A Proposal of Quality Evaluating Model
for Serious Game Contents*

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ABSTRACT

This paper is on the premise that we need objective and measurable researches on quality evaluation of serious game for users' correct selection of games fitting for their purposes, for development of competitive high-quality game, and for stable growth of game industry. At first, we looked into various characteristics of serious game, read the present situation of game market, and proposed the necessity of quality evaluating model for serious game. To guarantee the objectivity of the proposed models, we compared and analyzed various proposals of standard model on the basis of international standard quality-evaluating model, ISO/IEC 9126 S/W. And so we extracted quality-evaluating items for serious game that composed of 8 evaluating areas and 25 sub-attributes, and presented quality-evaluating indices of each area. The proposed quality-evaluating model was added 2 areas and 8 sub-attributes to the international standard model, and the validity of the extracted items' was verified by expert group's questionnaire. Accordingly, we expect that this paper will increase game users' satisfaction, promote the development of high-quality games, and contribute to continuous growth in serious game market.

Keywords: serious game, quality-evaluating area, quality-evaluating model

1. INTRODUCTION

In 2002, the Woodrow Wilson International Center for Scholars in the United States launched a "Serious Games Initiative" to encourage the development of games that address policy and management issues. Since then, the term "serious game" came into wide use with the Serious Games Initiative, games were being developed for non-entertainment purposes. The serious game is a software application developed with game technology and game design principles for a primary purpose other than pure entertainment.

That is, the serious game, using the proper function of game, is what the boundary is expanded by adding special purposes such as 'education', 'training', 'treatment' etc. to its main purpose 'fun'. It has been called 'Edutainment", or "Edu-game" or "Educational game", but is being gradually unified in the name of "serious game" throughout the world at the present day.

As the purpose of using serious game depends on the goal which the game achieves, it is important to meet with accurate information about the serious game fitting for the purpose and the level. For example, users who seek for serious game being serviceable for a certain learning want a variety of information related to the learning: how much learning ability the game has, what percentage of entertainment and education the game has, how difficult its learning is, how many hours the game or the

education takes, whether use of color graphics is helpful to learning or not, and how much eye fatigue the graphics has, and so on. Therefore it is unreasonable to equally evaluate the function of serious game on the basis of general contents. In other words, it is desirable to evaluate quality areas by adding characteristics of the serious game.

The serious game market is still new-born field. Moreover, the whole game markets are also in immaturity. So there has not been any standardized indicator for quality evaluation of games yet. But, just before providing the service for users, some standards for bug-testing have been prepared and operated internally and externally. And only a few quality-researches conducted in technical points of view about online games, PC games, mobile games etc. have been introduced.[1],[2]

Therefore this paper is on the premise that we need objective and measurable researches on quality evaluating model of serious game for supporting users' correct selection of games suitable to their purposes, for reflecting game's characteristics and combining up to categories above technological parts to develop competitive high-quality games.

In Section 2, we looked into various attributes of serious game and situation of game market, presented the need of quality evaluating model. In Section 3, we made a framework for developing the quality evaluating model of serious game, described the contents of step-by-step work. In Section 4, according to the framework, extracted quality-evaluating items which

reflected the characteristics of the serious game on the basis of international standard model and proposed 5-stage quality indicator which is composed of A, B, C, D and F. In Section 5, verified the validity of items extracted by expert group, and showed the results of verification. In Section 6, we lastly presented the effects of expectation this study has and the direction of research in the future.

2. THE NEED OF QUALITY EVALUATING MODEL OF SERIOUS GAME

2.1 serious game

Until now, 'Edutainment" or "Educational game" has occupied a large portion of serious game. However, as games for training or treatment appear on the scene, these are gradually being unified in the name of "serious game" all over the world.

As shown in Table 1, not only the serious games are being released in various fields such as food problem, dispute resolution, military training, brain training, promotion of learning ability, business administration and stock learning, training against fire and disaster, sports lessons, psychological and rehabilitative treatment and so forth, but platforms such as PC, On-Line, Console etc. are also currently being varied.[3]

Table 1. Representative serious games

game name	contents	platform	releasing company (organization)
Food Force	solution of food problem in underdeveloped countries	PC	U.N.'s World Food Program
MS Flight Simulator	Air Force flight training simulation	On-line	MicroSoft
Star Stone	prevention against violence in elementary school	PC	Korea game industry agency
Wii Fit	health care	Wii	Nintendo
SimCity Society	city construction & cultural life	PC	Tilted Mill
Audition English	learning English	On-Line	Hanbit Soft

As physical configuration of the serious game includes various components such as textual information, character images, several game worlds, quest or scenario of world unit, mini-games connected to the inside or outside of the game etc, it consists of multi-hierarchic segments based on multimedia. So it is said to have a partially similar configuration to movie-video contents, music contents, e-learning contents, information contents, broadcasting contents and so on.

But, differences between serious game and other games are that serious game includes specific goals such as learning or

training, and is designed by proper coordination, combining them with 'entertainment' and 'fun' elements.

With the development of local content industry and game industry, serious game industry records high growth every year, and the demand is also increasing every day. The worldwide sales of entire game industry recorded U.S.$ 105,898 million in 2008, and is approximately expected to exceed over U.S.$ 114,309 million in 2010. Among them, the size of overseas market of serious game was approximately U.S.$ 50,000,000 in 2005, is currently expected U.S.$ 360,000,000 in 2010. [4]

In Korea, various agencies and companies such as Korea Game Industry Agency, NHN, NC Soft, Soft Max, and HanbitSoft etc. have been developing serious games, and the Ministry of Culture, Sports & Tourism has launched a forum for serious games in July of 2008. Also, from this year, subjects applied to game will be formed in elementary and secondary schools' curriculum.[5]
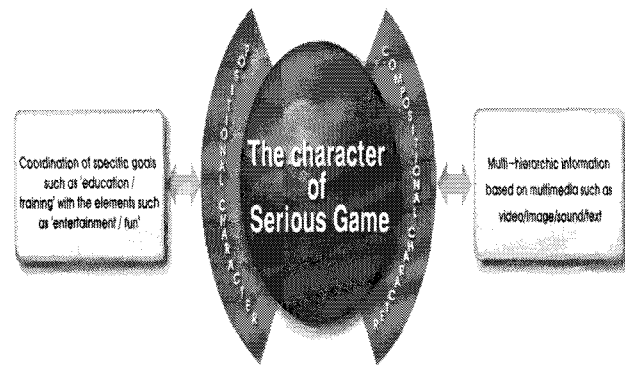

Fig. 1. The character of serious game

2.2 Preliminary investigation into the need for quality information of serious game

Because users of serious game access the information with special purposes, it is very important to provide quality information on the ground of objective and measurable basis. In addition, due to increased demand and anticipated high-speed growth of the game, researches on quality evaluation to develop high-quality serious game are very urgent. But there has not been any objective and measurable quality-evaluating model to reflect characteristics of serious game yet. Table 2. is a part of the survey results executed by this researcher, conducting a survey of verifying the produced outcomes of educational-game metadata being in the prototype stage, making the experts(25 in all including professors, game developers having a minimum of 2 years experience) an object of the survey, in 2007.

Table 2. confirmed survey results about need of quality information(2007.12)

question	contents of answer	result (persons)		
Which element do you refer in purchasing game	☐ News/Article ☐ Award-winning ☐ Event		1	Advertisement	24

content or select-ing service?	☐ Advertisement ☐ Word of mouth ☐ Consumer report ☐ Homepage ☐ Recommendation (Plural answer available)	2	Homepage	20
		3	Event	17
If the quality of the game content is graded, do you think the grade will affect your purchasing?	⊙ Certainly I do. ⊙ Yes, I do. ⊙ so-so. ⊙ No, I don't. ⊙ Certainly not.	Average : 4.2 (significance level: below $p<0.05$, reliability: in the range of 95%)		

As you see the results, we usually gain contents' information from services sites for the pertinent content, portal sites, news, books, the unwritten etc., which are influenced by marketing and changes of the times. <Question 1> shows that influential elements in buying or selecting contents are somewhat enterprise-leading and lack objectivity. And <Question 2> implies that users need measurable quality information about the content. Accordingly, this survey confirmed that some ways and means for game users' deciding the selection of appropriate contents should be provided on the basis of reliable and measurable quality information.

2.3 Whether metadata of content fields provide quality information or not

While users utilize metadata to get information about a certain content, most of metadata in fields of domestic content, though certified by Korea Telecommunications Technology Association, don't include any quality information as shown in Table 3. Moreover, the metadata of serious game have not been well developed yet, any research on quality evaluation is not working, too. [6]-[9]

Table 3. quality information in components of metadata

Standard Title	Field	Quality Information
components and types of metadata for broadcast & video	broadcast & video	unknown
components and types of metadata for animation	animation	unknown
components of metadata for distributing game	game	unknown
components and type of multiplatform e-Learning metadata	e-Learning	unknown

2.4 Problems of quality-evaluating standards in content fields at home and abroad

Some quality-evaluating standards are proposed as above mentioned. But the problem is that there's hardly any evaluating model containing measurable standards so that user can actually measure quality information of contents. Note Table 4.

Table 4. present status of study of quality evaluation in content fields at home and abroad

Field	Evaluation Content	Evaluating Model
ISO/IEC 9126 [10]-[13]	to present s/w items composed of 6 areas, 21 sub-attributes	Quantative Evaluating Model SQuaRE Project in progress.
IEEE[14],[15]	to establish 5 standards related to quality evaluation of s/w	Not Mentioned
s/w quality model of mobile game[16]	to present quality-evaluating items divided into 2 fields, 10 areas, and 35 sub-attributes	Not Mentioned
quality evaluating method of digital video contents[17]	to present quality-evaluating model using 6-variable areas by observer's experiment	Quantative Model (No Evaluating Standard)
quality-evaluating instruction of web-based s/w[18]	to present quality items composed of 6 areas, 23 sub-attributes	Not Mentioned

In other words, there has not been any evaluating models which establish measurable evaluating standard and induce quality evaluation in majority of content fields, so it is very difficult for users to encounter objective and reliable information about a certain content.

3. PROCEDURE AND SUBSTANCE FOR DEVELOPING QUALITY-EVALUATING MODEL OF SERIOUS GAME

It would be desirable to develop quality-evaluating model of serious game according to the framework shown in Fig 2 . This method is different from evaluating design of ordinary game in perspective that requirements of expert groups' fitting for special purposes such as education, treatment, training etc. should be collected at data-researching stage.

And, after configuring environments for evaluation in every field, we applied survey or simulation to each field in order to verify the feasibility of the model. Then we analyzed reliability of the results of evaluation, and made up for the weak points of model and improved them. Finally we proposed quality-evaluating model which can represent measurable rating-information. This study is now in progress up to developing prototype of the evaluating model.
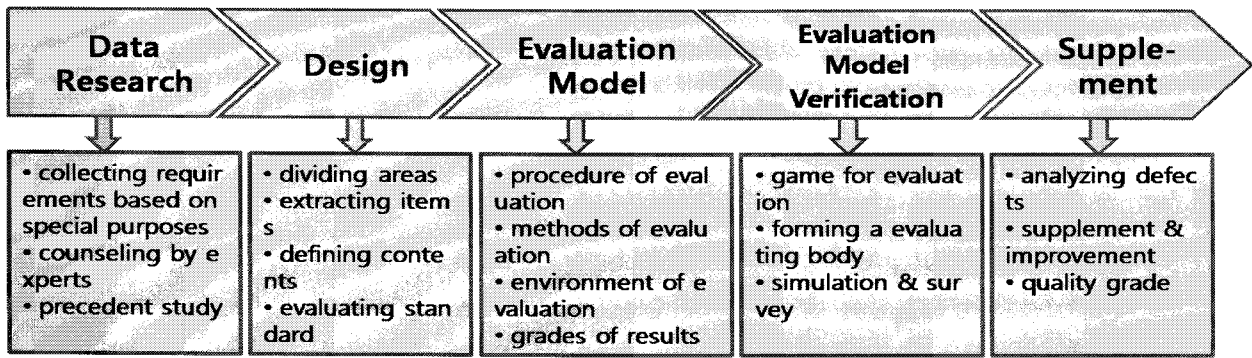
Fig. 2. framework for developing quality-evaluating model of serious game

4. DEVELOPMENT OF PROTOTYPE FOR QUALITY-EVALUATING MODEL OF SERIOUS GAME

4.1 Comparison and analysis of standardized materials of quality evaluation at home and abroad

Quality-evaluating model of serious game should be developed to guarantee objectivity and compatibility on the basis of international standards of related fields. So we selected the S/W quality-evaluating model ISO/IEC 9126 as a referential international standard, compared and analyzed various quality-evaluating models of contents area based on it.

To derive the core area of quality-evaluating model, we mapped out common areas on the evaluation-related standard document. As shown in Table 5, there are 3 quality-evaluating fields of contents, each field is composed of 6 attributes, that is, 'functional attribute or secure attribute', 'reliable attribute or stable attribute', 'usable attribute', 'efficient attribute', 'portable attribute or interoperable attribute', and 'maintainable attribute' as main area. And each area uses at least 2, at most 10 or more sub-attributes as evaluating items. Through overall investigation, we found that many of quality-evaluating areas and sub-attributes are quite similar, there are only a few emphasized areas or different sub-attributes according to characteristic of that s/w.

Table 5. comparison among sub-attributes of each s/w quality area at home and abroad

mobile game s/w	ISO/IEC s/w	web-based s/w
functional attribute	functional attribute	secure attribute
(suitability, accuracy, interoperability, security, concurrency)	(suitability, accuracy, interoperability, security)	(confidentiality, integrity, authenticity, non-repudiating function, possibility of access control, protection of privacy, compliance)
reliable attribute	reliable attribute	stable attribute
(maturity, fault tolerance, recoverability, adaptability for reliance, availability)	(maturity, fault tolerance, recoverability)	(availability, reliability, accessibility)
usable attribute	usable attribute	usable attribute
(understandability, learnable attribute, operational attribute, familiarity, adaptability for use, simplicity)	(understandability, learnable attribute, operational attribute, familiarity)	(suitability, accuracy, possibility of understanding, operational attribute, preference)
efficient attribute	efficient attribute	efficient attribute
(time efficiency, resource efficiency)	(reaction efficiency, resource efficiency)	(time efficiency, resource efficiency)
portable attribute	portable attribute	interoperable attribute
(adaptability, installation, coexistence)	(adaptability, possibility of installation, coexistence, substitutive attribute)	(linking attribute, compliance)
maintainable attribute	maintainable attribute	maintainable attribute
(analytic attribute, changeable attribute, stability, testability, adaptability for maintenance)	(analytic attribute, changeable attribute, stability, testability)	(analytic attribute, changeable attribute, testability, auditable and traceable attribute)

Observing domestic standard data of quality evaluation in [Table 5], though names of the main evaluating areas somewhat appear different and some sub-attributes show characteris-

tic dissimilarities according to contents' nature, we can see that the data have largely been worked on thebasis of international standard ISO / IEC 9126. The biggest differences are mostly shown in quality evaluating areas of Web-based S/W. Among the sub-attributes of the 'functional attribute' of ISO / IEC 9126, two of them become involved in 'usable attribute' of Web-based S/W, 'secure attribute' and 'interoperable attribute' were completely moved into upper evaluating areas from sub-attributes ISO / IEC 9126, 'security' and 'interoperability'.

In addition, as Web-based s/w are frequently installed in conjunction with other s/w on the Internet rather than separately installed, 'portable attribute' is substituted by 'interoperable attribute', and 'linking attribute' and 'compliance' are used as its sub-attribute. But, subdividing 'secure attribute' into 7 sub-attributes might prevent us from correctly evaluating due to excessive classification. Because 'suitable character' or 'accurate character' among sub-attributes of 'usable attribute' has functional feature, it is unreasonable to evaluate them in the 'usable attribute' area.

The quality-evaluating areas of Mobile game nearly observe the international standard ISO/ IEC 9126. However, some terms of sub-attributes have equivocal, similar, and redundant meanings. For example, evaluating-items such as 'understandability' and 'learnable attribute' have something to do with providing manuals which enable users to enjoy playing the game, so differences of the two meanings are insignificant, ambiguous, and preferably overlapping.

4.2 extraction of quality-evaluating area of serious game

On the basis of results of the above survey and of analysis of precedent studies, we developed a prototype of quality-evaluating model of serious game. In developing progress, we extracted sub-attributes from 6 main areas and supplemented or integrated them on the basis of ISO/IEC 9126, the international standard of S/W quality- evaluating model, and added evaluating areas reflecting characteristics of serious game.

This method of development is general means for objectivity and compatibility of quality-evaluating model, and have the advantage of separately evaluating quality peculiar to serious game.

Likewise, there were partial supplement, integration and removal of upper areas of the proposed quality-evaluating model, and we extracted 25 sub-attributes from 8 main areas which additionally reflected characteristics of serious game.

There are 8 areas, that is, 'Usable attribute', 'Functional attribute', 'Reliable attribute', 'Effective attribute', 'Maintain attribute', 'Portable attribute',' Special Purpose attribute', and 'Contents attribute' as upper evaluating area, but only two areas, 'Special Purpose attribute' and 'Contents attribute' were added for reflecting characteristics of serious game.

4.2.1 Usable attribute
■ understandability/ learnable attribute: specific attributes on whether manual or help was provided so that users can easily learn the game
■ operational attribute: an attribute concerning whether users can use interface device or not

■ familiarity: an attribute concerning whether hotkey, menu etc. are universally and easily designed as recognizable user interface(UI)

4.2.2 Functional attribute
■ suitability / accuracy: attributes on whether games suitably and accurately offer the given function or not
■ interoperability: an attribute on whether the game is designed for various interaction at the given platform
■ security: an attribute concerning whether blocking functions against unauthorized external access are provided or not

4.2.3 Efficient attribute
■ reaction efficiency: an attribute concerning whether a game handle a certain function within limited time without problems
■ resource efficiency: an attribute on whether a game was designed(or produced) to demonstrate the best performance under limited environment (minimum specification)

4.2.4 Maintainable attribute
■ analytic attribute / testability: attributes concerning whether function to collect and analyze the data linked to maintenance of game and function to test updated information are provided
■ changeable attribute: an attribute on whether the game patch is efficiently working or not
■ stability: an attribute concerning game is stably working after patching
■ serviceability: an attribute concerning whether service counters to solve some of users' questions or complaints are provided in a number of ways

4.2.5 Reliable attribute
■ maturity / fault tolerance: attributes on whether the system has ability to cope with defects without suspension of operation or not
■ recoverability: an attribute on whether the system has ability to automatically recover erroneous data by using back-up data or not

4.2.6 Portable attribute
■ adaptability / compatibility: attributes on whether the game has abilities to adjust itself to environmental changes such as various platforms(O.S. etc.), graphic cards and so on
■ possibility of installation : an attribute on whether the game is properly installed
■ coexistence: an attribute on whether the game efficiently use resources, for example, sharing memory with the other s/w and so forth

4.2.7 Special Purpose attribute
■ goal-realizing attribute: an attribute on how realizable user's goals are by training the serious game
■ Safety: an attribute on whether the game has health and safety issues, and on whether contents of the game violate so-

cial and moral sense or not, by reviewing video quality, sound etc.

■ interactive attribute: an attribute concerning whether two-way interactions between user and user or users and the system properly provides the immersion or not

■ adjustable attribute: an attribute on whether the system or supervisors have the ability to control the game, unlike ordinary entertaining game being addicted to it

■ evaluating attribute: an attribute concerning whether serious game provides function to check educational and training effects through self-evaluation or feedback after executing the game

4.2.8 Contents attribute

■ creative attribute: an attribute on whether scenarios, characters, and objects are creative, and are well harmonious with the game

■ imageable attribute: an attribute on whether videos, being in harmony with game concepts, goals, and users, help users to immerse in the game

■ musical attribute : an attribute on whether music, being in harmony with game concepts, goals, and users, help users to immerse in the game

4.3 quality-rating standards based on quality-evaluating area of serious game

The proposed prototype model provides evaluation-ratings having measured-values (for researchers) in order to correctly recognize evaluating-results from each quality-evaluating area. It endows each sub-attribute with evaluating results of 5 grades which is composed of the best(A), above average(B), average(C), below average(D), and the lowest(F). Then, calculating mean valueof each upper-level's evaluating area unit, it finally indicates the quality information consisting of 5 grades. However, for lack of accuracy, the quality ratings covering whole evaluating areas are not applied.

For example, among the various serious games that show qualities per evaluating area, user can decides which to choose according to their purposes. Evaluating methods should be variously presented by area unit, so Table 6, as evaluating metric of each area unit, shows two methods, dividing largely into simulation and survey.

The simulation is the method that measures error-occurring frequency using processing ratio based on objectively testable standard or boundary value following users' requirements, and that evaluates qualities by the ratio or value unit. The survey is the method that uses a target game aiming at experts or ordinary users under a certain environment, and that evaluates qualities by the response scores attained by the way of Likert's 5-point scale to items of questionnaire.

Table 6. metrics of each evaluating area

evaluating area	evaluating method	evaluator	remarks
usable attribute	survey	experts,	general-purpose

special purpose attribute		ordinary users	environmental construction of test (time, place and personnel)
contents attribute			
efficient attribute		system, person in charge of test	bug-occurring frequency, boundary value measurement etc.
maintainable attribute	simulation		
reliable attribute			
portable attribute			
functional attribute			

Table 7. is the case of survey evaluating the quality of 'understandability' or 'learnable attribute' out of 'usable attribute' area.

Table 7. quality-evaluating method of survey : example 1

area	usable attribute
sub-attribute	understandability / learnable attribute
contents of survey	Is the provided manual or help in detail to easily understand (or use)?
forms of response	□ fairly detailed □ detailed □ medium □ brief □ none

Table 8. is the measuring method of simulation evaluating the quality of reaction efficiency out of 'efficient attribute' area.

Table 8. quality evaluating method of simulation : example 2

area	efficient attribute
sub-attribute	reaction efficiency
forms of results	□ faster than over 20% □ faster than 0~20% □ standard value □ slower than 0~20% □ slower than over 20%

Table 9. is the measuring method of simulation evaluating the quality of 'possibility of installing' out of 'portable attribute' area.

area	portable attribute		
sub-attribute	possibility of installation		
forms of results	□ 0% □ 1~5% □ 6~10% □ 11~15% □ over 16%		

5. VERIFICATION FOR VALIDITY OF QUALITY-EVALUATING AREA OF SERIOUS GAME

To verify the validity of the proposed quality-evaluating area of serious game, we questioned 45 experts having more than 2 years of experience in related fields, including game developers, managers by Likert"es 5-point scale, and analyzed the validity.

Fig 3. is a part of the survey item asking the necessity of providing quality information, the results are shown in Table 10.

Among quality information related to using, developing, distributing, and operating the contents of Serious Game, if you want any, please see following items and check √ the corresponding item.

◆ elements of quality information of 'usable attribute'

1) Evaluated Information on whether this game provide user with a detailed manual or help to easily understand or use (understandability / learnable attribute)
□ absolutely necessary   □ necessary   □ medium
□ unnecessary   □ quite unnecessary

2) Evaluated Information on whether input devices(keyboard, mouse, keypad, input sensor etc.) of game are designed to be easily manipulated or not (operational attribute)
□ absolutely necessary □ necessary □ medium
□ unnecessary   □ quite unnecessary

Fig. 3 a part of survey

Table 10. verification for validity of quality-evaluating area

quality area	sub-attribute	response value	average
Usable attribute	understandability/ learning character	3.98	4.01
	operational attribute	4.00	
	familiarity	4.04	
Functional attribute	suitability / accuracy	3.91	3.68
	interoperability	3.35	
	security	3.78	
Efficient attribute	reaction efficiency	3.83	3.75
	resource efficiency	3.67	
Maintainable attribute	analytic attribute / testability	3.96	4.02
	changeable attribute	4.17	
	stability	4.15	
	serviceability	3.80	
Reliable attribute	maturity / fault tolerance	3.87	3.90
	recoverability	3.93	
Portable attribute	adaptability / compatibility	3.65	3.75
	possibility of installation	4.13	
	coexistence	3.48	
Special Purpose attribute	goal-realizing attribute	3.93	3.73
	safety	3.91	
	interactive attribute	3.52	
	adjustable attribute	3.35	
	evaluative attribute	3.93	

Contents attribute	creative attribute	3.30	3.46
	imageable attribute	3.59	
	musical attribute	3.50	
Average		3.79	

Table 11. two-group statistic

	T-test for Equality of Means						
	Levene's Test for Equality of Variances		t	degree of freedom	significance probability (2-tailed)	mean difference	std. error difference
	F	significance probability					
usable attribute	0.615	0.437	0.298	44	0.767	0.082	0.276
functional attribute	3.980	0.052	0.099	44	0.921	0.028	0.284
efficient attribut	10.839	0.002	-1.502	9.16	0.167	-0.518	0.345
maintainable attribute	0.182	0.6723	1.558	44	0.127	0.297	0.191
reliable attribute	0.213	0.647	0.664	44	0.510	0.204	0.308
portable attribute	3.507	0.068	-0.078	44	0.938	-0.016	0.204
special purpose attribute	1.472	0.123	1.068	44	0.291	0.241	0.226
contents attribute	0.363	0.550	-1.534	44	0.132	-0.484	0.316

The average for all respondents is 3.79/5.0, responding to the necessity above 'medium'. Especially, the average values of 'usable attribute' and 'maintainable attribute' are both above 4.0, showing them to be quite necessary quality information.

As a whole, there is no item below 'unnecessary' level (less than 3.0), so we can utilize the sub-attributes of each area as quality-evaluating items. In 'special purpose attribute' area reflecting characteristics of serious game, while 'goal-realizing attribute', 'safety', and 'evaluative attribute' are above the average value as sub-attributes, proving to be recognized as important quality information, 'interactive attribute' and 'adjustable attribute' are below average, showing them to be relatively less important.

We executed the Independent Samples T-test to inquire into whether there are statistically significant differences between the two groups, program / graphic developers (pg-gp) and planners (design). Through Levene's Test for Equality of Variances, only 'efficient attribute' area showed 0.002<0.05 significance probability. Therefore we selected the T-test significance probability of Equal Variances not Assumed in only 'efficient attribute' area, and selected the T-test significance probability of Equal Variances Assumed in the

remaining attribute areas. So we set the significance level, γ = 0.05. Observing the result of the T-test, 2-tailed significance probabilities of all areas show ' >0.05'. Accordingly we could see that there was no difference between program / graphic developers (pg-gp) and planners (design). See Table 10, 11.

Table 12. Independent Samples T-test (* Equal variances assumed, ** Equal variances not assumed)

		N	Mean	Std. Deviation	Std. Error Mean
usable attribute	design	9	4.07	0.89	0.30
	pg-gp	37	3.99	0.70	0.12
functional attribute	design	9	3.70	0.95	0.32
	pg-gp	37	3.68	0.72	0.12
efficient attribute	design	9	3.33	1.00	0.33
	pg-gp	37	3.85	0.54	0.09
maintainable attribute	design	9	4.25	0.59	0.20
	pg-gp	37	3.95	0.50	0.08
reliable attribute	design	9	4.06	0.92	0.31
	pg-gp	37	3.85	0.81	0.13
portable attribute	design	9	3.74	0.76	0.25
	pg-gp	37	3.76	0.49	0.08
special purpose attribute	design	9	3.93	0.45	0.15
	pg-gp	37	3.69	0.64	0.11
contents attribute	design	9	3.07	1.03	0.34
	pg-gp	37	3.56	0.81	0.13

6. CONCLUSIONS

Demand for serious game is rapidly growing, and scale of the game market is too. It is very important for users to correctly choose serious game fitting for special purposes such as education, training, treatment etc. by taking advantage of proper function of game. Therefore it is desirable to provide users with reliable quality information of serious game.

For this reason, as described in this paper, we studied the needs, developing procedures, and contents of quality-evaluating model providing reliable quality information of serious game, and developed a prototype of quality-evaluating model of serious game.

The quality-evaluating model of serious game was extracted from the existing quality-evaluating areas of related field, adding characteristics of serious game to them. The model is composed of 6 main-attribute areas and 27 sub-attributes, and designed to provide measurable quality grades in accordance with evaluation of each quality area.

In the near future, on the basis of the proposed prototype, we will develop web-based quality-evaluating tools, verify and supplement the validity, and provide users with reliable quality information through this study.

From the results of this study, we expect that the degree of users' satisfaction will be improved by selecting the serious game suitable for their purposes, that the development of high-quality serious game increased by developing-agencies' competition in good faith , and that the competitiveness in the world markets also strengthened.

REFERENCES

[1] HyeJung Jung, "An Evaluation Model of Game Software", *paper of Koreansociety for internet information Vol . 8, No. 6*, pp. 115-125, 2007.

[2] EunHee Choi, EunHee Park, JongSik Woo, SungWoo Sin, "The Research of SW Quality Evaluation in PC Game", *The Korean Institute of Information Scientists and Engineers*, 2003.

[3] Kocca, Korea, *a white Paper on Digital Contents*, pp. 67-94, 2008.

[4] DFC Intelligence, *Reports on the Status of Game Markets in 2008*, 2009.

[5] Ministry of Culture, Sports and Tourism, Korea, *Reports on the Digital Contents Markets*, 2009.

[6] Telecommunications Technology Association, *The Data Element and Format for Television Program Materials*, 2006.

[7] Telecommunications Technology Association, *The Data Element and Format for Animation*, 2006.

[8] Telecommunications Technology Association, *The Game Metadata Element Set*, 2008..

[9] Telecommunications Technology Association, *The Data Element and Format of MultiPlatform e-Learning*, 2005.

[10] iso/iec 9126-1, *Information Technology - Software Product Quality- PART 1: Quality Model* , 2001.

[11] Azuma, M., "SQuaRE: The next Generation of ISO/IEC 9126 and 14598 International Standards Series on Software Product Quality," in *Proceedings of the European Software Control and Metrics Conference (ESCOM)*, London, UK, pp. 337-346, 2001.

[12] ISO/IEC 14598-1, *Information Technology -Software product evaluation -Part 1: General overview*, 1999.

[13] ISO/IEC 14598-1, *Information Technology -Software product evaluation -Part 1: General overview*, 1999.

[14] IEEE 1061, *Standard for a Software Quality Metrics Methodology*, 2004.

[15] IEEE 730, *Software Quality Assurance Plans*, 2002.

[16] Telecommunications Technology Association, *The Quality Model for Mobile Game Software*, ttas.ko-11.0078, 2007.

[17] Telecommunications Technology Association, *Method of Digital Image Quality Assessment*, ttas.ko-10.0215, 2006.

[18] Telecommunications Technology Association, *Guidelines for the Evaluation of Web-based Software*, ttas.ko-11.0059, 2007.

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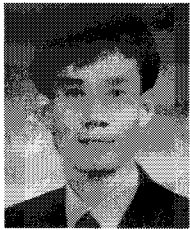
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