

# A Study on Development of Quality Standards of Educational Smart Contents

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*Received April 6, 2014; revised June 6, 2014; accepted June 10, 2014; published June 27, 2014*

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## Abstract

With advances in smart and ICT(information and communication technology) technologies, our life style has been changing dramatically. Now everybody can enjoy the benefits of such technologies in every aspect of his/her daily life. Currently more and more people are trying to have smart devices such as smart phones and tablet PCs so that smart devices become the bare necessities. New smart technologies have created a new concept called *smart learning* in education area.

As educational smart contents become popular, we need quality standards for the contents. Those standards are essential for evaluating the smart contents and suggesting guidance for future smart contents production. Although there are some standards for the existing e-learning environments, to our best knowledge, there are no standards for educational smart contents in the literature.

The purpose of this paper is to develop quality standards for educational smart contents. The proposed quality standards are based on the existing quality standards in e-learning environments and include some characteristics of smart learning. For development of quality standards, wide experts group from academy and industry are selected and surveyed. Their responses are analyzed based on thorough statistical analysis so that final quality standards for educational smart contents are developed.

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**Keywords:** Smart contents, quality standard, smart learning, ICT education

## 1. Introduction

In the current knowledge and information society, our daily life relies on the benefits of advanced ICT technologies. With aid of ICT technologies, our life style has been changed dramatically. Our life becomes more convenient and enjoyable than ever. How to use the advanced technologies becomes a part of social competitiveness as well as individual competitiveness.

Recently ICT technologies have been converged into smart technology. It means that the existing ICT devices become smaller, light, convenient, and portable. In this sense, the concept of “smart environment” is realized. Smart environment is defined as “a physical world that is richly and invisibly interwoven with sensors, actuators, displays, and computational elements, embedded seamlessly in the everyday objects of our lives, and connected through a continuous network.” [1]. In smart environment, every aspect of our life has been affected with smart technologies. Now advanced in smart technologies have created a new concept called “smart learning” in education area.

Smart learning is a new concept so that there is no clear definition yet. However, some research works introduce the definition of smart learning [2,3]. In [2], it is argued that the principle of smart learning has the following 3 characteristics: 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. Also, in [3], it is argued that smart learning is very essential in future education since it provides personalized contents and easy adaptation to the current education model.

The following **Table 1** shows the comparison of different types of education: traditional style, e-learning, m-learning(mobile learning), u-learning(ubiquitous learning), and smart learning, respectively. Historically and chronologically our education system has been changed: traditional style, e-learning, m-learning, u-learning, and smart learning. We see that smart learning is the most extensive and comprehensive education style in the current era.

**Table 1.** Comparison of Different Types of Education [4]

	Traditional Style	E-learning	M-learning	U-learning	Smart Learning
Intelligent Personalized Study			△	△	○
Cooperative Activity		△	△	○	○
Bi-direction		△	△	○	○
Participation Activity	△	△		△	○
Sharing Activity		△		○	○
Intelligent Study Information Management				○	○
Time/Space Limitation Conquest		△	△	○	○

Study Information Generation				<b>O</b>	<b>O</b>
Application of Social Networking		△		△	<b>O</b>
Application of Convergent Education Media					<b>O</b>
Non-linear Study		△	△	<b>O</b>	<b>O</b>

Note that the simbol  $\triangle$  represents “possible” and the simbol “O” represents “applicable”, respectively.

In [5], capabilities to be prepared for 21<sup>st</sup> century learners are announced. There are 3 categories: 1) learning and innovation skills, 2) life and career skills, 3) information, media, and technology skills, respectively. The following **Table 2** shows those capabilities for the 21<sup>st</sup> century learners. We can see that smart learning is very best education style and provides the best environment to achieve the capability of 21<sup>st</sup> century learners.

**Table 2.** Capabilities to be Prepared for 21<sup>st</sup> Century Learners [5]

Capability	Description
Learning and Innovation Skills	Critical Thinking and Problem
	Communications and Collaboration
	Creativity and Innovation
Life and Career Skills	Information Literacy
	Media Literacy
	ICT Literacy
Information, Media, and Technology Skills	Flexibility and Adaptability
	Initiative and Self-Direction
	Social and Cross-cultural Interaction
	Productivity and Accountability
	Leadership and Responsibility

As smart learning becomes popular, more educational smart contents have been produced and distributed. In this sense, we need some quality standards to determine how smart contents are useful or helpful for students as well as teachers. Those quality standards are very important because the future educational smart contents will be made based on the quality standards. That is, the quality standards will guide for teachers and contents manufacturers on how to prepare and make new educational smart contents. In the literature, there are some quality standards for the existing e-learning environments [6,7,8,9,10], to our best knowledge, there is no quality standard for educational smart contents. In [11], only outlines are introduced. In the meanwhile, for smart literacy standards [12] and smart skill standards [13] for teachers and students are presented lately.

The smart contents can be classified into 2 categories for their purpose: *teaching-learning* and *educaton support*. The “teaching-learning” contents means any contents that can be used in class instantly. That is, those contents need not be refined for teachers to use in their class.

Also, those contents can be used for students instantly. On the other hand, the “education support” contents means any contents that can be used as supplement tool for classes and students. Also, for teachers and students, those contents need to be refined for later use.

The purpose of this paper is to develop quality standards for educational smart contents. We develop the initial quality standards with various researchers and educators. The initial quality standards have 14 areas and 35 standards. In order to refine those quality standards, we ask various experts to check its validity and usefulness. Their valuable survey works are collected and analyzed. We finalize quality standards that have 14 areas and 34 standards.

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

## 2. Related Work

### 2.1 Characteristics of Smart Learning

In [4], some characteristics of smart learning are introduced. Those characteristics are summarized in **Table 3**. In smart learning, a student’s role is extended to be more active, more personalized, more experience-oriented. However, a teacher’s role is changed to be a guide and mediator.

**Table 3.** Characteristics of Smart Learning [4]

Characteristic	Description
Self-directed	(Knowledge Generator) Student’s role change: from knowledge consumer to knowledge generator Teacher’s role change: from knowledge messenger to helper (Intelligent) Online achievement diagnosis and prescription
Motivated	(Experience-oriented) Knowledge reconstruction: from lecture-oriented to experience-oriented
Adaptive	(Flexible) Flexibility of education system (Personalized) Role of school: from massive delivery to personalized study
Resource Free	(Open Market) Free sharing of online information based on cloud education service (Social Networking) Extension of cooperative study using collective intelligence and social learning

Technology Embedded	(Globalization) Anytime anywhere study and various study options for students
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Also, in [4], smart learning is compared with the traditional learning in terms of categories suggested in Table 3. The traditional learning means the existing class-based learning. The following Table 4 shows comparison of smart learning and traditional learning. As we can see, smart learning environment provides more self-directed study and motivated and adaptive study for students anytime anywhere.

**Table 4.** Comparison of Smart Learning and Traditional Learning [4]

Characteristic	Description
Self-directed	(Extension of Time) Anytime study based on onlie and cloud education service
Motivated	(Extension of Education Method) From the existing delivery-oriented study in classes to cooperative study, and individualized study based on wireless internet environment
Adaptive	(Extension of Education Capability) 7C capabilities(Critical thinking and problem solving, Creativity and innovation, Collaboration and leadership, Cross-cultural understanding, Communication, ICT literacy, Career and life skills) as well as 3R literacy in the existing education(Read, wRite, and aRithmetic)
Resource Free	(Extension of Education Contents) Overcoming limited contents in the book-style textbook and reference books, provison of abundant information using cloud education service and social networking
Technology Embedded	(Extension of Space) Anywhere study using wireless internet and smart devices

In [4], they argue that any smart contents must have the following 4 components. Those components are *participation*, *sharing*, *cooperation*, and *accessibility*, respectively. Each component is described as follows.

#### 1) Participation

Students can use smart contents anytime anywhere. For this purpose, smart education contents must be accessed anytime, anywhere, anyone. Especially the various existing contents must be compatible each other with aid of cloud computing. It means that smart contents must be stored and accessed in the cloud so that students can read, update, and store anytime using networking service.

#### 2) Sharing

Students can actualize and develop study process and results with other students and teachers using smart contents. The study contents can be developed by sharing with others. Smart contents can be shared eaisly due to its compatibility and openness.

### 3) Cooperation

In smart education, cooperative work is encouraged among students since smart education service provides diverse technical and social services like SNS. Cooperative works through smart education contents can support collective intelligence that ensures reliability of study results.

### 4) Accessibility

The great benefit of smart environment is that students can use wireless internet with various smart devices. Smart education contents can also be accessed easily without special hardware devices supporting internet connection. Also, various types of interaction can be possible in smart contents: student-contents interaction, student-student interaction, and student-teacher interaction.

## 2.2 Literature Review

In the literature, there is no quality standards for educational smart contents. However, there are some quality standards for the existing e-learning environments [6,7,8,9,10]. In this paper, we introduce the representative quality standards for the general educational contents in [8] since the quality standards in [8] are most extensive among the previous works. Table 5 shows those quality standards.

**Table 5.** Quality Standards for E-learning Environment [8]

Area	Sub-area	Standards
Requirement Analysis	Study Contents Analysis	Does study activity enable study objective to be achieved?
	Study Environment Analysis	Is it possible that study program and application software do not depend on platform and operating system, and selective execution is provided?
		Are application areas of study program and application software wide and diverse?
		Is it possible that study program and application program can exchange data with other programs?
	Is installation and updation of study program and application software easy and comfortable?	
Idea Generation	Can new study interest be incurred by adding creative ideas to the existing study contents	
Presentation of Study Objective	Presentation of Study Objective	Is study objective presented in smart contents?
	Study Material Selection	Are appropriate study materials(text data, graphic data, sound data, video data, etc) used considering student's level(age and experience)?

Instructional Design		Are various technical methods used for study contents and related information considering students, study contents, study environment?
	Screen Construction and Arrangement	Is screen systemically constructed considering students(age and study experience), study contents, and study environment?
		Is construction of study screen is simple and consistent?
		Are study information elements maximized and other elements(buttons, metaphor, background image) minimized?
		Is important information emphasized and constructed easily? Also, is the quality good?
		Does screen construction and arrangement include new idea?
	Interface and Progress	Are UI components(button, menu, icon, scroll bar, etc) constructed and arranged with consistency for student's study progress?
		Can students identify the current position within entire contents? Is movement easy?
Study Contents	Selection of Study Contents	Are contents selected for students to experience within their age level?
		Do study contents include new information and tendency?
		Are study contents non-repetetively and logically presented?
	Organization of Study Contents	Are study contents organized considering student's level(cognitive capability, etc)?
		Are glossary and spelling of study contents correct and error-free?
		Are semantic expression of study contents error-free?
	Study Level of Difficulty	Are study levels(easy, intermediate, and difficult, etc) selected appropriately?
Are study contents organized with study stages?		
Teaching-Learning Strategy	Selection of Teaching-Learning Strategy	Are appropriate teaching-learning strategies used in smart contents?
		Are appropriate teaching-learning strategies(problem-oriented learning, project-based learning, etc) selected considering online study environment and study contents analysis results?
	Selection of Support Contents	Are support contents that are necessary for students and teachers(study progress and study help, etc) included?
		Are detailed and effective support contents(help menu, study guide, and FAQ, etc) included?

Support System	Selection Methods	Support	Are appropriate and realizable support methods used?
			Are various support methods(checklist, worksheet, etc) applied considering characteristics of students and teachers?
	Application of Support Tools		Are various support functions that are available depending on study nature included?
Reusability	Restructuration		Are study process and contents constructed to be reusable for supplement purpose?
			Are study contents constructed to be reusable depending on study objectives, student's level, and study environment?
Ethicality	Ethical Norm		Do the contents include ethical bias such as religion, region, political belief, and violent expressions?
Copyright	Copyright Application		Do all writings follow the copyright laws and regulation?

### 3. Development of Educational Smart Quality Standards

#### 3.1 The initial Development of Smart Quality Standards

In order to develop new quality standards for educational smart contents, we develop the initial quality standards. The proposed standards are made based on the existing standards in [8] and add some features of smart learning environments. We emphasize accessibility and interactivity for smart contents. For accessibility, most smart contents must be accessed regardless of user's internet environments. Also, students with some kinds of disabilities must be considered. For interactivity, we must include the basic interaction for students: student-contents, student-student, and student-teacher. In addition, we include student-external specialist interaction.

Our proposed quality standards have 14 areas and 35 standards for those areas. The 14 areas are as follows: *requirement analysis*, *instructional design*, *study contents*, *teaching-learning strategy*, *interactivity*, *evaluation*, *feedback*, *support system*, *reusability*, *sharing & distribution*, *accessibility*, *restructuring*, *ethicality*, and *copyright*, respectively. **Table 6** shows the initial smart quality standards.

**Table 6.** The Initial Smart Quality Standards

Area	Sub-area	Serial No.	Standards
Requirement Analysis	Study Contents Analysis	1	Does study activity enable study objective to be achieved?
	Study Environment Analysis	2	Is it possible that study program and application software do not depend on



			platform and operating system, and selective execution is provided?
Instructional Design	Clarity	3	Is study objective presented clearly?
	Leveled Learning	4	Is the leveled learning possible for various study contents and methods depending student's capability?
	Study Material	5	Are appropriate study materials(text data, graphic data, sound data, video data, etc) used considering student's level(age and experience)?
	Screen Construction & Arrangement	6	Is screen systemically constructed considering students(age and study experience), study contents, and study environment?
	Interface &Progress	7	Is it possible that students can control study process and speed?
Study Contents	Study Contents Selection	8	Are the smart contents selected to help achievement of study objectives as core contents?
	Study Contents Selection	9	Do study contents include new information and tendency?
	Selection of Study Contents	10	Are study contents non-repetetively and logically presented?
	Organization of Study Contents	11	Are study contents organized considering student' level(cognitive capability, etc)?
	Organization of Study Contents	12	Are study contents themselves error-free?
	Organization of Study Contents	13	Are glossary and spelling of study contents correct and error-free?
	Organization of Study Contents	14	Do study contents include prerequisite contents and supplement-reinforcement contents?
	Study Level of Difficulty	15	Do study contents consider study levels(easy, intermediate, and difficult, etc) appropriately?
	The Amount of Study	16	Are the amount of study contents appropriate for each class?
Teaching-Learning Strategy	Selection of Teaching-Learning Strategy	17	Do study contents include appropriate teaching-learning strategy for online study?
	Motivation-Support Strategy	18	Do study contents include various motivation support strategy?
Interactivity	Student-Contents Interaction	19	Do study contents include interaction between students and the contents?
	Student-Student Interaction	20	Do study contents include interaction between students and other students?
	Student-Teacher Interaction	21	Do study contents include interaction between students and teachers?

	Student-External Specialist Interaction	22	Do study contents include interaction between students and external specialist(including parents)?
Evaluation	Evaluation Contents	23	Are evaluation contents organized to help students complete the course?
	Evaluation Methods	24	Are various evaluation methods used?
Feedback	Feedback	25	Are answers to student's questions and evaluation results provided to students?
Support System	Selection of Support Contents	26	Are support contents that are helpful for student's study progress included?
	Selection of Support Methods	27	Are various support methods(checklist, worksheet, etc) applied to students?
Reusability	Reusability	28	Are study contents constructed to be reusable depending on study objectives, student's level, and study environment?
Sharing & Distribution	Sharing & Distribution	29	Is metadata provided for sharing study contents?
Accessibility	Contents Accessibility	30	Are study contents accessible anytime anywhere using wired/wireless internet?
	Access Restriction	31	Is there any access restriction depending on student's mental or physical disabilities?
	Communication Tool	32	Are any communication tools(email, BBS, etc) provided for student's questions and answers to study contents?
Restructuring	Restructuring	33	Are study contents and process restructurable depending on study objectives and study environments?
Ethicality	Ethical Norm	34	Do the contents include ethical bias such as religion, region, political belief and violent expressions?
Copyright	Copyright Application	35	Do all writings follow the copyright laws and regulation?

### 3.2 Statistical Processing Procedure and Sampling Methods

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  $\alpha$  is used for checking reliability of quality standards for educational smart contents. Fourth, for empirical analysis of this study, significance level  $p < .05$ ,  $p < .01$ ,  $p < .001$  are used.

For our statistical analysis, 45 experts are surveyed. Those experts are professors and researchers majoring computer education or MIS(management information system). Also, teachers are selected for this study. They are interested in smart learning and working for master degree in computer education major. For unbiased sampling, 'convenient sampling' method is adopted. Also, overcome geographic-bias, all respondents are selected from all over

Seoul and suburbs of Seoul. Each respondent is required to answer every question of quality standards for both teaching-learning and education support categories. 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 Verification of Reliability

At first, reliability of 35 standards for both categories(teaching-learning and education support) are analyzed. The following **Table 7** shows analysis results of verification of reliability for 35 standards of 2 categories. The values represent Cronbach's  $\alpha$ . As we can see from the values of **Table 7**, Cronbach's  $\alpha$  is greater than 0.6 so that most standards are sufficient to be used for quality standards.

**Table 7.** Verification of Reliability for Each Standard

Area	Standard No.	Teaching-Learning		Education Support	
Requirement Analysis	1	.965	.674	.956	.496
	2	.966		.955	
Instructional Design	3	.965	.782	.956	.820
	4	.966		.956	
	5	.966		.956	
	6	.965		.956	
	7	.966		.956	
Study Contents	8	.964	.895	.956	.862
	9	.965		.955	
	10	.965		.956	
	11	.964		.955	
	12	.965		.956	
	13	.965		.955	
	14	.964		.954	
	15	.964		.954	
Teaching-Learning Strategy	17	.963	.689	.954	.657
	18	.964		.954	
Interactivity	19	.964	.840	.954	.891
	20	.964		.955	
	21	.964		.954	
	22	.965		.955	
Evaluation	23	.964	.650	.955	.553
	24	.964		.955	

Feedback	25	.964	-	.954	-
Support System	26	.964	.797	.955	.633
	27	.964		.955	
Reusability	28	.964	-	.954	-
Sharing & Distribution	29	.964	-	.954	-
Accessibility	30	.964	.822	.955	.655
	31	.964		.955	
	32	.964		.955	
Restructuring	33	.964	-	.955	-
Ethicality	34	.964	-	.955	-
Copyright	35	.964	-		-

Note that, for an area with only one standard, reliability value is not considered.

### 3.3.2 Verification of Validity for Standards

Evaluation of importance for each standard of 2 categories is analyzed. **Table 8** shows analysis results for evaluation of importance. In the table, the following notations are used:

- A: never important
- B: not important)
- C: so-so
- D: important
- E: very important

**Table 8.** Evaluation of Importance for Each Standard

Standard	Teaching-Learning					Education Support				
	A	B	C	D	E	A	B	C	D	E
1			8.9%	26.7%	64.4%		4.4%	4.4%	37.8%	53.3%
2		2.2%	13.3%	37.8%	46.7%	2.2%		15.6%	42.2%	40.0%
3			11.1%	31.1%	57.8%			17.8%	33.3%	48.9%
4			6.7%	37.8%	55.6%			15.6%	42.2%	42.2%
5		2.2%	8.9%	20.0%	68.9%			8.9%	40.0%	51.1%
6			8.9%	33.3%	57.8%			13.3%	40.0%	46.7%
7		4.4%	13.3%	46.7%	35.6%	2.2%		20.0%	46.7%	31.1%
8			15.6%	17.8%	66.7%			24.4%	22.2%	53.3%
9		2.2%	31.1%	31.1%	35.6%		4.4%	20.0%	28.9%	46.7%
10		4.4%	20.0%	46.7%	28.9%		8.9%	26.7%	42.2%	46.7%
11			11.1%	22.2%	66.7%			17.8%	35.6%	46.7%
12			13.3%	15.6%	71.1%			11.1%	20.0%	68.9%
13		4.4%	13.3%	35.6%	46.7%		2.2%	22.2%	31.1%	44.4%
14		8.9%	31.1%	33.3%	26.7%	2.2%	6.7%	35.6%	24.4%	31.1%
15		6.7%	28.9%	28.9%	35.6%		8.9%	26.7%	26.7%	37.8%
16		2.2%	28.9%	31.1%	37.8%		4.4%	31.1%	33.3%	31.1%

17		4.4%	15.6%	31.1%	48.9%		2.2%	20.0%	33.3%	44.4%
18		2.2%	20.0%	35.6%	42.2%		6.7%	26.7%	31.1%	35.6%
19		6.7%	26.7%	31.1%	35.6%	2.2%	8.9%	24.4%	31.1%	33.3%
20	4.4%	15.6%	11.1%	35.6%	33.3%	4.4%	15.6%	17.8%	33.3%	28.9%
21		8.9%	24.4%	28.9%	37.8%		4.4%	35.6%	24.4%	35.6%
22	2.2%	20.0%	37.8%	13.3%	26.7%	4.4%	22.2%	28.9%	17.8%	26.7%
23		2.2%	11.1%	24.4%	62.2%	2.2%		17.8%	31.1%	48.9%
24		4.4%	31.1%	31.1%	33.3%		8.9%	22.2%	35.6%	33.3%
25		4.4%	11.1%	21.1%	53.3%		2.2%	17.8%	33.3%	46.7%
26			33.3%	28.9%	37.8%	2.2%		22.2%	40.0%	35.6%
27		11.1%	26.7%	31.1%	31.1%		6.7%	24.4%	33.3%	35.6%
28		2.2%	22.2%	40.0%	35.6%		4.4%	20.0%	37.8%	37.8%
29		11.1%	31.1%	24.4%	33.3%		6.7%	40.0%	11.1%	42.2%
30		4.4%	17.8%	31.1%	46.7%		6.7%	11.1%	31.1%	51.1%
31		6.7%	17.8%	35.6%	40.0%		4.4%	17.8%	26.7%	51.1%
32	2.2%	4.4%	24.4%	33.3%	35.6%		11.1%	20.0%	31.1%	37.8%
33		4.4%	26.7%	40.0%	28.9%		8.9%	20.0%	40.0%	31.1%
34		8.9%	20.0%	17.8%	53.3%		4.4%	20.0%	24.4%	51.1%
35			17.8%	22.2%	60.0%		2.2%	15.6%	24.4%	57.8%

For further analysis of importance evaluation, average and standard deviation for each standard are calculated. Also, ranking is calculated. Note that the highest score for each standard is 5(very important) and the lowest score for each standard is 1(never important). **Table 9** shows results of further evaluation of importance for each standard.

**Table 9.** Further Evaluation of Importance for Each Standard

Standard	Teaching-Learning			Education Support		
	Average	Standard Deviation	Ranking	Average	Standard Deviation	Ranking
1	4.56	.659	2	4.40	.780	3
2	4.29	.787	12	4.18	.860	16
3	4.47	.694	8	4.31	.763	6
4	4.49	.626	6	4.27	.720	9
5	4.56	.755	2	4.42	.657	2
6	4.49	.661	6	4.33	.707	5
7	4.13	.815	18	4.04	.852	21
8	4.51	.757	5	4.29	.843	7
9	4.00	.879	23	4.18	.912	16
10	4.00	.826	23	3.78	.902	32
11	4.56	.693	2	4.29	.757	7
12	4.58	.723	1	4.58	.690	1

13	4.24	.857	13	4.18	.860	16
14	3.78	.951	33	3.76	1.048	33
15	3.93	.963	28	3.93	1.009	25
16	4.04	.878	21	3.91	.900	28
17	4.24	.883	13	4.20	.842	15
18	4.18	.834	16	3.96	.952	23
19	3.96	.952	25	3.84	1.065	31
20	3.78	1.204	33	3.67	1.187	34
21	3.96	.999	25	3.91	.949	28
22	3.42	1.158	35	3.40	1.232	35
23	4.47	.786	8	4.24	.908	11
24	3.93	.915	28	3.93	.963	25
25	4.33	.853	11	4.24	.830	11
26	4.04	.852	21	4.07	.889	20
27	3.82	1.007	31	3.98	.941	22
28	4.09	.821	19	4.09	.874	19
29	3.80	1.036	32	3.89	1.049	30
30	4.20	.894	15	4.27	.915	9
31	4.09	.925	19	4.24	.908	11
32	3.96	.999	25	3.96	1.021	23
33	3.93	.863	28	3.93	.939	25
34	4.16	1.043	17	4.22	.927	14
35	4.42	.783	10	4.38	.834	4

After thorough analysis for importance evaluation, the following results are obtained. For teaching-learning category, the highest standard is No. 12(4.58 average) and the lowest standard is No 22(3.42 average). No. 22 is the only standard that has less than 70% of the perfect score 5. On the other hand, for education support category, No. 12 has the highest score 4.58 average while No. 22 has the lowest score 3.40 average. No. 22 is excluded since it has less than 70% of the perfect score, that is, 3.5. **Table 10** shows the summary of the analysis.

**Table 10.** The Excluded Quality Standard

Standard	Teaching-Learning			Education Support		
	Average	Standard Deviation	Ranking	Average	Standard Deviation	Ranking
22	3.42	.1.158	35	3.40	1.232	35

In the meanwhile, we analyze importance for areas. The following **Table 11** shows the importance of each area. For teaching-learning category, the most important area is “instructional design” while the least important area is “interactivity”. On the other hand, for education support category, the most important area is “copyright” while the least important area is “interactivity”. For both categories, “interactivity” has the least score. This can be explained as follows. The smart contents inherently include various types of interaction with wired/wireless communication tools so that “interactivity” need not be emphasized.

**Table 11.** Evaluation of Importance for Each Area

Area	Teaching-Learning			Education Support		
	Average	Standard Deviation	Ranking	Average	Standard Deviation	Ranking
Requirement Analysis	4.42	.630	2	4.29	.670	2
Instructional Design	4.43	.522	1	4.28	.566	3
Study Contents	4.18	.620	7	4.10	.611	7
Teaching-Learning Strategy	4.21	.750	5	4.08	.776	10
Interactivity	3.78	.891	14	3.71	.967	14
Evaluation	4.20	.734	6	4.09	.778	8
Feedback	4.33	.853	4	4.24	.830	4
Support System	3.93	.850	11	4.02	.783	11
Reusability	4.09	.821	9	4.09	.874	8
Sharing & Distribution	3.80	1.036	13	3.89	1.049	13
Accessibility	4.08	.808	10	4.16	.730	6
Restructuring	3.93	.863	11	3.93	.939	12
Ethicality	4.16	1.043	8	4.22	.927	5
Copyright	4.42	.783	2	4.38	.834	1

### 3.4 The Final Smart Quality Standards

Based on extensive statistical analysis in 3.3, we finally the following quality standards for educational smart contents. The final standards consist of 14 areas and 34 standards for both categories. **Table 12** shows the final areas and standards.

**Table 12.** The Final Quality Standards for Educational Smart Contents

Area	Sub-area	Serial No.	Standards
Requirement Analysis	Study Contents Analysis	1	Does study activity enable study objective to be achieved?
	Study Environment Analysis	2	Is it possible that study program and application software do not depend on platform and operating system, and selective execution is provided?
	Clarity	3	Is study objective presented clearly?
	Leveled Learning	4	Is the leveled learning possible for various study contents and methods depending student's capability?
	Study Material	5	Are appropriate study materials(text data, graphic data, sound data, video data, etc)

Instructional Design			used considering student's level(age and experience)?
	Screen Construction & Arrangement	6	Is screen systemically constructed considering students(age and study experience), study contents, and study environment?
	Interface & Progress	7	Is it possible that students can control study process and speed?
Study Contents	Study Contents Selection	8	Are the smart contents selected to help achievement of study objectives as core contents?
	Study Contents Selection	9	Do study contents include new information and tendency?
	Selection of Study Contents	10	Are study contents non-repetetively and logically presented?
	Organization of Study Contents	11	Are study contents organized considering student' level(cognitive capability, etc)?
	Organization of Study Contents	12	Are study contents themselves error-free?
	Organization of Study Contents	13	Are glossary and spelling of study contents correct and error-free?
	Organization of Study Contents	14	Do study contents include prerequisite contents and supplement-reinforcement contents?
	Study Level of Difficulty	15	Do study contents consider study levels(easy, intermediate, and difficult, etc) appropriately?
	The Amount of Study	16	Are the amount of study contents appropriate for each class?
Teaching-Learning Strategy	Selection of Teaching-Learning Strategy	17	Do study contents include appropriate teaching-learning strategy for online study?
	Motivation-Support Strategy	18	Do study contents include various motivation support strategy?
Interactivity	Student-Contents Interaction	19	Do study contents include interaction between students and the contents?
	Student-Student Interaction	20	Do study contents include interaction between students and other students?
	Student-Teacher Interaction	21	Do study contents include interaction between students and teachers?
Evaluation	Evaluation Contents	22	Are evaluation contents organized to help students complete the course?
	Evaluation Methods	23	Are various evaluation methods used?
Feedback	Feedback	24	Are answers to student's questions and evaluation results provided to students?



Support System	Selection of Support Contents	25	Are support contents that are helpful for student's study progress included?
	Selection of Support Methods	26	Are various support methods(checklist, worksheet, etc) applied to students?
Reusability	Reusability	27	Are study contents constructed to be reusable depending on study objectives, student's level, and study environment?
Sharing & Distribution	Sharing & Distribution	28	Is metadata provided for sharing study contents?
Accessibility	Contents Accessibility	29	Are study contents accessible anytime anywhere using wired/wireless internet?
	Access Restriction	30	Is there any access restriction depending on student's mental or physical disabilities?
	Communication Tool	31	Are any communication tools(email, BBS, etc) provided for student's questions and answers to study contents?
Restructuring	Restructuring	32	Are study contents and process restructurable depending on study objectives and study environments?
Ethicality	Ethical Norm	33	Do the contents include ethical bias such as religion, region, political belief, and violent expressions?
Copyright	Copyright Application	34	Do all writings follow the copyright laws and regulation?

### 3.5 Implication of Statistical Analysis

As we can see from analysis results in previous section, most of the initially proposed quality standards are selected as the final quality standards. The only rejected standard is No. 22 for both categories: student-external specialist interaction. In additions, the importance of interactivity is given lower priority based on the survey work. It implies that smart contents themselves have already various interaction mechanism and communication tools inherently. Thus, interactivity needs not be considered redundantly.

On the other hand, accessibility area is considered more important than interactivity. It means that smart contents must be accessed anytime anywhere anyplatform, and any network. Accessibility is very important premise for smart learning. Also, the disabled must access smart contents without any barriers as well as the non-disabled.

Analysis results also show that the quality standards of smart learning include the quality standards of the existing e-learning since the concept of smart learning includes the concept of the existing e-learning as indicated in [4].

## 4. Conclusion and Further Works

In the current knowledge and information age, with aid of advances in smart and ICT technologies, our life style has been changing dramatically and greatly. Regardless of age, sex,

and region, everybody can enjoy the benefits of advanced technologies in every aspect of our daily life. As more people have smart devices and use them in their daily life, smart devices become the necessities. Smart technologies have affected educational area so that a new concept called smart learning is introduced.

As educational smart contents become abundant, we need quality standards for the smart contents. Those standards are very important for evaluating the smart contents and can be a milestone to guide for future smart contents production. Although there are some standards for the existing e-learning environments, to our best knowledge, there are no quality standards for educational smart contents in the literature.

The purpose of this paper is to develop and present quality standards for educational smart contents. The proposed quality standards are made based on the existing quality standards in e-learning environments and include some distinct characteristics of smart learning. For development of quality standards, 45 experts group from academy and industry are selected and surveyed. Their responses are analyzed based on thorough statistical analysis so that final quality standards for educational smart contents are developed. The final quality standards consist of 14 areas and 34 standards.

Our further research issues are as follows. First, we need to develop quality standards for different applications of smart environments such as text contents, graphic contents, sound contents, and video contents, etc. Second, we also need to develop quality standards for elementary school, middle school, and high school, even for lifelong education center, etc. Finally, our task is to develop practical guidelines for educational smart contents production. Those guidelines can be a milestone for every type of smart contents production for teachers, researchers, and manufacturer, etc.

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