

knowing ICT literacy and use. In order to develop such individuals, the following factors must be considered in national educational system [7]. First, it is important to foster individuals with self-study ability. Second, it is necessary to raise individuals with creative thinking and problem-solving ability. Third, each individual must deal with global world. Fourth, it is important to realize that everyone belongs to a community.

With advances in smart device technologies, the existing PC-based environments have faced the rapid changes. Smart technologies have brought so called “Internet in the palm”. More and more people have various smart devices such as tablet PCs and smart phones. Smart technologies are changing our daily life very quickly and dramatically. Those technologies have also affected education areas so that the new concept called “smart learning” is created.

Smart learning is an important and new paradigm of learning. The concept of smart learning plays an important role in creation of an efficient learning environment that provides personalized contents and easy adaptation to the current education model [5]. There is no agreement on the definition of smart learning. In [6], the principle of smart learning has the following three elements: First, rich instructional resources as learning contents, Second, participatory learning environments with interactions among teachers and learners as learning methods, Third, practical and realistic contexts as learning environments.

Literacy standards are very helpful to test extensive status and competitiveness of an individual, a group, a society, and a nation for a specific area. However, development of a literacy standard is a very difficult task that includes time-consuming work and extensive survey from various experts. Also, literacy standards can be changed and updated time after time in order to ensure correctness and up-to-date status. ICT literacy and smart literacy are very important measurements to improve digital divide. For example, smart literacy standards are used to check progress of informatization for the disabled every year.

There are some ICT literacy standards in literature works. However, there have been a few works on smart literacy standards. Those smart literacy standards have some drawbacks and need to be updated. In this paper, we proposed smart literacy standards for teachers and students.

The purpose of this paper is to develop smart literacy standards for teachers and students. The proposed literacy standards are developed based on the existing ICT literacy standards. In this work, smart literacy standards include four main areas, smart education, smart knowledge, smart application, and smart ethics, respectively. For development of smart literacy, wide experts from teachers, professors, and researchers are selected and surveyed. Their responses are analyzed using through statistical analysis.

This paper is organized as follows. First, in Chapter 2, we discuss literature reviews for ICT literacy and smart literacy. In Chapter 3, we propose smart literacy standards for teachers and students. We collect responses from expert groups and do wide statistical analysis. Based on statistical analysis, we propose final smart literacy standards. Finally, in Chapter 4, we discuss conclusions and further research works.

2. Literature Reviews

2.1. ICT Literacy Standards

There are some definitions of ICT literacy. In [9], ICT literacy is used for digital technology, communications tools, and/or networks to access, manage, integrate, evaluate, and create information in order to function in a knowledge society. Especially, there are five components of ICT literacy.

- Access: knowing how to collect and/or retrieve information
- Manage: applying an existing organizational or classification scheme.
- Integrate: interpreting and representing
- Evaluate: making judgments about the quality, relevance, usefulness, or efficiency of information
- Create: generating information by adapting, applying, designing, inventing, or authoring information.

In [1], the ICT literacy assessment for secondary school student is developed to evaluate their ICT literacy level. To do this, the concept of ICT literacy and framework of the test were developed on the basis of literature review works and opinions from expert groups. Item pool was developed

under the strands of ‘contents’ and ‘abilities’. The strands of contents were categorized into 3 dimensions: i) computer and network, ii) information processing, and iii) information society and ethical issues. The strands of abilities were categorized into 6 dimensions: i) to identify a problem, ii) to process information acquired, iii) to evaluate the reliability of information acquired, iv) to create and re-organize information acquired, v) to utilize and manage information acquired, and vi) to communicate and share with information.

In [4], the ICT literacy of primary and secondary school students in Korea is developed and evaluated. In their work, ICT literacy was defined with 6 competencies namely *define, access, evaluate, create, manage, and communicate*, respectively. For this study, web-based multiple choice tests and performance tests were conducted at the Core level and the Advanced level depending on student age. Overall 12,165 primary school students (from fourth to sixth grade, core level) and 14,699 secondary school students (from seventh to ninth, advanced level) took the test. The ICT literacy levels were categorized as “below basic”, “basic”, “proficient”, “excellent” using bookmark method.

The following results are obtained after wide statistical analysis. The average score of the Core level test was 57.41 (scaled score of 100 points, SD=6.41), the average score of the Advanced level test was 59.91, SD=6.65). In both the Core and Advanced level tests, higher grade students had higher average scores. Especially, in Core level, for high grade students, for those living in big cities,

2.2. Smart Literacy Standards

Smart literacy is defined as follows [9]. Smart literacy is the abilities to obtain basic technological skills to handle a smart device, judge and assess the value of information provided in a smart environment, creatively solve a problem by sharing knowledge with others through smart media, and practice social responsibility. Smart devices include all kinds of tablet PCs and smart phones based on wireless communication technologies.

According to their work, smart literacy has the following components. Functional literacy includes ‘hardware and digital technology, software, and network’. Critical literacy includes ‘content, interface, and user’. Social literacy

includes ‘communication, law, and social contribution’.

Functional literacy has the following subareas.

- Hardware and digital technology: understanding the functions of smart media and utilizing service
- Software: finding necessary information by utilizing diverse applications on a smart device
- Network: engaging in active communication with others by utilizing various programs on a smart device.

Critical literacy has the following subareas.

- Content: having knowledge about required information, finding and utilizing the information in any space, and judging the reliability of the acquired information.
- Interface: producing new information actively and providing or distributing the information through a smart device.
- User: doing cooperative activities with others such as production, participation, and sharing in a smart environment and having the capabilities to make proper use of information through critical judgment.

Social literacy has the following subareas.

- Communication: having the capability to empathize with others in smart media.
- Law: observing a stable of norms including libel, violation of privacy, distribution of false information, and copyright in a smart environment.
- Social contribution: practicing social responsibility through smart media.

In [2], smart literacy standards for students are proposed. Smart literacy standards for students consist of 30 multiple choice items. The smart literacy standards consist of three main parts, that is, smart media understanding, smart media application, a smart media world. The ‘smart media understanding’ area has three subareas, understanding of smart devices, understanding of software, and understanding of cloud computing. The ‘smart media application’ area has the following subareas: analysis of information, contents production, and application of information. The ‘smart media world’ has the following subareas: smart society, smart culture, and smart ethics.

The existing smart literacy standards have the following

problems. In [9], smart literacy standards are too general. It is quite possible that students may respond in their subjective manner. On the other hand, smart literacy standards in [2] are too specific and practical. The standards are device-specific and software-specific so that the standards need to be updated for up-to-date technologies.

3. Development of Smart Literacy Standards

3.1. The Initial Development of Smart Literacy Standards

In order to develop smart literacy standards, we surveyed the existing ICT literacy standards and smart literacy standards. Also, we consulted with smart learning experts from professors and researchers. Our smart standards consist of 4 areas: smart education, smart knowledge, smart application, and smart ethics, respectively for both teachers and students. Especially, smart knowledge area has the following subareas: hardware, software, and network for teachers and students. Also, smart application area has the following subareas: information use, information creation, and information sharing.

The following tables show smart literacy standards for teachers.

(Table 1) Smart Education Area: Teacher

Number	Standard
1	I understand characteristics of smart learning
2	I can apply smart-based education to real class activities
3	I can teach students how to use smart devices
4	I have some training experience on smart-based education
5	I have IT-related certificate(s)

(Table 2) Smart Knowledge Area: Teacher.

Number	Standard
Hardware	
6	I understand internal components and functions of smart devices
7	I know well how to use smart devices
8	I understand the basic concept of cloud computing

Number	Standard
Software	
9	I understand the operating system of smart devices
10	I can install the necessary software in smart devices
11	I understand how to use QR code
Network	
12	I know how to connect smart devices to wired/wireless networks
13	I know how to connect smart devices to other devices with network sharing

(Table 3) Smart Application Area: Teacher

Number	Standard
Information Use	
14	I can search the necessary information using smart devices
15	I can listen music using smart devices
16	I can play video data using smart devices
17	I can move or copy data in smart devices to external storage devices
18	I can copy or remove data in smart devices
19	I can create a new folder in smart devices
Information Creation	
20	I can create text data using smart devices
21	I can create sound data using smart devices
22	I can create video data using smart devices
23	I can create graphic data using smart devices
Information Sharing	
24	I can exchange data with other people using smart devices
25	I have used SNS using smart devices

(Table 4) Smart Ethics Area: Teacher

Number	Standard
26	I can teach ethics in smart environments to students
27	I know ethics on such as privacy information protection, copyright, netiquette in cyber space
28	I know information security methods in smart environments
29	I know laws and regulations on privacy information protection and copyright
30	I know how to diagnose and prevent smart phone addiction

The following tables show smart literacy standards for students

(Table 5) Smart Education Area: Student

Number	Standard
1	I understand characteristics of smart learning
2	I have taken course(s) based on smart learning
3	I have taken course(s) on smart contents creation
4	I have IT-related certificate(s)

(Table 6) Smart Knowledge Area: Student

Number	Standard
Hardware	
5	I understand internal components and functions of smart devices
6	I know well how to use smart devices
7	I understand the basic concept of cloud computing
Software	
8	I understand the operating system of smart devices
9	I can install the necessary software in smart devices
10	I understand how to use QR code
Network	
11	I know how to connect smart devices to wired/wireless networks
12	I know how to connect smart devices to other devices with network sharing

(Table 7) Smart Application: Student

Number	Standard
Information Use	
13	I can search the necessary information using smart devices
14	I can listen music using smart devices
15	I can play video data using smart devices
16	I can move or copy data in smart devices to external storage devices
17	I can copy or remove data in smart devices
18	I can create a new folder in smart devices
Information Creation	
19	I can create text data using smart devices
20	I can create sound data using smart devices
21	I can create video data using smart devices
22	I can create graphic data using smart devices
Information Sharing	
23	I can exchange data with other people using smart devices
24	I have used SNS using smart devices

(Table 8) Smart Ethics: Student

Number	Standard
25	I know ethics on such as privacy information protection, copyright, netiquette in cyber space
26	I know information security methods in smart environments
27	I know how to diagnose and prevent smart phone addiction

3.2. Statistical Processing and Sampling Method

The following statistical processing methods are adopted for this study. First, for each response from each standard, frequency analysis is performed. Second, descriptives such as average and standard deviation are used for check importance of each area. Third, cronbach's is used for checking reliability of smart literacy standards for teachers and students. Fourth, for empirical analysis of this study, significance level $p < .05$, $p < .01$, $p < .001$ are used.

For our statistical analysis, 17 experts are surveyed. Those experts are professors at educational universities, researchers at education institutes, and teachers. For unbiased sampling, 'convenient sampling' method is adopted. Each respondent is required to answer every question of smart literacy standards for teachers and students. 5 scales are used for each question: 5 (very important), 4 (important), 3 (so-so), 2 (not important), 1 (never important), respectively.

3.3. Statistical Analysis

3.3.1 Statistical Analysis for Teachers

The following is responses from 17 respondents for smart literacy standards(teachers).

Importance of each area for teachers is represented in Table 9, 10, 11, and 12, respectively.

(Table 9) Importance of smart education area

Number	Mean of Importance	Standard Deviation
1	4.18	.883
2	3.88	1.166
3	3.53	1.281
4	3.41	1.661

Number	Mean of Importance	Standard Deviation
5	2.41	1.372
Mean of area	3.48	.837
Mean of all areas	3.83	.692

(Table 10) Importance of smart knowledge area

Number	Mean of Importance	Standard Deviation
6	3.00	1.225
7	3.71	1.047
8	3.18	1.185
9	2.65	1.115
10	3.71	1.263
11	3.76	1.393
12	3.82	1.286
13	3.47	1.328
Mean of area	3.41	1.038
Mean of all areas	3.83	.692

(Table 11) Importance of smart application area

Number	Mean of Importance	Standard Deviation
14	4.41	.795
15	4.12	1.054
16	4.12	.993
17	4.41	.939
18	4.47	.874
19	4.29	1.160
20	4.06	1.144
21	3.12	1.166
22	3.35	1.412
23	3.00	1.323
24	4.65	.493
25	4.18	1.131
Mean of area	4.01	.713
Mean of all areas	3.83	.692

(Table 12) Importance of smart ethics area

Number	Mean of Importance	Standard Deviation
26	4.71	.470
27	4.88	.332
28	4.12	1.166
29	4.18	.951
30	4.24	.831
Mean of area	4.42	.640
Mean of all areas	3.83	.692

From result of Table 9, 10, 11, and 12, we know that, for the proposed 30 smart literacy standards, overall 30 literacy standards except number 1 and 9 have importance. Number 5 and 9 have importance 2.41 and 2.65 so that they are much below than mean of all areas.

The table 13 shows reliability of smart literacy standards for teachers. We calculated cronbach's α to check reliability of smart literacy standards. As we can see from Table 13, each standard has value of cronbach's α greater than 0.6 so that all standards are qualified.

(Table 13) Reliability of smart literacy standards for teachers

Area	No.	Corrected item-all correlation	Cronbach if item is deleted	
Smart Education	1	.223	.663	.649
	2	.703	.459	
	3	.747	.417	
	4	.340	.647	
	5	.145	.716	
Smart Knowledge	6	.696	.939	.941
	7	.802	.933	
	8	.853	.928	
	9	.526	.949	
	10	.899	.925	
	11	.863	.927	
	12	.864	.927	
	13	.814	.931	
Smart Application	14	.770	.872	.887
	15	.684	.873	
	16	.725	.871	
	17	.782	.869	
	18	.688	.874	
	19	.735	.869	
	20	.488	.884	
	21	.486	.885	
	22	.540	.884	
	23	.616	.878	
Smart Ethics	24	.635	.882	.849
	25	.298	.895	
	26	.452	.866	
	27	.335	.885	
	28	.884	.763	
	29	.918	.735	
	30	.875	.755	

The descriptive statistical results of each area are shown in Table 14,15,16, and 17.

(Table 14) Descriptive statistical results of smart education area

Number	Mean	Median	Mode	SD
1	4.18	4.00	5.00	.88
2	3.88	4.00	5.00	1.17
3	3.53	4.00	5.00	1.28
4	3.41	4.00	5.00	1.66
5	2.41	2.00	2.00	1.37

(Table 15) Descriptive statistical results of smart knowledge area

Number	Mean	Media	Mode	SD
6	3.00	3.00	3.00	1.22
7	3.71	4.00	3.00	1.05
8	3.18	3.00	3.00	1.19
9	2.65	2.00	2.00	1.11
10	3.71	4.00	5.00	1.26
11	3.76	4.00	5.00	1.39
12	3.82	4.00	5.00	1.29
13	3.47	4.00	4.00	1.33

(Table 16) Descriptive statistical results of smart application area

Number	Mean	Median	Mode	SD
14	4.41	5.00	5.00	.80
15	4.12	4.00	5.00	1.05
16	4.12	4.00	4.00	.99
17	4.41	5.00	5.00	.94
18	4.47	5.00	5.00	.87
19	4.29	5.00	5.00	1.16
20	4.06	4.00	5.00	1.14
21	3.12	3.00	3.00	1.17
22	3.35	3.00	3.00	1.41
23	3.00	3.00	4.00	1.32
24	4.65	5.00	5.00	.49
25	4.18	5.00	5.00	1.13

(Table 17) Descriptive statistical results of smart ethics area

Number	Mean	Median	Mode	SD
26	4.71	5.00	5.00	.47
27	4.88	5.00	5.00	.33
28	4.12	5.00	5.00	1.17
29	4.18	4.00	5.00	.95
30	4.24	4.00	4.00	.83

Based on statistical results from Table 14, 15, 16, and 17, we can conclude the followings: For smart education area, overall standards except standards 5 are suitable. Median and mode of standard number 1~4 are between 4 and 5. For smart knowledge area, mean of standard 9 is very low, and median and mode are also 2.00. Standard 9 should be excluded. For smart application area, mean of each standard is greater than 3, and median and mode are between 3 and 5. Thus, all standards of smart knowledge are suitable. Finally, for smart ethics area, mean of all areas are greater than 4.12, and median of mode of all standards are between 4 and 5. Thus, all standards are suitable.

3.3.2. Statistical Analysis for Students

Importance of each area for teachers is represented in Table 18, 19, 20, and 21, respectively.

(Table 18) Importance of smart education area

Number	Mean of Importance	Standard Deviation
1	3.82	1.015
2	3.94	1.298
3	3.12	1.616
4	2.41	1.326
Mean of area	3.32	.955
Mean of all areas	3.79	.656

(Table 19) Importance of smart knowledge area

Number	Mean of Importance	Standard Deviation
5	2.94	1.144
6	3.59	1.121
7	3.18	1.185
8	2.65	1.057
9	3.65	1.222
10	3.53	1.328
11	3.82	1.237
12	3.59	1.326
Mean of area	3.37	.983
Mean of all areas	3.79	.656

(Table 20) Importance of smart application area

Number	Mean of Importance	Standard Deviation
13	4.59	.618
14	4.24	1.033
15	4.24	.970
16	4.47	.874
17	4.53	.800
18	4.41	.939
19	4.18	.809
20	3.06	1.144
21	3.29	1.404
22	3.00	1.061
23	4.65	.493
24	4.06	1.197
Mean of area	4.06	.596
Mean of all areas	3.79	.656

(Table 21) Importance of smart ethics area

Number	Mean of Importance	Standard Deviation
25	4.82	.393
26	4.24	1.147
27	4.41	.870
Mean of area	4.49	.718
Mean of all areas	3.79	.656

From the results from Table 18, overall mean of smart education area is 3.32 that is lower than mean of overall areas, 3.79. Especially standard 4 has low mean value, 2.41. That means it is not suitable for final candidate. For smart literacy standards of smart knowledge area, overall mean is 3.37 that is lower than 3.79, mean of overall areas. Standards 5 and 8 have mean value 2.94 and 2.65. It means that those standards are not suitable for final candidates. For smart literacy standards of smart application area, overall mean, 4.06 is greater than overall mean of all areas. However, standard 20 and 22 have lower mean values, 3.06 and 3.00, respectively. For standards of smart ethics area, all standards have mean value greater than 4.00. It means that all standards are suitable for final candidates.

The table 22 shows reliability of smart literacy standards for students. We calculated cronbach's α to check reliability of smart literacy standards. As we can see from Table 22, each standard has value of cronbach's α greater than 0.6 so that all standards are qualified.

(Table 22) Reliability of smart literacy standards for students

Area	No.	Corrected Item-All Correlation	Cronbach if item is deleted	
Smart Education	1	.379	.676	.686
	2	.648	.503	
	3	.661	.473	
	4	.258	.747	
Smart Knowledge	1	.744	.919	.928
	2	.817	.914	
	3	.838	.912	
	4	.519	.934	
	5	.875	.909	
	6	.724	.921	
	7	.776	.916	
	8	.742	.920	
Smart Application	9	.827	.818	.851
	10	.669	.819	
	11	.761	.811	
	12	.669	.821	
	13	.750	.817	
	14	.683	.819	
	15	.329	.846	
	16	.307	.853	
	17	.371	.856	
	18	.368	.846	
Smart Ethics	19	.504	.838	.780
	20	.279	.780	
	21	.188	.745	
	22	.723	.408	
	23	.847	.371	

The descriptive statistical results of each area is shown in Table, 23, 24, 25, and 26, respectively.

(Table 23) Descriptive statistical results of smart education area

Number	Mean	Median	Mode	SD
1	3.82	4.00	4.00	1.01
2	3.94	4.00	5.00	1.30
3	3.12	4.00	1.00	1.62
4	2.41	2.00	1.00	1.33

(Table 24) Descriptive statistical results of smart knowledge area

Number	Mean	Median	Mode	SD
5	2.94	3.00	3.00	1.14
6	3.59	3.00	3.00	1.12
7	3.18	3.00	3.00	1.19
8	2.65	3.00	2.00	1.06
9	3.65	4.00	4.00	1.22
10	3.53	4.00	3.00	1.33
11	3.82	4.00	5.00	1.24
12	3.59	4.00	4.00	1.33

(Table 25) Descriptive statistical results of smart application area

Number	Mean	Median	Mode	SD
13	4.59	5.00	5.00	.62
14	4.24	5.00	5.00	1.03
15	4.24	4.00	5.00	.97
16	4.47	5.00	5.00	.87
17	4.53	5.00	5.00	.80
18	4.41	5.00	5.00	.94
19	4.18	4.00	5.00	.81
20	3.06	3.00	3.00	1.14
21	3.29	3.00	3.00	1.40
22	3.00	3.00	3.00	1.06
23	4.65	5.00	5.00	.49
24	4.06	4.00	5.00	1.20

(Table 26) Descriptive statistical results of smart ethics area

Number	Mean	Median	Mode	SD
25	4.82	5.00	5.00	.39
26	4.24	5.00	5.00	1.15
27	4.41	5.00	5.00	.87

Based on descriptive statistical results from Table 23, 24, 25, and 26, we can conclude as follows. For smart education area, standard 4 has mean, median, and mode are 2.41, 2.00, and 1.00. Those values are much lower than other standards. Thus, standard 4 cannot be final candidate. For smart knowledge area, standard 5 and 8 have lower mean value than other standards. Also, their mean and median values are relatively low. Standard 5 and 8 cannot be final candidates. For smart application area, standard 20, 21, and 22 have low mean values, however, their median and mode values are

equal to or greater than 3.00. Thus, all standards are suitable for final candidates. Finally, for smart ethics area, all of standards have mean greater than 4.24 that is much higher than overall mean of all areas. Also, all of standards have median and mode values 5.00. So, all of those standards are suitable for final candidates.

3.4. The Final Smart Literacy Standards

Based on extensive statistical analysis in 3.3, we can have following final smart literacy standards for teachers and students. Final smart literacy standards for teachers have 27 standards. Table 27, 28, 29, and 30 show each area and its standards.

(Table 27) Smart Education Area: Teacher

Number	Standard
1	I understand characteristics of smart learning
2	I can apply smart-based education to real class activities
3	I can teach students how to use smart devices
4	I have some training experience on smart-based education

(Table 28) Smart Knowledge Area: Teacher

Number	Standard
Hardware	
5	I understand internal components and functions of smart devices
6	I know well how to use smart devices
7	I understand the basic concept of cloud computing
Software	
8	I can install the necessary software in smart devices
9	I understand how to use QR code
Network	
10	I know how to connect smart devices to wired/wireless networks
11	I know how to connect smart devices to other devices with network sharing

(Table 29) Smart Application Area: Teacher

Number	Standard
Information Use	
12	I can search the necessary information using smart devices

Number	Standard
13	I can listen music using smart devices
14	I can play video data using smart devices
15	I can move or copy data in smart devices to external storage devices
16	I can copy or remove data in smart devices
17	I can create a new folder in smart devices
Information Creation	
18	I can create text data using smart devices
19	I can create sound data using smart devices
20	I can create video data using smart devices
21	I can create graphic data using smart devices
Information Sharing	
22	I can exchange data with other people using smart devices
23	I have used SNS using smart devices

(Table 30) Smart Ethics Area: Teacher

Number	Standard
24	I can teach ethics in smart environments to students
25	I know ethics on such as privacy information protection, copyright, netiquette in cyber space
26	I know information security methods in smart environments
27	I know laws and regulations on privacy information protection and copyright
28	I know how to diagnose and prevent smart phone addiction

The final smart standards for students have 24 standards. Tables 31, 32, 33, and 34 show smart literacy standards for each area.

(Table 31) Smart Education Area: Student

Number	Standard
1	I understand characteristics of smart learning
2	I have taken course(s) based on smart learning
3	I have taken course(s) on smart contents creation

(Table 32) Smart Knowledge Area: Student

Number	Standard
Hardware	
4	I know well how to use smart devices
5	I understand the basic concept of cloud computing

Number	Standard
Software	
6	I can install the necessary software in smart devices
7	I understand how to use QR code
Network	
8	I know how to connect smart devices to wired/wireless networks
9	I know how to connect smart devices to other devices with network sharing

(Table 33) Smart Application Area: Student

Number	Standard
Information Use	
10	I can search the necessary information using smart devices
11	I can listen music using smart devices
12	I can play video data using smart devices
13	I can move or copy data in smart devices to external storage devices
14	I can copy or remove data in smart devices
15	I can create a new folder in smart devices
Information Creation	
16	I can create text data using smart devices
17	I can create sound data using smart devices
18	I can create video data using smart devices
19	I can create graphic data using smart devices
Information Sharing	
20	I can exchange data with other people using smart devices
21	I have used SNS using smart devices

(Table 34) Smart Ethics Area: Student

Number	Standard
22	I know ethics on such as privacy information protection, copyright, netiquette in cyber space
23	I know information security methods in smart environments
24	I know how to diagnose and prevent smart phone addiction

4. Conclusions and Further Works

With advances in smart device technologies, the existing PC-based environments have faced the rapid changes. Smart technologies have brought so called “Internet in the palm”. Many people have various smart devices such as tablet PCs and smart phones. Smart technologies are changing our daily

life very quickly and dramatically. Those technologies have also affected education areas so that the new concept called smart learning is created.

Literacy standards are very helpful measurement to check the current status and competitiveness of an individual, a group, a society, and a nation. However, development of a literacy standard is a very difficult and time-consuming task. Also, literacy standards can be changed and updated regularly in order to ensure correctness and up-to-date status of literacy standards. ICT literacy and smart literacy are very important measurements for the current knowledge-based society.

Those smart literacy standards have some drawbacks and need to be updated. In this paper, we proposed smart literacy standards for teachers and students. The purpose of this paper is to develop smart literacy standards for teachers and students. The proposed literacy standards are developed based on the existing ICT literacy standards. In this work, smart literacy standards include four main areas, smart education, smart knowledge, smart application, and smart ethics, respectively. For development of smart literacy, wide experts from teachers, professors, and researchers are selected and surveyed. Their responses are analyzed using through statistical analysis.

After wide and through statistical analysis, we have smart literacy standards for teachers and students. Those smart literacy standards consist of 4 areas for both teachers and students: smart education, smart knowledge, smart application, and smart ethics, respectively. The final smart literacy standards for teachers and students have 28 and 24 standards, respectively.

The immediate research issue is to check efficiency of the proposed smart literacy standards. We are planning to apply our standards to both teachers and students. We are interested in how our standards are working in real environments. Another research is to provide specific standard for teachers and students. For instance, we need to develop standards for elementary school teachers, middle school teachers, and high school teachers, respectively. Also, we can develop standards for elementary school students, middle school students, and high school students, respectively.

References

- [1] S. Baek, D. Kim, M. Kim, H. Kim, Y. Yu, S. Park, S. Kim and M. Kim, The Development of Standardized ICT Literacy Assessment for Secondary School Student, *Asia Pacific Education Review*, Vol. 10, No. 1, 2009, pp. 175-198.
- [2] S. Chun, J. Kim, Y. Kim, O. Lee, S. Choi, S. Park, and K. Lee, A Study on Development of Smart Education Policy Achievement Index, *Research Report KR 2013-1*, KERIS, 2013.
- [3] Educational Testing Service, Digital Transformation: A Framework for ICT Literacy, *A Report of the International ICT Literacy Panel*, 2007.
- [4] K. Kim, S. Lee, W. Jun, H. Kim, H. Kwak, J. Kim and J. Seo, Measuring ICT Literacy of Primary and Junior High School Students in South Korea, *Korea Elementary Education*, Vol. 22, No. 3, 2011, pp. 195-211.
- [5] S. Kim, S. Song and Y. Yoon, Smart Learning Services Based on Smart Cloud Computing, *Sensors*, Vol. 11, 2011, pp. 7835-7850.
- [6] K. Lim, Research on Developing Instructional Design Models for Enhancing Smart Learning, *Journal of Korean Society of Computer Education*, Vol. 14, No. 2, 2011, pp. 33-45.
- [7] Ministry of Education & Human Resources Development, Korea Education & Research Information Service, *Information and Communication Technology in Education*, 2002.
- [8] L. Roerden, Net Lessons: Web-Based Project for Your Classroom, *O'Reilly Press*, Sebastopol, California, USA, 1999.
- [9] H. Yang, A Delphi Study on the Definition and Components of Smart Literacy, Mater Thesis, Graduate School of Education, Kyunghee University, 2012.

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