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Baseline Analysis on ICT in General Education of Mongolia

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Abstract. These days ICT has penetrated into almost all sectors of the economy and society of Mongolia. More and more effort and attention is being paid to integrating ICT into the education sector. The current education reforms have a big component related to ICT, which includes the development of a Master plan for ICT in the Education sector, addressing the issues of ICT policy, infrastructure, hardware, software, human resource development and capacity building, content development etc. This paper describes the current state of ICT in general education in Mongolia. The paper also tries to address strengths, weaknesses, opportunities, and threats in ICT education.

Keywords: general education, ICT education, informatics, informatics curriculum, informatics teacher development.

1. Introduction

Mongolia is located in Asia, bordering China and Russia. Mongolia has a territory of 1,564,116 sq.km. The population is 2,869,500 (NSO, 2012), GDP – real growth rate is 12.7% (2012 est.), population growth rate is 1.469% (2012 est.), education expenditure is 5.6% of GDP (2009), and the literacy rate is 97.4% (World Fact book, 2012). The political system of Mongolia is parliamentary, with elections held every four years for the 76 seats. There is a president, also elected for a four-year term.

The base-line of the Mongolian telecommunications network consists of about 5,200 km of digital system radio relay line, over 13,000 km of fiber optic network, around 27,000 km of air lines, and 23 VSAT stations. There are international Intelsat satellite stations, which provide services to over 332 communication stations with a capacity of 135.2 thousand telephones. The high-speed optical cable network installed covers 21 province centers and over 50% of all soums in Mongolia. There are over 70 ISPs, which share 11.2Gbps bandwidth and provide services to about 200,000 Internet subscribers, who are using more xDSL, fiber optic, 3G, and GPRS connections. Four cellular mobile operators currently provide mobile services to over 2.5 million subscribers throughout the territory

of Mongolia (92% of penetration). The establishment of these networks is fundamental to developing new ICT services and applications, and to expand mobile communications and Internet services, e-Government, distance learning, and telemedicine. It is also one of the key factors in reducing the digital divide between rural and urban areas. According to some surveys and studies, two types of digital divide exist in Mongolia: that between urban and rural areas, and that between the centre and the suburbs.

2. Education System

Mongolia's educational administrative structure is organized Ministry of Education and Science (MOES) as the national and central authoritative body, followed by subsequent administrative bodies, such as aimag[1] (provincial) education boards, soum[2] (district) education offices, and school councils. Key policy documents are The Primary and Secondary Education Law (1995), The Education Law (2002), and The Education Master Plan for 2006–2015 (2006).

The Mongolian education system consists of pre-school education (kindergarten), general education (primary, lower secondary, upper secondary), and tertiary education (universities). Primary and secondary education is legally free to all. Traditionally, the Mongolian general secondary education system consists of combined schools such as combined primary and lower secondary, and combined primary, lower secondary, and upper secondary. The biggest soums have combined primary, lower secondary and upper secondary, while the rest have combined primary and lower secondary due to the population size.

The country is making significant reforms and structural changes to the education system. In 2004, the Government of Mongolia implemented a change from a 10-year education system to an 11-year education system. From the 2008–2009 school year, the Mongolian Parliament again made an amendment to the Education Law, changing the 11-year education system to a 12-year education system. The transition to 12-year education system will be complete by 2016. At the start of the academic year 2008–2009, all fifth grade students will be transferred to the 7th grade of 12-year schools. Thus, all grades' transitions to the new system will be completed within five years. Students from 6th to 11th grade will finish 11-year school. The 12-year education system consists of primary education (six years), lower secondary (three years) and upper secondary education (three years). Primary education caters for children starting at age six. Lower secondary education caters for pupils from 12 to 14 years old and upper secondary pupils from 15 to 18 years old. Basic education includes primary and lower secondary education.

In the 2011–2012 academic year, 505409 students (256584 in primary, 169275 in lower secondary, 79550 in upper secondary) were reported to be studying at 752 (614 public schools, 138 private schools) general education schools nationwide (MOES, 2011).

The current national curriculum standard took effect in 2005, and both public and private institutions must comply with them. Due to the current on-going process

[1] Administrative unit of Mongolia, equivalent to provinces. There are 21 aimags in Mongolia
[2] Sub-administrative unit of Mongolia

of transitioning from an 11-year education system to a 12-year education system, the new system needs to be supported by curriculum reform and the development of agreed education standards for each subject and grade level. The focus of the new system is on shifting from academic-oriented instruction to a life-oriented one, and the overall curriculum aims to develop students' competencies in learning and living in the global world (UNESCO, 2009). In the 2012–2013 academic year, grades I–V and VIII–X use the 12-year education curriculum, and grade VII uses the transition curriculum.

3. The Current Situation of the ICT in General Education

The Government of Mongolia started the process of extending the general education system from an 11-year system to a 12-year system in 2008–2009. The Master Plan gives high priority to the expansion of the school system, which will be in accordance with the common practice of general secondary education in the world. In this regard, the measures to continue renewal of content and environmental standards and curricula, the renewal of textbooks, the increase of supplies of instructional materials, techniques, and equipment, the introduction of Internet services, computer technologies and ICT-based training, re-training teachers and implementing the issue of lunch and meals for children need to be undertaken (UNESCO, 2009).

According to the survey, conducted in 2009, about 80% of participants in the survey stated that ICT is very important in teaching and the remaining 20% stated that it is important. 50% of teachers stated that their schools have introduced ICT in teaching in last 1–3 years, around 38% stated that the teaching of ICT was introduced more than three years ago and the remaining 12% stated that the teaching of ICT was introduced less than one year ago. (Baigaltugs *et al.*, 2009). According this survey, about 66% of teachers stated that they use ICT in less than once or one to three times per week, 28% do not use ICT in teaching at all, and only 6% stated that they use ICT in their teaching almost every day.

3.1. *Policies, Strategies and Programs*

There are a number of key legal and policy documents ratified by the Parliament of Mongolia which govern ICT in education in Mongolia:

a) **ICT Vision-2010.** The Parliament of Mongolia adopted the ICT Vision-2010 as a blueprint for ICT development in the country. It recognizes ICT as an important pivotal tool for development in Mongolia. ICT Vision-2010 has three major components: government-legislation, business-economy and people-society framework. Within this concept, the following ICT related activities in education are to be implemented:

- Create a well defined curriculum structure that provides ICT education for all citizens.
- Set up knowledge and education-based high-tech centers in Ulaanbaatar and in socio-economic development regions.

- Provide people with a set of opportunities to access IT at mobile sites running sustainable common services, libraries, aimag and soum schools.
- Create info structure for education.
- Resolve in detail the human resource development issues of the national info structure (user, trainer, specialist); Introduce electronic versions of the library system such as ordering, searching and others.
- Support lifelong learning through open and distance learning.
- Introduce electronic services for leisure and entertainment activities (virtual libraries, museums, etc.) (GOM, 2000).

b) **ICT Vision 2010 in Education Sector of Mongolia.** The vision for ICT in education has four major components, covering following areas:

1. Training: Full utilization of ICT in each educational level curriculum and its contents in order to introduce ICT possibilities and gain knowledge and skills in using it.
2. Hardware: A good supply of hardware enables better training and provides possibilities of free access to information.
3. Teaching staff: Support and encourage teaching staff who are able and keen to develop themselves in terms of their own knowledge and skills and keep up to date with the rapid development of ICT.
4. Information service: Ensure a variety of information service availability and accessibility by establishing educational information databases and networks. (MOES, 2001).

c) **E-Mongolia National Program.** The vision of the E-Mongolia National Program is to establish an information society structure and initiate a Knowledge-based society in Mongolia by enhancing the extensive application of ICT in all society sectors. The e-Education goals within the framework of this program are (GOM, 2005):

1. Achievement of an average international ICT literacy level by 2012 (80% of all capable people).
2. 70% of soums, 100% of provincial centers and cities will provide distance learning systems by 2012.
3. Creation of an e-schools model (50% of schools will have e-school capability by 2012).

d) **Master Plan to Develop Education of Mongolia in 2006–2015.** The ICT-related objectives for general education are (GOM, 2006):

1. Connect all schools to the Internet, and introduce ICT into training, information exchange, monitoring, evaluation and registration systems.
2. Organize ICT-based training for teachers and prepare training materials and manuals.
3. Establish classrooms with equipment for electronic training, and supply them with computers.
4. Apply e-software to monitoring, analysis and evaluation.

5. Connect complex schools and schools in regional centers to the national distance education network, and supply the necessary equipment.
6. Establish centers to provide ICT training and consulting services.

Expected outputs for the objectives above are:

1. Teachers will be trained to use computers and the internet in teaching, which will increase training efficiency.
2. E-training cabinets equipped with modern technology connected to the internet will be established and used in inter-soum and complex schools.
3. The environment and conditions needed for using e-training methodologies will be created in soum schools.
4. 10 students in senior grades, 104 students in secondary grades and 520 students in primary grades will be supplied with computer.
5. Example schools applying best practice in ICT application in training will be established.

e) **Science and Technology Master Plan of Mongolia 2007–2020.** The Master plan contains following five main goals, which are to be implemented through stages: 2007–2010 (1st), 2011–2015 (2nd), and 2016–2020 (3rd stage):

1. Establish and develop a competitive R&D sector.
2. Create an effective national innovation system.
3. Create a legal and institutional system of protecting and utilizing the results of R&D.
4. Reforming the economy on the basis of technological innovation.
5. Develop effective international co-operation in science and technology.

The Master plan includes the models for six targeted programs, which will serve as the main mechanism for the implementation of the objectives and activities of the Master plan:

1. Identifying and implementing S&T priorities and key technologies of Mongolia.
2. National Innovation System Development.
3. Enhancing S&T Information, Monitoring and Evaluation System.
4. Development of Advanced Technology in Mongolia.
5. Training and supporting young researchers.
6. Supporting university R&D (MOECS, 2007).

f) **National Program on Distance Education 2002–2010.** The main goal of the program is to improve the quality of official and unofficial services to give people an opportunity for lifelong learning to improve their living standards and to build a national distance education system. The immediate goals are to establish a distance education strategy coordination and management system; to create a mechanism for distance education services and activities; to develop the ability of human resources to train distance education specialists; to create a quality, beneficial, sufficient distance education environment; and to choose the most apt distance learning method, to process and implement its content and methodology.

The fast growing ICT market and the expanded use of ICT in the education sector are driving policymakers to improve current ICT policy and legislation in the education sector and develop a new regulatory framework.

3.2. *Hardware*

Hardware is a major component of the ICT infrastructure in schools. The availability of hardware is an essential condition for being able to use ICT in education and to conduct informatics training in primary and secondary schools. The Government of Mongolia is working towards achieving the goal of computerizing all schools and has started supplying computers to secondary schools and providing access to the Internet. The Master Plan to Develop Education in Mongolia in 2006–2015 (GOM, 2006) has as a target the radical increase of computerization in the general secondary schools. Specifically: to reach a ratio of students per computer in primary education from 1250 to 250 (250 students per computer), to reach a ratio of students per computer for middle grades from 250 to 50 and for senior grades from 25 to 5 (Table 1). Table 2 shows expenditures (in MNT) to be allocated from state centralized investment to computerization at the primary and secondary education.

MOES is working towards achieving the targets for computerization above at the general secondary schools. Unfortunately detailed data on the actual ratio of students per computer by school level that could be compared with these targets is not available. Each year MOES promotes the computerization of schools by providing a specific number of computers, and thankfully some public, private and government entities also provide some support for the computerization of schools. Compared to the beginning of 2000, when statistics show that there were about 600 computers in secondary schools, the situation has improved as a result of Government activity: in total 35103 computers are available in 752 secondary schools, or 46 computers per school on average. 30755 of these computers are used for training. The remaining 4348 computers are use used in school administration (MOES, 2012) (Table 3).

Table 1

Ratio of students per computer in primary and secondary education (GOM, 2006)

Student/computer ratio	Targets	Targeted years	Annual growth rate	2004–2006 base year	2005–2006	2008–2009	2010–2011	2015–2016
In primary	250	11	-13.6%	1250	1080	696	520	250
In lower secondary	50	11	-13.6%	250	216	139	104	50
In upper secondary	5	11	-13.6%	25	22	14	10	5

Table 2

Expenditures to be allocated to computerization at primary and secondary education (in MNT)

Year	2006–2010 average	2006–2010 total	2011–2015 average	2011–2015 total
Expenditure	3,301,705.6	16,508,528.2	5,103,900.8	25,519,504.3

Table 3

Number of computers in secondary schools, 2011–2012 academic years. (MOES, 2012)

School type	Number of students	Number of schools					Number of computers used for training	Number of computers per school	Number of students per computer
		Total	Primary (Grade 1–6)	Lower secondary (1–9; 7–9)	Upper Secondary (1–12; 10–12)	Complex school			
By school type									
Public	477073	614	45	140	381	48	27788	45.2	17.2
Private	28336	138	17	4	117	0	2969	21.5	9.5
By location									
Ulaanbaatar	186704	206	10	6	174	16	9643	46.8	19.4
Aimags	318705	546	52	138	324	32	21112	38.6	15.1
Total	**505409**	**752**	**62**	**144**	**498**	**48**	**30755**	**40.9**	**16.4**

According to statistics from the Ministry of Education, and Science (MOES), for the 2011–2012 academic year (Table 3) 27788 computers (used for training) are available in 614 public schools, or 45.2 computers per school and 17.2 students per computer in average. In private schools, 2969 computers are used for training in 138 schools, or 21.5 computers per school and 9.5 students per computer on average. In the schools of Ulaanbaatar (capital) city, 186704 computers are used in 206 schools, or 46.8 computers per school and 19.4 students per computer on average. Regarding aimag schools, there are on average 38.6 computers per school and 15.1 students per computer. Fig. 1 shows the number of students per computer for the year 2006–2011. There are no uniform standard or education sector-accepted hardware product specifications for secondary schools.

According to statistics, 16691 computers or 55.2 per cent of total computers used for training are Pentium IV or computers with higher specifications, which meet today's needs and requirements.

Computer usage and training in rural areas (aimags) are depending on infrastructure development and computer hardware supply. Moreover electricity supply creates inevitable problems unless solved by the government. Many soums have electricity problems due to their inability to pay the bills. Most schools are understaffed or lack trained staff able to handle and configure their computers. In the last few years, the computer supply

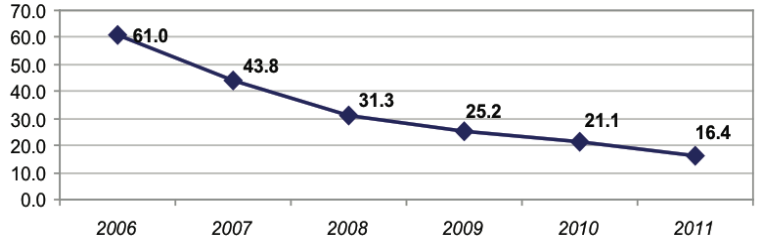

Fig. 1. Number of students per computer, 2006–2011 (MOES, 2011).

Table 4
Computer specifications in secondary schools, 2011–2012 academic years. (MOES, 2012)

School type	Total number of computers used for training	Number of computers by specification				
		Pentium I	Pentium II	Pentium III	Pentium IV and above	Notebook
By school type						
Public	27788	165	1431	2192	14410	9590
Private	2969	41	43	310	2281	292
By location						
Ulaanbaatar	9643	31	92	894	6891	1735
Aimags	21112	175	1382	1608	9800	8147
Total	**30755**	**206**	**1474**	**2502**	**16691**	**9882**

Table 5
Informatics laboratories in secondary schools, 2011–2012 academic years. (MOES, 2012)

School type	Total number of computers used for training	Number of Informatics laboratory	Number of computers per Informatics laboratory	Number of Pentium IV (and above) used for training	Number of Pentium IV (and above) per Informatics classroom	Number of students per Pentium IV (and above)
By school type						
Public	27788	655	42.4	14410	22	33.1
Private	2969	110	27	2281	20.7	12.4
By location						
Ulaanbaatar	9643	240	40.2	6891	28.7	27.1
Aimags	21112	525	40.2	9800	18.7	32.5
Total	**30755**	**765**	**40.2**	**16691**	**21.8**	**30.3**

Table 6
Equipment used in secondary school, 2011–2012 academic years. (MOES, 2012)

School type	TVs		Printers		Scanners		Copiers		Video cameras		LCD projectors	
	Total	per school	Total	per school	Total	per school	Total	per school	Total	per school	Total	per school
By school type												
Public	2452	4	4196	6.8	738	1.2	1479	2.4	401	0.6	1533	2.5
Private	377	2.7	470	3.4	154	1.1	207	1.5	90	0.6	207	1.5
By location												
Ulaanbaatar	943	4.6	1555	7.5	280	1.3	559	2.7	260	1.3	666	3.2
Aimags	1886	3.4	3111	5.7	610	1.1	1127	2.1	295	0.5	1074	2
Total	**2829**	**3.8**	**4666**	**6.2**	**890**	**1.2**	**1686**	**2.2**	**555**	**0.7**	**1740**	**2.3**

and hardware situation in primary and secondary schools has improved drastically in rural areas (aimags). However, there is a need to address the issue of supplying computers to soum schools. Moreover, the number of students per computer (number of students per Pentium IV or computers with higher specifications was 32.5, by 2011), maintenance, and troubleshooting still require attention.

3.4. *Internet Access*

In 1999, a network of academic institutions and schools – ErdemNet Internet Service Provider was established. According to statistics from the MOES, 489 schools were connected to the Internet. Most of them were connected via ADSL and fiber optic. 51 schools in soums were connected via VSAT. Fig. 2 shows the number of schools and computers connected to the Internet.

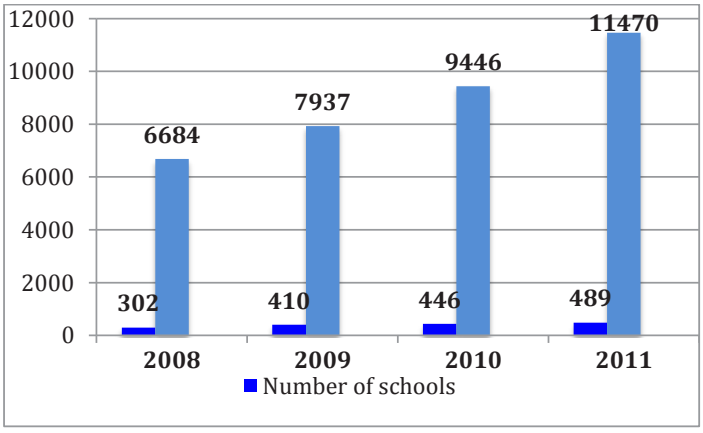

Fig. 2. Number of schools and computers connected to the Internet.

Table 7

Number of computers connected to the Internet, 2011–2012 academic years. (MOES, 2012)

School type	Total number of computers used for training	Number of students	Number of computers connected to the Internet	Number of computers connected to the Internet per school	Number of students per computers connected to the Internet
By school type					
Public	27788	477073	9326	15.2	51.1
Private	2969	28336	2144	15.5	13.2
By location					
Ulaanbaatar	9643	186704	5281	25.6	35.3
Aimags	21112	318705	6189	11.3	51.5
Total	**30755**	**505409**	**11470**	**15.2**	**44.1**

3.5. *Software and Applications*

There is no uniform technical standard or education sector-accepted software product specification for secondary schools. Most of the secondary schools use pirated Windows operating systems and non-licensed application programs such as Microsoft Word, Microsoft Excel, and Microsoft PowerPoint etc. Versions of existing Windows operating systems vary from computer to computer, causing difficulties for teachers, for the teaching of informatics, the use of school informatics textbooks, and the use of computer hardware and software. There were a number of initiatives to introduce open source Unix based operating systems in secondary schools, however most of them failed due to inadequate graphic user interface and uncommon use for home and school. For example the Sakura project provided second-hand computers using open source software (Linux-based operating system), the Star Office package and access to an e-mail system to several soum schools. Within the framework of the project, manuals were developed using Linux OS and the Star Office package and training was provided to teachers and students in their use (Ide, 2003).

Some software applications in Mongolian language were developed in the market such as touch-typing, spell checking, translators and thesaurus programs etc. The "ICT Vision 2010 in Education Sector of Mongolia" has a provision that says "School textbooks, guideline materials and teaching aids prepared on software programs and Internet web sites should be available for students and teachers. In this regard there should be a mechanism to protect Intellectual property and authors' copyrights (from the academic year 2001–2002)".

4. Informatics Training in General Education

4.1. *The Informatics Curriculum Standard for Primary and Secondary Education*

Over recent years, a number of activities took place to enhance the informatics subject curriculum, such as the development of standards, the training of informatics teachers, the development of training manuals and materials for informatics in secondary schools. The following informatics curriculums for secondary schools have been developed since 1988: Informatics Curriculum (MOECS, 1991), MNS-5001-498: Informatics Standard (MOECS, 1998) and Informatics Curriculum Standard for Primary and Secondary Education MNCSM (2004). The first informatics curriculum covers the basic concepts of informatics, the basics of algorithms and programming, word processing and spreadsheets. This curriculum was not fully covered due to the lack of computers, training was mostly concentrated on providing programming and algorithm development skills. In 1998 MOECS approved informatics standard for secondary education. The standard is (Uyanga 2002, p. 38):

- The identification of the level of learning materials for informatics for secondary schools.
- The formulation of informatics training requirements and required skills.

- This standard is a blueprint that confirms the presence of informatics in the training plan for secondary education.

This standard was current nationwide until the 2003–2004 academic year. From the results of the surveys (Table 8), it can be seen that the content of teaching related to the informatics standard such as basics of informatics, computer, human and computer interface, basics of algorithms, Windows system, text processing, spreadsheet, and solving problems of physics, math and other subjects is not sufficient. Programming, which is not included in the informatics standard, is still being taught in some schools (Uyanga, 2006).

While using ICT in teaching, attention should be paid not only to the technical provision of tools but also to the impact of ICT on students' minds, their ability to improve their knowledge, the teacher – students relationship and the roles of students and teachers. Until the year 2000, the above-mentioned issues were not addressed while developing the curriculum. One of the most important steps taken by government to improve informatics training was the development of the first standard for informatics education in the year 2000–2004. It is notable that this curriculum included the aforementioned points to some extent. In 2004, the Mongolian National Center for Standardization and Metrology approved the Informatics Education Standard for Primary and Secondary Education (MNCSM, 2004), which commenced in September 2005. According to this standard the subject of Informatics should be taught starting at the 5th grade from the academic year 2005–2006.

This standard has the following advantages (Uyanga *et al.*, 2004):

- The development of the educational standard of informatics by using the content standard of informatics in complete secondary education.
- It is focused more on competence based goals than on subjective goals.
- The content standard is based on domains of systematic knowledge of informatics science.
- It does not only assess knowledge and capability, but also students' ICT competencies are accumulated.
- The standard is tailored to primary and complete secondary education respectively.

Table 8

Inclusion of Informatics standard's contents in Informatics teaching (Uyanga, 2006)

Academic year	Basics of informatics	Computer	Human and computer interface	Basics of algorithm	Windows system	Text processing	Spreadsheet	Solving problems of mathematics, physics, and other subjects
1998–1999	69.1%	55.0%	25.8%	49.2%	31.5%	20.8%	25.3%	12.3%
1999–2000	61.0%	58.7%	16.3%	45.3%	33.1%	13.3%	22.7%	6.4%
2000–2001	42.1%	47.5%	18.3%	54.5%	29.2%	21.3%	23.3%	11.9%
2001–2002	61.3%	63.3%	27.0%	53.7%	40.8%	27.9%	32.9%	11.7%
2002–2003	65.3%	68.0%	23.3%	30.5%	50.0%	65.0%	30.4%	9.3%
2003–2004	62.8%	70.6%	20.4%	28.7%	57.2%	66.5%	32.6%	10.0%

- The content standard has clear focus: that trainees gain knowledge and skills in using informatics, computer and information technology effectively and efficiently, and in resolving issues met in practice and in other courses.
- The needs and demands in informatics education and standards are determined based on the needs of both individuals and society.
- The standard is supervised that teachers of informatics not only teach the informatics, computer and information technology, but also develop the skills of students to use them effectively and individually.
- The standard states that teachers of informatics should create an environment where the standard can be implemented successfully by supporting other teachers to use informatics, computer and information technology more widely in their teaching.
- Comprised the correlation between other subjects.
- The content is well suited to international standards, according to the contents of documents and standards for ICT education produced by specialized international organizations.
- It is independent of certain tools and types of information technology.

There are five content domains: Information, Computer, Algorithm, Model, and Information Technology (MNCSM, 2004). Each piece of information in particular domain is tightly linked with other pieces of content within the same domain and closely linked with that in other domains (Uyanga, 2005).

Informatics is taught from the 6th grade to the 12th grade. The total number of hours allocated to informatics for primary and secondary education is 314 hours, which is 3.8% of the total number of hours for grade VI–XII in an academic year. Table 9 shows the total number of hours for informatics subject per academic year and week by grade.

According to the survey on the implementation of the Informatics Curriculum Standard for Primary and Secondary Education (MNCSM, 2004) carried out within the framework of the Curriculum development of University Computing and ICT Education in Mongolia project (Uyanga and Munkhtuya, 2009a) in 46 secondary schools (12 of them in rural areas) during the 2008–2009 academic year, the Informatics Curriculum in all the schools comprised computer basics, such as the Windows operating system, text processing (Microsoft Word), design multimedia presentations (Microsoft PowerPoint), use of spreadsheets (Microsoft Excel) and was in accordance with the specifications of the Informatics Curriculum Standard. The study also confirmed that knowledge and skills defined in the information technology domain were offered to students. Standard contents such as service applications and database management were not included in the

Table 9
Organization of Informatics Subject (Grades VI–XII)

	VI	VII	VIII	IX	X	XI	XII	Total
Total number of hours in academic year	884	1190	1225	1225	1225	1225	1225	8199
Total number of hours for Informatics subject	34	35	35	35	70	70	35	314
Total number of hours per week	26	34	35	35	35	35	35	
Number of hours for Informatics per week	1	1	1	1	2	2	1	

curriculum in any of the 46 schools. A few schools still offered non-standard contents: programming (30.4%), web technology (15.2%) and publishing (17.3%). Regarding programming, the survey showed that schools were using languages such as C+ and Pascal.

Table 10
Topics of Informatics Content Standard

Domain	Primary Education (Grade VI)	Lower Secondary Education (Grades VII–IX)	Upper Secondary Education (Grades X–XII)
Information	Information (simple types, various forms of information); Representation of information (text, image, sound and video information); Information processing (input, output, transfer, storage, processing, information collection, examples).	Characteristics of information (measuring information, size and parameters, role of information in society, selection, use and evaluation of information); Representation of information (basic forms of representation of information, abstract representation); Information processing (information processing, coding, security, information search, basic steps of processing information; evaluation on information processing).	Information (information is a basic of cognitions, linkages between information and knowledge, information based society, roles of information in society, needs of information sharing, analysis and evaluation of information); Representation of information (various forms of representation of information and its analysis); Information system (components of informationsystem,simplesystems, analysis of information system).
Computer	Computer hardware (computer architechture, main components and their functions, technical and safety issues); Computer software (major types of software, widely used application software, user interface, operating system, standard and simple applications, touch typing).	Computer hardware (operation of computer system and its peripherals, printer, scanner, external storage devices); Computer software (operating system, file and its parameters, file and folder organization, standard applications, widely used menus and commands, multiple applications operating environment); Evolution of computers.	Computer hardware maintenance (functions of various peripheral devices, installation of peripherals, network, basic components of computer networks); Computer software maintenance (installation of applications, maintenance, hardware and software problems, spell checking, translators and thesaurus programs, multitasking environment).
Algorithm	Algorithms and their characteristics (operation, sequence, objective, sequence with linear operations); Algorithm executor and its command system.	Representation of algorithms (word and image representation, using symbols); Computer algorithm executor (computer algorithms, examples); Types of algorithm (linear and conditional algorithms, repetitions, examples).	Representation of algorithm (linear and conditional algorithms, repetitions, loops, types of representaion of repetition, checking and analysing algorithms).
Model	Object, entity, and its characteristics (entity, occurrence, object and its characteristics, physical and abstract models); Model (physical model, representation of an model of object, characteristics and forms of models); Modeling (role and needs of modeling, examples).	Object, operations on object (object environment, operations on object); Model and its types (geometrical and math models, logical models, examples); Modeling (relationship between problem and model, modeling, experimenting and analysing of model).	Model of information system (basic steps of modeling of information system, examples, design, anaysis and development of systems); Models of physical, math, biological and economics information systems (examples, design and analysis, computer processing of models, analysis and evaluation of models).

Domain	Primary Education (Grade VI)	Lower Secondary Education (Grades VII–IX)	Upper Secondary Education (Grades X–XII)
Information Technology	Information technology (simple technology and its examples, IT); Use of IT.	ICT development (ICT, use of IT, selection of IT, electronic development, examples, e-commerce, e-learning); Use of IT (touch typing, document processing, drawing application, spreadsheet, network, data exchange, internet, e-mail, coding standards, standard for mongolian cyrillic).	Information technology (current situation and development trends of ICT, ICT in society, electronic development, e-commerce, e-learning, e-governance); Use of IT (positive and negative impact of technology on human culture, document processing, multimedia presentation, spreadsheet, network); Internet usage (electronic communication tools, search engine, principles of information searching, e-mail, Internet services, Internet and web based learning, e-commerce, use of Internet for other subjects).

It can be concluded that implementation of the Informatics Curriculum Standard was not satisfactory. The survey highlights that computer and information ethics was studied only by slightly more than one third of the schools surveyed (16.7% of rural schools and 41.2% of Ulaanbaatar schools), while information culture was studied by 21.7% (16.7% of rural schools and 23.5% of Ulaanbaatar schools). Information and information systems were studied in 65.2% of the schools surveyed (25.0% of rural schools and 79.4% of Ulaanbaatar schools). The study also revealed that the curriculum coverage of contents for the information domain was not the same in urban and rural schools.

4.2. *Informatics Teacher Development*

Informatics teachers play a crucial role in the adoption and implementation of ICT standards and curricula in primary and secondary education. They also play a key role in adoption of ICT and its integration into education. The "ICT Vision 2010 in Education Sector of Mongolia" program has objectives to conduct training and re-training of teaching staff in education sector and to expand professional teachers' training activities to accommodate all professional teaching staff in information science, who are expected to rise by up to 90% in numbers by 2007. However, secondary schools still lack professional informatics teachers and some teachers of other subjects might potentially also teach informatics. The survey shows that mainly mathematics and physics teachers teach informatics at schools where there is no professional informatics teacher. In some remote area schools, informatics is taught by un-licensed personnel who are considered to be good with computers. The results of surveys show that the supply of informatics teachers is increasing.

Beginning in the academic year 2005–2006 due to the inclusion of the informatics curriculum in primary education, secondary schools in rural areas stearted retraining

their informatics teachers. However, they still lack professional teachers and most of the informatics teachers are graduates from basic computer training courses. It also happens that some students aremore IT-literate than their teacher.

However, any graduates related to ICT field may work as an informatics teacher. There are 24 ICT educational institutions in Mongolia, which train ICT professionals, of which 7 are public institutions, and the remaining are private institutions. There are over 6,000 students studying in those institutions, specializing in software engineering, network administration, information systems and management, hardware engineering, telecommunications engineering, postal services, electronics engineering, optic communications, television and radio technology, satellite and wireless communications, information technology, etc. (ICTPA, 2001).

Preparing informatics teachers includes both initial teacher education and continuing professional development. Informatics teachers must be given opportunities to regularly update their ICT knowledge and skills and modern teaching and learning methods, as well as to exchange views on changing curricula and pedagogical practices with the integration of ICT into education. At present, the School of Computer and Information Technology (SCIT) of the Mongolian State University of Education (MSUE), the School of Mathematics and Computer Science (SMCS) of the National University of Mongolia (NUM), the Khovd Branch of the NUM and the Arkhangai aimag Teachers College. The SCIT of the MSEU offers two separate courses, training teachers of math-informatics and informatics. The SMCS of the NUM offers math and informatics teachers training. These institutions have compulsory courses such as Informatics didactic, Informatics contents which aim to deliver vision, contents and assessments of informatics standard. Future informatics teachers participate in the practice of teaching informatics at secondary schools 2–3 times in month during their study. The aforementioned institutions are planning to update their curricula to reflect the new informatics curriculum. Updates will be made to the curriculum to cover areas such as teaching informatics to primary school pupils; the use of modern active teaching and learning methods; developing the curriculum; choice of training content materials.

In order to increase the supply of informatics teachers, the government is taking various measures such as encouraging applicants from rural areas in terms of tuition fee discount; scholarship under local government contract; retraining of teachers etc., These steps still cannot solve the need for informatics teachers. Graduates with informatics teacher certification in most cases move to work in non-educational sectors, such as government and non government organizations, private enterprises and companies. The SCIT of the MSEU and Institute of Education are responsible for Informatics teacher re-training and development. There are two curricula: one for informatics teachers and another for non-informatics teachers. Nationwide re-training of informatics teachers has been organized since academic year 2005–2006 so as to enable teachers to follow the new standards. Even though extensive re-training and courses have been conducted for informatics teachers, there is still a considerable demand and need for basic to advanced levels of ICT training for informatics teachers. The SCIT of the MSUE has organized a nationwide module training for 650 informatics teachers in 2012 (SCIT, 2012).

4.3. *Teaching and Learning Materials*

Although the availability of hardware, software and teaching staff are essential conditions for being able to conduct informatics training in primary and secondary schools, it is obvious that the availability of teaching and learning materials is essential too. Informatics teachers use a range of teaching materials, such as hardcopy support, audio-visual materials, computers and peripherals, school informatics textbooks, various office application manuals, software and applications etc. In many cases the teachers themselves create materials such as hardcopy support and audio-visual materials.

When the teaching of informatics in Mongolian secondary schools began, an informatics textbook translated from Russian (Ershov *et al.*, 1985) was used. The first Mongolian informatics textbooks were "Informatics 9" (Batbaatar, *et al.*, 1989) and "Informatics 9–10" (Jagdal and Choijoovanchig, 2001). All Informatics textbooks for 5–12 grades (Choijoovanchig *et al.*, 2008, 2009, 2010, 2011, 2012) were developed according to the new Informatics Education Standard during the year 2005–2009. The MOES is re-developing all Informatics textbooks and teacher's guide book in regard to transferring. The teaching materials for informatics teachers are not limited only to informatics textbooks but there are also CDs, computer and IT related books on subjects such as programming languages, application programs and Internet use. In addition, educational broadcasting television programs provide some basic training in ICT.

4.4. *Content Linkages in ICT Training in General and Tertiary Education*

ICT training in tertiary education is divided into compulsory and specialized ICT training. Compulsory ICT training in tertiary education must be tightly linked to and lead on from Informatics lessons in secondary schools and become a tool for other subjects. Compulsory ICT courses at the tertiary level are offered under various names such as "Introduction to Computers", "Introduction to Informatics", "Application programs", "Using Computers", "Computer applications" etc. Compulsory ICT training aims to give appropriate knowledge and skills for using ICT as a tool in their future learning activities. There are no common standardsofor ICT training in tertiary education nationwide. The subject contents are concentrated on the basics of computers and application programs. Most of the contents of compulsory ICT training in tertiary education is the same as the contents of informatics training in secondary schools. However no advanced contents are to be found in tertiary education. From surveys and research conducted at the end of 2010, one may conclude that the contents of compulsory ICT training in tertiary institutions commonly consists of the basics of computers, the Windows operating system, word processing, spreadsheets, multimedia presentation, Internet use and networking (Uyanga and Munkhtuya, 2009b). These common contents were previously taught in the informatics curriculum for secondary education and are still at the same level as in secondary education, without any linkages or improvements. Also the linkage between the contents of compulsory ICT training in tertiary institutions is not clear.

5. Conclusion

Computer training and informatics as a subject has been included in the secondary school curriculum in Mongolia since 1988. Over time a number of actions were taken to enhance the informatics curriculum, such as the development of standards, the training of informatics teachers; the implementation of ICT related projects and initiatives, the development of training manuals and materials for informatics in secondary schools.

Recently great emphasis was given to the setting up of ICT infrastructure and providing computer literacy. At present, specially designated policy is needed to support effective use of ICT in education and to incorporate it into the policy on educational innovations and activities like teaching and learning. It is crucial to integrate ICT with the curriculum of each subject so this could replace traditional teaching methods with new teaching tools and technology (Uyanga *et al.*, 2004). The impact of ICT on students' behaviour, the development of student skills to use ICTs for their life long learning activities and teacher student relationships are some critical issues to be considered in developing the curriculum. The internet and computers are not widely used for teaching except in Informatics. On the other hand, there is not much opportunity to initiate training based on ICT in schools, as in developed countries. This is related to the hardware and software supply, infrastructure and teacher competence. There are 30755 computers in 752 schools, or 40.9 computers per school in average. Students per computer ratio were 1:16.4 in the 2011–2012 academic year. Considering the above-mentioned situation and current circumstances, it is appropriate to improve Informatics teaching and to initiate ICT education on the basis of informatics with direct involvement from informatics teachers. There are a number of constraints on ICT in education in Mongolia, each of which needs to be addressed within the framework of policy and regulation, infrastructure development, human development and capacity-building, and content and learning materials. Strengths, weaknesses, opportunities, and threats in ICT education are presented in Table 11.

Table 11
SWOTs

Strengths:	• Adequate policy and regulation environment in intro-ducing ICT into the education sector. • ICT training experience of 25 years. • Public and private organizations support computeri-zation of schools. • Recognition of the importance and needs of ICT education. • Wide utilization of Information technology for daily life. • ICT teacher supply is increasing. • All Informatics textbooks and curricula have been re-developed wth respect to transferring to the 12 year schooling system. • Government institutions train professional ICT/informatics teachers. • The teachers see the main difference between tradi-tional and computer-based training as saving time, motivating students, lightening workload, and displaying teaching aids easily. • The fast growing ICT market and expanded ICT use in education sector are driving policymakers to improve current ICT policy and legislation in education sector and develop a new regulatory framework. • Computer supply is increasing. There are 30755 com-puters in 752 schools, or 40.9 computers per school in average. Students per computer ratio are 1:16.4 in 2012 (there are 3100 computers in 613 schools, or five computers per school in average. Students per computer ratio are 1:80 in 2004).

Weaknesses:	• Undeveloped infrastructure in remote areas. • There is no uniform standard or education sector-accepted software and hardware product specifications. • Insufficiency of computers used in training (there are 30755 computers in 752 schools, or 40.9 computers per school in average. Students per computer ratio were 1:16.4 in 2012). • Theoretical and methodology research of teaching ICT in pri-mary school and integrating to other subjects. • Due to lack of computers and professional teachers the skills and knowledge transferred to learners do not meet the minimum standards of informatics education. • No mechanism to repair and main-tain school computers. • Lack of professional informatics teachers.
Opportunities:	• Bring together educational organizations and busi-nesses. • Integrate ICT into other subjects. • Further develop the informatics content for the specia-lized training classes. • Allocate a specific amount of money in the state budget for the computerization of secondary schools. • Re-train teachers and involve graduates in informatics teacher training.
Threats:	• There is misunderstanding that ICT education is just a computer literacy or knowledge of widely used applications. • High turnover of informatics teachers. Graduates on informatics teacher in most cases move to work in non-educational sectors. • The consequences of inadequate com-puter supply will result in suspension of the teaching of informatics.

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IKT taikymo bendrajame ugdyme Mongolijoje analizė

Sambuu UYANGA

Šiandien IKT taikomos beveik visuose Mongolijos ekonomikos ir visuomenės sektoriuose. Vis didesnis dėmesys skiriamas IKT integracijai į ugdymą. Pagal dabartinę švietimo reformą yra parengta IKT taikymo struktūrinė programa, kurioje pateiktas ir išplėtotas nacionalinis IKT integravimo į švietimo sektorių planas. Jame aptariami IKT taikymo švietime politikos, infrastruktūros, techninės ir programinės įrangos, žmogiškųjų išteklių, turinio kūrimo ir kt. klausimai. Straipsnyje pristatoma dabartinė Mongolijos IKT taikymo bendrajam ugdymui situacija. Taip pat aptariami IKT taikymo švietime privalumai, trūkumai, galimybės ir grėsmės.