Embedded Selforganizing Systems

A Competency Framework Implementation for International Public in the Information, Communication and Technology

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Abstract - Due to the 4th industrial revolution, technology is evolving and new employment are being created in significant numbers, but many jobs are expected to be eliminated from the market as well [1]. Therefore, citizens of the 21st century need to improve their knowledge of ICT in order to adapt to the digital transformation and acquire the skills required for new jobs. International organizations and the private sector have developed digital skills framework while providing the global digital skills and assess education levels. In this study, a total of 12 frameworks and skills of ICT competency frameworks and skills issued by countries and private sector organizations that are widely used internationally which are leading in ICT competence of citizens have been analyzed. Furthermore, the researchers studied the measures and implementation in several countries in the field of improving public information, communication and technological knowledge and skills.

Keywords – digital, skills, competency, framework, ICT, technology

I. INTRODUCTION

In the information age of the 21st century, information, communication, and technology (ICT) is developing rapidly. It has already taken a certain place in our daily work and lifestyle. Moreover, ICT skills have been identified as one of the fundamental skills of humankind.

Due to the 4th industrial revolution, technology is evolving and new employment are being created in significant numbers, but many jobs are expected to be eliminated from the market as well [1]. Therefore, citizens of the 21st century need to improve their knowledge of ICT in order to adapt to the digital transformation and acquire the skills required for new jobs. Due to the global pandemic of COVID-19, there was a need to keep distance between people, and with the help of ICT, we were working, learning and communicating online, so there was an urgent need for everyone to develop digital skills.

"Sustainable Development - 2030 Program" was first initiated in Rio de Janeiro in 2012 during the United Nations "Sustainable Development" conference, which was attended by heads of state. The Sustainable Development Goals (SDGs) are a continuation of the "Millennium Development Goals" that concluded in 2015 and the 70th session of the United Nations General Assembly approved 17 goals and 169 goals of the SDGs in 2015.

The "Sustainable Development Goals" (SDGs) have been in effect since January 1, 2016, and are a long-term global policy framework aimed at achieving sustainable development based on three pillars: social, economic, and environmental. SDG-4, objective 4.4, which aims to provide accessible and equal quality education and support lifelong learning opportunities for all by 2030, includes relevant skills for employment, decent work, and self-employment, including technical and professional skills, in order to increase the number of young people and adults by [x] percentage [2]. However, while assessing progress toward this goal, the proportion of adults and young people with information, communication and technology skills is studied by type of skills. Both targets and indicators represent countries' commitments and visions.

Furthermore, it is clear that each country has different contexts, and these different contexts and country's priorities need to be reflected in the development of measurement methodologies to generate the internationally comparable data needed to monitor SDG-4 progress [3]. Besides, the Global Alliance for Monitoring Training (GAML) created a working group of experts and country representatives led by the GEM Report. This work was important as the UNESCO Institute for Statistics (UIS) collects internationally comparable data on education for SDG-4 indicators, the Global Education

Monitoring Report (GEM) analyzes the results, and the University of Hong Kong's Education Information in cooperation with the Center for Technology (CITE) and the GAML working group, the first version of the Global Digital Literacy System was developed [4].

International organizations and the private sector have developed a digital skills framework in order to provide global digital skills and assess education levels [5]. In this study, 12 frameworks of ICT competences have been analyzed from countries and private sector organizations in order to define and develop the fundamental framework of information, communication, and technology skills in Mongolia, which can be widely used internationally and increase citizens' ICT competences. The following relevant international sources were collected and studied to compare the framework of the ICT competency framework implemented internationally (table 1).

TABLE I.   INTERNATIONAL ICT COMPETENCY FRAMEWORK RESEARCH LIST

№	ICT Competency Framework	Developed area	Date of processing	Types and categories
1	Digital Competency Framework for Citizens	European Union	2013 (First version), 2022 (Version 2.2)	National, concept
2	A Competency Framework of Global Digital Literacy Competence	UNESCO	2018	International Organization, Empirical
3	Digital Literacy Certificate	Microsoft	2019	Institutional, Certification
4	Digital Literacy Program	IC3	2015	Institutional, Certification
5	International Computer Driving License (ICDL) Digital citizens	ECDL, ICDL	2015	Institutional, Certification
6	Skills Framework to bring digital skills to real results	DiSTO Project, London School of Economics	2014	Institutional, Output (Research and evaluation)
7	Digital Competency Core Framework	UK, Department for Education	2018	National, Empirical
8	Singapore's Integrated Digital Competency Framework	Republic of Singapore	2021	National, Empirical
9	Digital Competency Framework for Adults	US State of Maryland, Department of Labor	2019	National, Empirical
10	Digital Competency Framework	Philippines	2013	National, Empirical, Curriculum
11	Digital Competency Framework	Quebec, Canada	2019	National, concept
12	Digital Competency Framework	UK, Wales	2015	National, Empirical, Curriculum

Singapore, the Philippines, and Kazakhstan, which implemented the digital literacy framework in Asia, were studied. These countries were selected specifically because they have successfully implemented digital transformation programs and campaigns and have shared characteristics with Mongolia.

- According to the World Competitiveness Center's (IMD) 2022 report, Singapore ranks fourth out of 63 countries, Kazakhstan ranks 36th, and the Philippines ranks 56th. [6]

- Singapore has nearly the same population as Mongolia, with 5.4 million people, yet it is considered the 7th smartest city in the world out of 141 countries, or the leading place in Asia, according to the 2023 IMD Smart City Index for third year running. It also tops the globe in digital access, participation, and skill assessment. [7]

- According to a 2021 survey conducted by the PIDS (Philippine Institute for Development Studies) in the Philippines, only around 40 percent have at least one of the six information and communications technology (ICT) skills monitored for the Sustainable Development Goals. Furthermore, youngsters aged 10 to 14 and citizens aged 65 and up have the lowest digital skills.

- Kazakhstan was an autonomous nation, and it is culturally, economically, and geographically comparable to our country. Literacy rates among adults are 99.5%. Primary (grades 1-4), secondary (grades 5-9), and upper secondary (grades 10, 11, 12) education is provided to children. The e-Kazakhstan campaign was initiated, and attempts to accelerate the digital transformation were implemented in each sector, with positive results.

II.   A COMPARATIVE ANALYSIS OF INTERNATIONAL digital COMPETENCY FRAMEWORKS

International organizations and the private sector have developed a digital skills framework to provide global digital skills and assess education levels.

The framework includes the appropriate skills that citizens need to use information technology properly on a daily basis. International frameworks that are currently in use include, for instance, the UNESCO Global Framework for digital Skills; the European Commission's DigComp framework; Economic Cooperation Development Institutional Framework; national and sub-national or British Columbia digital skills guidelines; as well as ICDL issued by the enterprise; Microsoft and IC3 [6].

Furthermore, governments are prioritizing digital skills as essential for citizens' formal and informal education, and they are designing and implementing ICT competency frameworks. There are numerous digital literacy competency frameworks in use around the world, divided into national and institutional frameworks.

Fig. 1. The following figure shows the framework countries are implementing [1]

When comparing ICT Frameworks used internationally:

1. Countries are implementing several types of frameworks depending on their policies.
2. Eleven countries are developing and implementing their own national frameworks, 7 of which are implementing a combination of frameworks issued by organizations. On the other hand, 36 countries are implementing frameworks issued by institutions only.
3. Forty-three countries are implementing the three types of institutional frameworks across the country.
   a. International Computer Driver's License (ICDL) - 31 countries.
   b. Certiport Internet and Computing Core Certification (IC3) - 13 countries.
   c. Microsoft Digital Literacy Standard Curriculum - 11 countries.
4. Some countries implement several institutional frameworks, and Colombia, Egypt, Indonesia, Oman, Qatar, Rwanda, South Africa, Thailand, and the United Arab Emirates implement a combination of 2 types of frameworks. However, Malaysia and Vietnam implement 3 types of frameworks.
5. Information Technology National Park of Mongolia conducts ICDL certification exams, and there is currently no integrated ICT competency framework in Mongolia.

A total of 12 ICT competency frameworks and skills issued by the private sector and international organizations of countries that are widely used internationally and leading in ICT competence of citizens were studied.

When comparing these competency frameworks researched together, a total of 9 skills are iterative and characteristic. It includes the following:

1. *Information and data literacy*: Using ICT to identify, search, obtain, store, collect, organize, process, and analyze information, evaluate, judge, and properly use information [7-18].
2. *Communication and collaboration*: It means to be aware of the characteristics of culture and age, communication, support, and cooperation based on ICT. Join social networks and communications, communicate, and connect in the online environment, share resources, collaborate, raise awareness, and foster appropriate and civilized use of the online environment. [7-18].
3. *Digital content creation*: Creating and editing new content using ICT (editing words, images, videos, web pages, etc.), combining and reworking previous knowledge and content; creative expression and creation, handling and application of intellectual property rights and licenses. [7-18].
4. *Safety*: In the digital environment, take responsibility for your information, physical and psychological health, protect human rights and freedoms, ensure the accuracy of information, and take measures to protect safety [7-9], [15].
5. *Problem-solving*: Determining ICT needs, problems, applications, and resources, choosing the optimal tools and devices for the purpose, making decisions, solving problems with electronic tools, and obtaining digital services. [7-8], [14-15].
6. *Devices and software operations*: Identify and use basic ICT concepts, hardware, and technology, and understand how to apply software applications [8], [12], [14-15].
7. *Computational thinking*: Selective use and management of ICT according to needs, solving problems using programming technology [12].
8. *Concepts of ICT*: Explain basic concepts related to the use of information communication technologies (ICTs) in an increasingly digital world [10-11], [17].
9. *Career-related competencies*: Acquiring ICT skills that are required for specific field [8], [15], [17].

III. INTERNATIONAL EXPERIENCE

In this study, measures and implementation in several countries in the field of improving universal information, communication and technology knowledge and skills have been studied. It includes,

A. Experience of the Republic of Singapore

The Unified Framework for Digital Literacy in Singapore (UFDL) aims to promote digital skills as part of the Digital Readiness Blueprint. It targets strengthening the coordination between all kinds of systems, programs and campaigns implemented in Singapore, and to bring people's digital skills to a unified level. Implementation of the UFDL will have many impacts on the lives of the citizens of the country, and examples of the DigComp framework provided by the European Commission have been adapted to the Singapore context [19].

The Unified Framework for Digital Literacy in Singapore will be used to:

- Citizens who have limited or no prior knowledge of information, communication and technology will learn the necessary daily skills.

- Jobseekers reflect and evaluate their digital skills in their CV.

- Identify the skill when employers write job descriptions.

- For use by recruiters to exchange job information or provide professional advice.

- Use education and training centers and long-term training institutions in the development of service policies.

Implementation of an integrated digital skills framework: Concepts of UFDL and other international digital skills programs are compared, and three digital skills programs that can be adapted for UFDL implementation are discussed.

B. Experience of the Republic of Kazakhstan

Nowadays, digital money, digital services, and communication are closely linked to everyone's daily life. With the active entry of the national program "Digital Kazakhstan," the term "digitalization" is used not only in the major industries and economic sectors, but also in everyone's daily social life. For example, eGov.kz was developed as an e-Government portal aiming at providing citizens with easy access to government services. However, due to the numerous issues that the people of the country experience, such as a lack of awareness of the digital environment and the usage of technology, new approaches are required to fully implement the service.

Kazakhstan conducts its program solely under the ICDL (International Computer Driving License) framework issued by the European Commission. As of 2016, Kazakhstan ranks 52nd out of 175 countries in terms of global information, communication, and technology development, and has set a goal of becoming 30th in 2022, 25th in 2025, and 15th by 2050 [20]. In order to be accessible to everyone who wants to acquire the necessary digital skills and expand their reach, an open national education platform has been established, on which e-learning courses are conducted with the participation of teachers and professors from the University of Kazakhstan. In 2018, digital skills courses were organized all around Kazakhstan, with the aim of providing free education to everyone who wants to enhance their following skills.

1. General digital skills - Use of desktop computers, laptops, mobile phones, the internet, and protection of safety in the digital environment.

2. E-Government and public services - How to use the e-government portal and get government services from your phone without leaving home.

3. Open Governance - Open information, open legal acts, open discussion, and budgeting.

4. E-commerce - Buying and selling goods and services online.

The training was held in schools, colleges, and libraries, and more than 2729 institutions of Kazakhstan participated. Thus, up to 83% of the population is expected to improve their digital skills in 2022.

C. Experience of the Republic of Philippines

The vision of imparting digital skills has always been part of the country's education system. A detailed and strategic digital skills plan was launched in 2013-2014 as part of the country's education system's K-12 plan, or a curriculum to teach children from kindergarten through high school. The Philippines conducts programs in the following areas:

1. Digital Concepts - Explain the general concepts of information, communication and technology applications.

2. Digital Operations and Management - Demonstrate knowledge of basic computer hardware and software operations, and file management.

3. Digital programs - Use of office software packages as a tool to solve problems encountered in everyday life in document processing and information management.

4. Networking of digital systems - Moving to global digital systems to find information and resources, and to interact with others in our daily lives.

5. Devices - Using mobile devices as a means of accessing information and communicating with others.

6. E-ethics - demonstrate ethical practices and values for using technology in the 21st century

Statistics show that 63 million people in the Philippines do not have basic digital skills, and many young people are unable to get an education due to economic incapacity. Therefore, a major program implemented in the country is Digibayanihan (Touch, Train,Transform). It is a movement to equip Filipinos with digital skills and aims to include people in remote areas such as the Visayas and Mindanao [21].

Moreover, the Philippines has been implementing an digital skills program under the Microsoft Digital Literacy Standard Curriculum along with the national digital skills program for 25 years. By 2023, the Philippines has set a goal of training 25 million citizens in digital skills and job training.

IV. DISCUSSION

It is necessary to compare the framework of international digital skills, for the purpose of promoting a digital citizen with the necessary skills to adapt to the digitalization, to reflect it in the framework of Mongolia's general ICT competence structure, and to develop it based on national characteristics.

V. CONCLUSION

A total of 12 frameworks and skills of ICT competency frameworks and skills issued by the countries and private sector organizations that are widely used internationally which are leading in terms of ICT competence of citizens have been studied. A total of 9 competencies were replicated across these studied competency frameworks. Hence, ICT competence encompasses a wide range of complex competences rather than just using applications and communicating online.

Nowadays, the countries of the world are developing the competency framework of ICT capabilities based on their

national characteristics and improving them in line with their development goals. According to the research, one country implements one or more frameworks (National-enterprise, Enterprise-enterprise, National-national), which means that these frameworks alone cannot fully cover the conditions for national digital skills and reach citizens.

There is currently no comprehensive ICT competency framework in Mongolia. Citizens of the 21st century need to improve their knowledge of information, communication, and technology to adapt into the digital transition and acquire the skills required for new jobs. Therefore, there is a need to define the competency framework of universal ICT capabilities in Mongolia.

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