Solution EXPO (EDIX) 2018)

5.2.2 Results of Web Questionnaire

Basic information of 14 companies which answered the questionnaire is described in the following table.

Table 30. Company Information

Capital Fund (JPY)

Capital Fund	Number of answer
Less than 10 million	2
10 million- 50 million	5
50 million – 100 million	3
100 million – 300 million	2
More than 300 million	2

Number of Employees (person)

Employees	Number of answer
6 - 20	4
51-100	3
101-300	5
More than 300	2

Table 31. Main solutions of companies (multiple answers allowed)

Solutions	Number of answer
Administrative support system (administration/school work system, exam scoring system, school information delivery system, library system, students recruiting solutions, etc.)	3
Teaching material/education contents (digital textbook/teaching materials, movie for education, software/application for education etc.)	9
e-learning/lecture delivery (teaching materials and contents for e-learning, LMS, learning platform, recording lecture, mobile learning, remote lecture)	4

[42] Learning Management System is the system to manage the date related the education such as students' attendances, students' achievement, materials and examination distribution.

ICT devices (digital blackboard, PC/tablet device, network devices, printer, storage equipment)	5
Other	4
• Blackboard, whiteboard, bulletin board, choke, blackboard eraser, whiteboard marker etc.	
• Production/sales of stand for display, storage for tablet device	
• Development/sales of IT security software	
• Laboratory table, fume hoods etc.	

12 companies out of 14 companies answered the questionnaire that they are interested in promoting developing countries. Remaining two companies are in neutral or not interested in promoting overseas. The reason of no interest in overseas promotion is limitation of company's capacity. All 12 companies which are interested in promoting developing countries have promoted or are expecting to promote Asia. And, 6 companies promoted or are expecting to promote Middle East, Africa and South America, 5 companies to Oceania countries, and 4 companies to Middle America/Caribbean countries. Those companies listed up particular countries and regions in the following table. Mongolia is targeted from four companies.

Table 32. Expected countries and regions to promote

Asia	Bangladesh, Mongolia, Myanmar, Vietnam, Indonesia, Thailand, Malaysia, Kirghiz, Uzbekistan, ASEAN countries, China, South Korea
Oceania	Tonga, Papua New Guinea
Africa	Ghana, Mozambique, Sierra Leone, Ethiopia, Countries in African continent
Middle East, Europe	Middle East countries

The reasons why the companies listed those countries/regions up are shown as follows.

- No competitors
- Distance from Japan and possibility of expanding the market
- Specific connections
- There are many Japanese companies there
- There are many Japanese learners there
- Experience of conducted trainings
- Possible distribution route
- Own educational contents will be able to contribute to solve problems offered by JICA

- Other project of own company has being implemented there

Expectation and advantage of expanding their business overseas are answered as follows. Many companies indicated the advantage of exploitation of new market. Social contribution is also mentioned as one of the answers.

- Expansion of the market, exploitation of new market, expansion of distribution routes
- Less competition since market is still less developed
- Practice and dissemination of own service and technology
- Less investment size compare to other developed countries
- International social contribution, CSR activity

On the other hand, some issues are also listed as follows. It is obvious that companies tend to feel difficulties in collecting information of target countries, constructing network. Addition to this, one company noted that it is extremely delicate issue to grasp the local regulation and trading custom in terms of import and export, thus information collection itself is beyond difficult. From those opinions, it is cleared that the necessary support of expanding overseas is in collecting the information.

Table 33. Issues to promote developing countries

Issues	Number of answers (multiple answers allowed)
Market trend, recognize their needs	10
Secure the reliable partners	9
Secure sales destination	8
Secure profitability forecast	8
Local regulation, recognize trading custom	8
Market size	6
Development products/services for overseas	5
Secure human resources for promoting overseas	5
Language, communication	4
Cultural difference	4
Secure necessary fund	3
Less information about the country Difficult to obtain the information	2

Custom	1
Balance between required quality and purchasing power at local level	1

(Made by the survey team based on the questionnaire)

7 companies out of 12 companies knew the JICA's scheme of partnership with the private sector, 3 companies heard but did not checked details, and 2 companies did not know this scheme at all.

Especially, companies which are counting Mongolia as a target country consider businesses such as education hardware, analytical equipment, development of science and mathematics textbooks and teaching materials including digital version and e-learning. The motivations of considering to promote Mongolia are invitation from business partners and existed connections, participation in JICA study tour, there is a product applied Russian language which is similar to Mongolia language. Besides, there are some concerns such as distribution channels, economic size and difficulty in recognizing local market trends and needs. The information collection is therefore implied to overcome those problems.

5.3 Door-to-Door survey on Japanese companies which are expanding their business to Mongolia

The door-to door survey was implemented towards Japanese IT companies which are expanding their business to Mongolia and Mongolian IT companies to find the advantage and issues of promoting business in Mongolia, IT sector situation and IT human resources in Mongolia. We visited two Japanese companies and four Mongolian companies in the following list.

Table 34. Interviewees in Mongolia

Country	Company	Founded in	Main business
Japan	E	2013	Off-shore development, advertisement, internet related development
Japan	F	2019	AI related business
Mongolia	G	2015	ERP[43]system sales and consultation
Mongolia	H	2011[44]	Software, Application, Web development
Mongolia	I	2013	ERP system introduction, consultation
Mongolia	J	2004	System development, introduction, equipment procurement[45]

The Japanese IT companies both are working mainly for off-shore development for the sake of their Japanese affiliated companies. Among the Mongolian IT companies, two are targeting ERP related work, one is targeting software development work, and one is targeting system development and equipment procurement. The advantages and issues of IT field in Mongolia are described as follows.

(i) Advantage of expanding business to Mongolia

1) Mongolia as plenty of very capable people whom companies can easily get

A company answered that they feel Mongolian people more diligent compared with other country people, which is one of key points from which the companies decided to expand their business to Mongolia. There are many people with experiences of study in Japan[46] and many people with ability of communication in Japanese or English. So it is possible to employ staff with good command of languages.

As another advantage, it is pointed out that Mongolian industry is still developing with less competition to acquire human resources. Labor costs in Mongolia are lower than those in Japan; we cannot always say the costs are cheaper than other countries. The interviewee who had experience in working at Japanese IT Company emphasized that Mongolians have excellent skills, high motivation and challenging mind to develop new things.

The findings above seems to be backed up by the following, which shows ranking of smoothness for business publicized by WB: Mongolia is ranked 7th county out of 25 Asia Pacific countries, which means that Mongolia is a country where business can be carried out relatively

[43] Abbreviation of Enterprise Resources Planning. A method for effective utilization of management resource of all the company or comprehensive system to realize it.
[44] Registered year is 2011. Actual operation is started in 2015
[45] Various procurement such as security camera installation for building, equipment procurement for mine, system development for finance organizations
[46] Refereed to the Investigation on Foreign Students Study Condition by JASSO in 2017, 298,980 international students are in Japan as of May 2018. The biggest number is 114,950 students from China, then 72,354 students from Vietnam, 24,331 students from Nepal, 17,012 students from South Korea, 9,524 students from Taiwan, 8,329 students from Sri Lanka, 6,277 students from Indonesia, 5,928 students from 3,962 students from Thailand, 3,540 students from Bangladesh, and 3,640 students from Mongolia.

smooth.

Table 35. WB Doing Business Ranking (Asia Pacific Region)

Rank	Country	Rank	Country
1	Singapore	11	Samoa
2	Hong Kong	12	Tonga
3	Taiwan	13	Vanuatu
4	Malaysia	14	Fiji
5	Thailand	15	Papua New Guinea
6	Brunei	16	Philippines
7	**Mongolia**	17	Solomon Islands
8	Vietnam	18	Palau
9	Indonesia	18	Cambodia
10	China (PRC)	20	Laos

(Excerpted from handouts of a seminar at Mongolia-Japan Center for Human Resources Development)

2) Developing IT Industry

Although Mongolia has been invested in IT infrastructure, the market of IT area is still under developing with the small number of IT enterprises. IT is spreading among Mongolia with mobile phone communication spearheading; immatureness of the market seems to be advantage for Japanese IT companies. As of 2017, there are 53 companies which belong to software industrial association, Mongol Software Association[47]. We could not gather information especially from enterprises which provide educational services or products. We find through interview sessions with local companies in Mongolia that Mongolian companies feel EduTech as area that do not yield much profit and so it is hard to expand their business in the area.

Since current Mongolian economy depends on mining sector which contributes 90% of foreign currency acquisition of Mongolia, Mongolian economy tends to go up and down: diversification of economy is important. As candidates for new industries, we consider development of IT to be prospective in Mongolia.

3) Mongolia has high affinity to Japan

Mongolia is a country which has high affinity to Japan with the effect of Mongolian Sumo wrestlers in Japan, animation and cartoon. Japanese education, technology and industry are reliable to Mongolian. The number international students who study in Japan is the world best in terms of ratio of population. And, Japanese learners at Mongolia-Japan Human Resources

[47] Mongolia Business Environment Guide in 2017 issued by JICA

Development Center are increasing year by year. Grammar of Mongolian and Japanese is similar such as word order. Mongolian Japanese Language Proficiency Test N1 holder's Japanese proficiency is native speaker-like.

(ii) Concerns to launch business in Mongolia[48]

1) Job turnover rate

A lifetime employment system is not a common in Mongolia, and Mongolian people tend to change their jobs for their own carrier after gaining experience. Interviewed company is disturbed by their turnover to move another company in/out of Mongolia or study abroad even though the company has cultivated engineers in a few years. This issue is found not only in Japanese companies but also in Mongolian companies. It is not expected for Mongolian to continue their work in long-term like Japanese do so. And, even if they come back from abroad after advancing their carrier, they usually request to work as a manager, not as an engineer.

2) Determine the excellent human resources

There are numerous human resources who have high language proficiency such as Japanese. However, it should be minded that language proficiency is not equal to high working ability. Some interviewees mentioned that ensuring human resources who can share the principles and objectives of the company is the key to advance the business smoothly in Mongolia. And, the salary[49] and incentive (such as providing the chance to work in Japan after working several years in Mongolia) are effective to recruit excellent human resources.

3) Market size

The small population is one of the issues in promoting business in Mongolia. Indeed, one interviewed company is subcontracted from foreign company to develop off-shore market[50]. But, the services that require periodical purchases or updating will be profitable even though the population size is small. One good example can been seen in the business by Mobicom, which is the biggest in the market and funded by Sumitomo Corporation and KDDI. The services or products which can gain big market-share and can be used continuously will be candidates to complement the small market size.

4) Access to correct information

One company answers that difficulties in establishing company are unclear regulation or

[48] For details, refer to "Mongolia Seminar" issued by Mongolia-Japan Human Resource Development Center
[49] Excellent human resources tend to work in mining sector or construction works.
[50] For example, Mongolian Software Corporation Co., Ltd is founded in cooperation of six companies which include the person who studied in Japan or worked in Japanese IT companies. This company works as a role of counterpart to receive the project from Japan.

requirement as well as that provided information is not standardized by the persons in charge. In Mongolia, access to correct information and its resources and building network are important. Possible access points to the information are Japanese Business Council in Mongolia[51], Mongolia-Japan Human Development Center, and the companies which are already promoting in Mongolia.

[51] Many of Japanese companies in Mongolia associate in Japanese Business Council in Mongolia. The member companies are 54 as of February 2017.

Chapter 6 Needs Analysis, Issues, and challenges for Introduction of ICT

As introduction of ICT in education is highly encouraged at policy level, government takes the initiative to lay a fiber-optic cable at each Sum and optical fiber has been connected at hospital, police station, and schools of 90% of Sum. Almost one computer is provided for each teacher at schools. Because of the conditions of geography and environment, mobile phones are widely used among citizens. The interview survey with MECSS, MIER, ITPD, and teachers at rural primary schools reveals that there is no negative opinion towards introduction of ICT in education from governmental organization level to principal level and practitioner realize the importance of it. Some schools have started using ESIS as education database and Moodle as schools management system for student management and practice in class. Science and mathematics simulation PhET, mathematics software Suraad and Mathshop are also utilized in class and home education. Consciousness of primary school teachers and staff towards ICT shall have influence on secondary teachers and management levels, since primary education and secondary education are in the same school building in most of Mongolia.

The environment to introduce ICT in education sector has been prepared and installation of ICT can be the effective tools to solve current issues in education sector.

Therefore, the possibilities for assistance byJICA are as follows.

6.1 Assistance for introduction of IT solutions to streamline academic affairs

One of the effects of ICT utilization in education is the “conversion into electronic of school affairs”. The cost of preparation, management and analysis of in-school information will be cut down significantly by replacing the paper based information to digital data. The survey to Japanese companies also pointed out that the efficiency of school administrative works by using ICT is beneficial. In fact, utilization of school affairs support system in Osaka city is reported to have brought form teachers more than 224-hour reduction of working time for per year. [52]

However, in Mongolia, many schools have not yet been improved in terms of digitalization or efficiency. Through this survey we could get only information that schools are using Excel and Word for management about teaching plans or student data; no information on advanced utilization of ICT. Since Japanese companies supply a variety of products and services such as portal sites for schools and school affairs management system, digital distribution system of teaching materials, the effective utilization of these products and services is expected. Meanwhile, we would like to emphasize the necessity of compatibility with ESIS in introduction of such solutions. Since ESIS requires, as mentioned in Chapter 4, input of huge fundamental data on

[52] Special subcommittee for working style in schools, ‘Reference 5-On working efficiency brought by integrated support system for school affairs’, 3 October, 2017.

education, we suppose that automatic system for data sharing with ESIS will be needed for the introduction of the new solutions.

6.2 Support for introduction of digital teaching materials

6.2.1 Supplementary teaching materials for science subjects

Through the survey, we find that there is a high demand for digital educational teaching materials which can be the alternative for real science experiments at schools, because it is difficult for students to do experiments due to shortage of experimental instruments. Especially the high demand is for ICT that fills the role of support for teachers' instruction of scientific theories and phenomena using videos, animations and simulations. Although MECSS is planning development and improvement of experimental instruments, the plan is still unclear. It is important to disseminate ICT tools step by step to classroom from private levels. We consider it effective for JICA to promote dissemination of supplementary teaching materials for science subjects in cooperation with Japanese companies, which is one of feasible support measures by JICA. Japanese companies have already developed many products of supplementary teaching materials such as movies of science experiments and many types of contents are on sale. Some of the teaching materials can be utilized at schools where the internet is unavailable. In addition, Japanese companies have not only offered teaching materials but also proposed combination of materials and teaching plans suitable for curriculum. Japanese company service know-how would be useful for consideration smooth implementation of teaching materials to class rooms in Mongolia.

When introducing the ICT tools, it is necessary to conduct detailed market research on language to be used, adjustment to Mongolian curriculum, software and services of competitors. As mentioned in 5.2.2, some companies that consider expansion their business to Mongolia, develop textbooks and teaching materials for science and mathematics. We suggest that JICA provide consultation to those companies to make full use of JICA's scheme.

6.2.2 Support for introduce of home digital learning materials

As mentioned in 2.2, in rural areas there is no sufficient educational support for student, such as self-teaching after-school study centers while in urban areas, there are still some schools with three-shift system which cannot provide sufficient education to students. Therefore, it is of importance to have support for study at home. We consider that Mongolia has potential demand for home digital learning materials, for the reasons as follows: (i) In Mongolia smart phones are widely used and students are familiar with how to use digital devices through smart phones of their families; (ii) Some students have been using teaching materials such as Suraad.mn, Mathshop purchased by their parents. Although Suraad.mn and Mathshop are lack of teaching support for better understanding of the subjects and system for proper iterative learning, there is

still room for technical improvement. On the other hand, the command of concise explanation and teaching support as well as attractive design to attract students in terms of teaching materials is similar in Japan and in other countries. If Japanese companies could develop products and conduct R&D to solve these problems, it will be possible for them to expand their business to Mongolia and to disseminate their products.

6.3 Development of advanced IT human resource

As mentioned in Chapter 4, although large-scale data have been collected via ESIS, there is a shortage of human resources who are capable of analyzing these data. The support for relevant human resource development through JICA's technical cooperation will lead to the formulation of evidence-based education policy.

6.4 Challenges in implementing support measures

(i). Access to internet

Due to the development of the mobile phone network and national Internet infrastructure development projects, most schools have an environment where they can connect to the Internet. However, there is a problem with the communication speed. Even inside the school, Internet connection is not available in all classrooms. This problem is particularly noticeable in rural areas. During author's visit to Ger, there was no reception for mobile phone or access to Internet. At this stage, it is important to provide offline function when introducing ICT to schools, especially when the targeting schools are in rural areas.

(ii). Teachers' ICT Capability and workload

It was pointed out in the interview survey that teachers' ability in using ICT is insufficient and training to improve the capacity of ICT is necessary. The person in charge of physics at ITPD also pointed out that some teachers would not use features other than creating tables in Excel. In addition, the necessity of conducting training on the use of ICT in class and the preparation of guidance has also been pointed out. As mentioned in 2.2.3, the heavy workload of teachers in urban areas becomes a problem. It is difficult for teachers to make time to learn ICT tools when ICT tools are newly introduced to schools. Therefore, in order to proceed the introduction smoothly, ICT tools need to be user-friendly. And it is necessary to have support and manuals which teachers can learn ICT tools in a short and easy manner.

(iii). Understanding from school administrators and users

In order to promote the introduction of ICT tools in schools, it is important to obtain

school administrators' understanding and cooperation. It is particularly necessary to explain to school administrators about the utilization of ICT, the introduction process as well as the educational problems that can be solved by introducing ICT tools.

Appendix 1.List of Interviewees

Company in Japan	SuRaLa Net Co., Ltd、Classi Corp. , SoftBank Corp. , UCHIDA YOKO Co., Ltd.
Related Institute in Mongolia	MECSS, CITA, EEC, Metropolitan Education Department、MIER、ITPD、Dondgovi Education Culture Department, Mongolia-Japan Center For Human Resources Development, ITpark、Life Long Education Center
Schools in Mongolia	MNUE, NUM, Dondgovi No.1 and No. 4 school, New Mongol Institute of Technology, No. 57 school, No. 62 school
Japanese Company in Mongolia	Unimedia Solutions, Dentsu Data Artist Mongol
Mongolian Company	Asterisk Technologies, Arvis Systems LLC, Inter Solutions Management LLC, UBISOL, itools
NGO	Mongolian Education Alliance
International Agency	KOICA, WB, UNCESCO, ADB

Appendix 2.Web Questionnaire for Japanese IT Company

企業属性	
問 1.	貴社名
問 2.	ご記入者様の所属
問 3.	ご記入者様の役職
問 4.	ご記入者様の氏名
問 5.	ご記入者様のメールアドレス
問 6.	貴社の設立年(選択肢) 1950 年代以前 / 60 年代 / 70 年代 / 80 年代 / 90 年代 / 2000~04 年 / 2005~09 年 / 2010~14 年 / 2015 年以降
問 7.	貴社の資本金(選択肢) 個人企業(個人事業主) / 1,000 万円以下 / 1,000 万円超~5,000 万円以下 / 5,000 万円超~1 億円以下 / 1 億円超~3 億円以下 / 3 億円超
問 8.	貴社の従業員数(選択肢) 0 人 / 1~5 人 / 6~20 人 / 21~50 人 / 51~100 人 / 101~300 人 / 301 人以上
問 9.	主に取り扱っているソリューション(複数回答可) • 学校業務支援(事務・校務支援システム、採点システム、学校情報配信システム、図書館向けシステム、生徒募集ソリューション等) • 教材・教育コンテンツ(デジタル教科書・教材、教育用動画、教育用ソフト・アプリ等) • e ラーニング・授業配信(e ラーニング用教材・コンテンツ、LMS、ラーニングプラットフォーム、授業収録、モバイルラーニング、遠隔講義等) • ICT 機器(電子黒板、PC・タブレット、ネットワーク機器、プリンタ、保管機器等) • その他
問 10.	主な対象顧客(複数回答可) 保育園・幼稚園 / 小学校 / 中学校 / 高校 / 高専 / 専門学校・短期大学 / 大学 / 自治体 / 企業 / その他
2. 途上国への進出	
問 11	途上国への進出に関心はありますか(選択肢) 関心がある / どちらでもない / 関心が無い
問 12.	問 11 にて「どちらでもない」「関心が無い」とお答えされた方にお伺いします。もし理由がありましたら、ご記入ください。
ここからは、問 11 にて「関心がある」とお答えされた方に質問します。	
問 13.	現在「既に進出している」、または「将来進出を想定している」地域をお答え下さい(複数回答可) アジア / 大洋州 / 中東・ヨーロッパ / アフリカ / 中米・カリブ / 南米 / 検討している地域は特に無い / その他
問 14.	もし具体的な対象国がありましたらご記入ください。
問 15.	上記の設問で、なぜその地域・国を対象としたのか、理由がありましたらご記入下さい
問 16.	途上国へ進出に当たっての期待や貴社にとっての途上国進出のメリットはなんですか
問 17.	途上国への進出するに当たって課題はなんですか(複数回答可) 販売先の確保 / 市場規模 / 採算性の見通しの確保 / 現地の市場動向・ニーズの把握 / 海外向け商品・サービスの開発 / 海外進出を行うために必要な人材の確保 / 現地の法制度・商習慣の把握 / 信頼できる現地の提携先の確保 / 必要な資金の確保 / その国のことをそもそもよく知らない・情報を入手しようとしても手に入らない / 言語・コミュニケーション / 文化的差違 / その他

問 18.	途上国への進出するに当たって「最も重要な」課題はなんですか(選択肢) 販売先の確保 / 市場規模 / 採算性の見通しの確保 / 現地の市場動向・ニーズの把握 / 海外向け商品・サービスの開発 / 海外進出を行うために必要な人材の確保 / 現地の法制度・商習慣の把握 / 信頼できる現地の提携先の確保 / 必要な資金の確保 / その国のことをそもそもよく知らない・情報を入手しようとしても手に入らない / 言語・コミュニケーション / 文化的差違 / その他
問 19.	JICA の行っている、途上国への進出を検討している企業に対する支援スキームをご存じですか(選択肢) 知っていた /聞いたことはあったが、調べたことは無かった / 全く知らなかった
問 20.	もし JICA に期待することがありましたら自由にご記入ください
ここからは、問 14 で「モンゴル」とお答えされた方にお伺いします。	
問 21.	どのような事業を検討していますか。差しさわりの無い範囲でご記入ください
問 22.	モンゴル進出を検討するに至ったきっかけがありましたら教えて下さい
問 23.	想定されている事業の想定顧客は次のうちどれですか(選択肢) 児童・生徒 / 教師・教員 / 小学校 / 中学校 / 高校 / 大学・短大 / 職業訓練校 / 検討中 / その他
問 24.	モンゴル進出を行う上での特に重要な課題・問題がありましたら教えて下さい