

모바일 기기 기반의 이러닝 콘텐츠 품질관리 평가 기준 개발

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Development of Quality Assurance Criteria for Mobile Device Based e-learning Contents

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Abstract A wide variety of contents are now provided along with the development of information appliances. The purpose of this study was to examine what should be considered to boost the quality of mobile device based e-learning contents. For this study, 12 evaluation domains and 26 evaluation items were selected using the Delphi method.

The factors to be considered for mobile device based e-learning contents quality are summarized 4 factor. In other words, for the purpose of managing the quality of mobile device based e-learning contents, there exist four areas to be considered, 'foundation', 'contents', 'teaching design' and 'technology.' The findings of this study are expected to contribute to the improvement of the quality of the educational contents.

Key Words : e-learning Contents, Quality Assurance, Mobile

1. Introduction

In online learning, contents are used for delivering the details of a lesson. Students and instructors cannot face one another face-to-face, so the importance of the contents is naturally emphasized. The goal is to reflect suggestions and ideas from students into content to create more effective learning materials. Thus, the

objective of quality management for online learning has been to protect students' rights against contents failing to meet a certain level and encourage service providers to develop good quality contents[1]. Also, quality management for online learning has addressed all the overall aspects of online learning such as content quality evaluation tools development, quality management system development, and online learning

* 본 논문은 2012년 정보통신산업진흥원의 모바일 기반 이러닝 콘텐츠 품질관리 기준 개발 연구비에 의해 지원되었음
Received 6 January 2014, Revised 6 February 2014
Accepted 20 February 2014
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management system development[2][3].

It is not an over-statement to say that online learning has continued to develop along with the development of ICT. The development of ICT has contributed greatly to being able to provide education suitable for students anywhere and at any-time[4]. The development of ICT has been steadily evolving such that analog systems are being replaced by digital convergence. The changes in foundation technologies have blurred the borderline between technologies and industries, and are accelerating the production of creative and innovative contents. Technology developments such as cloud computing and N-screens are now enabling production of distinct contents suitable for the changes occurring in the content delivery environment. Especially, mobile devices that are evolving in various ways are upgrading the level of e-learning (online learning) and in some cases the devices tend to lead the education environment[5][6]. Web-based content designed for PCs have been offered so far, but it's now required to produce different forms of content suitable for mobile devices. To make this happen, even the same contents should be designed somewhat differently in consideration of the characteristics of mobile devices, and the use of different technologies is required as well[7][8][9].

In the past, learning content was provided from the web, but now we need to consider an evolution to accommodate the distinct criteria that shape the mobile device environment. Even if the details of the content are the same the design methods and technologies must reflect the characteristics of the devices. Unlike standardized online learning, we must consider all the various mobile device environments. In the mobile environment, contents should be implemented in such a way that they can improve the learning effects as well as support functions usable among differing mobile devices and their differing screen sizes. In this study, which factors should be taken into account to ensure the quality of mobile device based contents is

discussed.

2. Related work

2.1 Quality management

Quality is a term for end users[10]. Quality indicates the degree of fitness of the product to an end user's requirements and goals. In other words, quality indicates to what degree the goals are achieved by comparing with the original goals of the product [11] such as the degree of fitness to students' requirements or the degree of contribution to improving the learning effects [12][13]. Also, Kim and others(2010) defined content quality management as a series of management processes taking place to improve the educational effects of digital material created for online learning[10].

In the mobile device environment, contents are media used for delivering lessons to students. Content quality is a term used for indicating the degree of contribution of learning delivered to students. Even if the education environment is changed due to the development of ICT, learning should be managed in such a way that it can achieve its own unique goals instead of being subordinated to technology[14]. Thus, it is a content development, management and certification system necessary for managing the quality of mobile device based content and its educational value.

2.2 Status of quality management

The development of ICT has indelibly changed the educational environment. Mobile devices such as tablet computers and wireless touch-screen readers will be significantly more affordable and accessible by the year 2030[15]. Mobile device based learning tools have promoted interactions between students and instructors. In other words, in the past, educational units (textbooks, learning materials, outside experts,

<Table 1> Quality Management by Three Organizations

	KERIS	NIPA	KoreaTech
Contents to be tested	Contents for students Contents for distance teacher training	Contents for on-the-job training and qualification training	Contents for occupational ability development
Cut-off score and Characteristics	70	80 (cut-off score 70 for both learning content and instructional design)	activation/inactivation partition advanced/general partition

students, teachers, schools, classrooms) were separated but now they are automatically connected with one another through smart infrastructure (cloud storage, wifi, mobile devices, etc.) to create new educational values (participation, sharing, cooperation, creative convergence and problem solving. Therefore, many countries are now developing ways to improve education by improving the quality of mobile device based contents.

In Europe, for example, Denmark has directly mentioned mobile device based learning in their national policy documents and implemented the contents market for various types of mobile device based learning. The Netherland's Kennisnet, which is responsible for ICT innovations in education, is currently developing content and the Dutch government has proposed a guideline for content development [16]. The UK is the country with the most active mobile device based learning among European countries [17]. And the Education Commission of the EU has unfolded various polices to develop the software and hardware necessary for strengthening mobile device based learning[18][19].

Let's now discuss how the quality of content is managed and how mobile devices are used for e-learning in Korea. In Korea, content quality management is handled by three organizations as summarize Table 1[1].

Starting in 2006, KERIS (Korea Education Research and Information Service) has extended the coverage of educational quality certification from elementary and secondary education to higher education. In 2007, KERIS became the first institution in the world to have

<Table 2> NIPA Contents Quality Management Criteria

Foundation	Organization and human resources	Organization structure	
		Acquiring human resources	
		Education training	
	Quality strategy	Repair & maintenance plans	
		Quality management plans	
		Copyrights of education materials	
Resource management	Content management		
Technology reliability	Integrity		
Learning contents	Learning content	Interoperability	
		Education goals	
		Selection of learning contents	
		Organization of learning contents	
		Learning levels	
		Learning quantity	
Teaching design	Requirement analysis	Requirement analysis	
		Student analysis	
		Educational environment analysis	
		Instructor analysis	
		Suggesting ideas	
		Teaching/education strategies	
	Teaching design	Motivation	
		Education materials	
		Screen organization	
		Interface	
		Web accessibility	
		Interaction	Interactions
		Educational support	Support methods
Learning content + teaching design	Evaluation	Evaluation methods	
		Evaluation content	
		Evaluation tools	
	Ethics	Ethics of educational content	

its e-learning quality certification process authorized by the ISO. In 2008, the quality assurance criteria

developed by KERIS were selected as national standards for Korea (KS).

NIPA (National IT Industry Promotion Agency) is responsible for content quality management for all areas other than for K-12 and vocational ability development content. The content evaluation criteria commonly used by NIPA are shown in Table 2[20].

NIPA's quality management arena consists of 'foundation', 'learning content', 'learning design' and 'learning content + teaching design.' The common area of 'learning content + teaching design' are covered by quality management in 'learning content' and 'teaching design.' We can say that the scope of NIPA's quality management responsibility can be classified to cover three areas. It should be noted that in the 'foundation' area, the focus is on managing the qualification and professionalism of organizations that plan and develop contents. In the 'teaching design' area, we can check specifically whether interested parties' requirements are fully reflected in education. In many countries, e-learning quality certification is granted by a certification authority. In Europe such qualification is granted by the Open ECBCheck of the EFQUEL. The Germans have their own qualification authority, known as the Qualitätsplattform Lernen of D-Elan, as do the Swiss, which is the EFMD CEL (teChnology-Enhanced Learning accreditation). In Taiwan there is the E-Learning Quality Service Center (eLCQC). The scope of contents quality certification varies depending on each country. This is summarized in Table 3[21].

〈Table 3〉 Foreign Countries' e-learning Contents Quality Certifications

	lifelong	higher education	K-12
USA : DETC	O	O	
EU : UNIQue		O	
Germany : Qualitätsplattform Lernen	O	O	O
Switzerland		O	
EU : Open ECBCheck	O	O	O
Sweden : E-learning quality (ELQ)		O	
Taiwan : eLCQC	O	O	O

Germany, EU : Open ECBCheck, Taiwan and others are certifying contents in the field of lifelong education and K-12 as well as higher education.

3. Research methods

The objective of this research is to identify the factors for managing the quality of mobile device based contents and reveal what should be managed. To achieve the goal, Delphi-based research was conducted in the following order.

In Step 1, we considered expert groups by considering their vocation groups, adequacy, industrial groups and class. In Step 2, we selected 20 experts from those selected in Step 1. The selected experts were classified into Delphi targets and opinion analysis experts. Thus, 12 persons were chosen for Delphi proceeding and 5 persons were used for analyzing Delphi contents. Unfortunately, 3 participants dropped out in the middle of the study, so they had to be excluded.

In Step 3, we proceeded with the three-step Delphi on experts selected to cover areas, evaluation areas and evaluation items for mobile device based contents. In the 1st Delphi, we selected fields and areas. In the 2nd Delphi, we selected evaluation areas and items for each field. In the 3rd Delphi, we collected opinions up to the 2nd Delphi.

In Step 4, based on opinions gathered from the participants, the group of five experts conducted two sessions of reviews to confirm the mobile device based content evaluation criteria. The confidence level for those evaluators participating in the Delphi analysis is .928, which is quite reliable.

4. Mobile device based contents quality evaluation criteria

The factors to be considered for mobile device based contents quality are summarized Table 4. In other

words, for the purpose of managing the quality of mobile device based contents, there exist four areas to be considered, 'foundation', 'contents', 'teaching design' and 'technology.' The four areas, the twelve evaluation areas, and the twenty six evaluation items are analyzed as follows.

4.1 Contents quality management's foundation area

In the 'foundation' area for content quality management, we can evaluate the foundations of content development. In other words, there are four areas and five evaluation areas: copyrights for materials/organization/design of contents, ethics required to publish contents, technological reliability to deliver content faultlessly, and consistent management of contents. Compared to general content quality

management criteria, we can note that the Organization area is deleted while Contents Accessibility is maintained.

4.2 Content quality management learning areas

The learning area includes all the aspects that should be maintained even if the environment is changed. In other words, it consists of contents related to learning. We believe that it should not be overly different from the organization of existing e-learning contents. In the mobile device based environment, the contents were deleted. The new education goal came to include the question, "Is it marked properly so that a student can be aware of it?" In case of web-based contents designed for PCs, the screen size is relatively large, so we can manage whether the education goal is

<Table 4> Mobile Device Based Contents Quality Management Criteria

Foundation	Copyrights	Clarity of copyrights	Maintained.
	Resource management	Usability of management	Maintained.
	Technology reliability	Reliability of contents	Maintained.
		Accessibility of contents	Modification maintained.
	Ethics	Ethical adequacy of contents	Maintained.
Education contents	Education contents	Education goals	New.
		Selection of education contents	Modification maintained.
		Organization of education contents	Modification maintained.
		Education levels	Maintained.
Teaching design	Teaching design	Teaching/education strategy	Modification maintained.
		Motivation	Maintained.
		Education materials	Maintained.
	UI design	Screen organization	Maintained.
		Interface	Modification maintained.
	Interaction	Interactions	New.
		Communication	New.
	Educational support	Supporting method	Modification maintained.
	Evaluation	Evaluation method	Maintained.
		Evaluation content	Maintained.
Evaluation tools		Maintained.	
Technology	Technology application	Supporting technology	New.
		Supporting functions	New.
		Technology compatibility	New.
	Repair and maintenance	Data management	New.
		Repair and maintenance	New.
		User feedback	New.

specific or suitable for the education goal. However, in the mobile device environment, we focused on whether a student can easily understand the educational goals. Thus, the 'learning' area was confirmed to have a single evaluation area and four evaluation items.

4.3 Contents quality management's teaching design areas

We considered the things that should be changed as the education environment changes, and also the things for which it was deemed difficult to maintain objectivity (from the perspective of quality management) when trying to decide what to delete, maintain or modify. As indicated by the opinions of many experts, all the analyses of the requirements were deleted because it was difficult for the evaluators to evaluate their items and indices objectively. It was hard to find objectivity for the question, so it was necessary to rely on qualitative evaluations by the evaluators. As for 'interaction,' functional adequacy was newly added to emphasize the functional aspects of whether various media were supported in addition to the diversity aspects. Therefore, finally, the 'teaching design' area has five evaluation areas and eleven evaluation items.

4.4 management's technology areas

The 'technology' area is new, and it is not found any other existing e-learning content evaluation criteria. Unlike web-based contents, for mobile device based contents we need to consider the characteristics of mobile devices to improve their educational effects when developing content. For example, we need to use auto resizing when the device size is changed and also need to use cloud services for selecting the proper resolution and data sharing. The hardware configurations of each device also needs to be considered such as the touch screen, GPS, camera, media players and voice assistant, etc.

The experts believed that the 'technology' area was very important as we dealt with the mobile device

based contents. Considering the technical aspects and history management of students, in 'management', they emphasized data management, repair and maintenance, and user feedback as the important issues. In 'technology application', they carefully reviewed whether supporting technology, supporting functions and compatibility were subordinated to a device. In 'repair and maintenance', they considered cloud computing and selected 'data management' and 'real time application of user feedback' as being the key quality management items for that category. The 'technology' area was confirmed to have two evaluation areas and six evaluation items.

5. Conclusion and discussions

The objective of this study was to discover which items should be considered to improve the quality of educational contents provided for a device. 17 experts participated to discern what items should be considered for mobile device based contents quality management.

In conclusion, as a guideline for mobile device based contents quality management, we derived four areas, twelve evaluation areas and 26 evaluation items. The areas include 'foundation', 'contents', 'teaching design', and 'technology.' In developing contents quality management guidelines for delivery of educational material to mobile devices it was difficult to discern the aspect of interaction as compared to delivery of web-based contents. According to the research results for quality management, it is reported that the level of interaction is low. Thus, according to our mobile device based contents quality management guides, students and instructors can interact with one another in real-time and non-real-time, which are the characteristics of remote learning, and students can reorganize their study load in the environment[22].

Unlike existing content, much of the content designed for mobile devices focuses on subject matter

instead of lectures. Subject matter oriented contents are developed to acquire specific knowledge and in many cases, its lecture goals, summary or evaluations are not systematically clarified.

It will be possible to develop various sorts of contents available for mobile environments, but doing so won't produce any benefits if the quality is not properly guaranteed. The findings of this study on content quality assurance guidelines are expected to suggest some of the right directions for quality improvement that can be used in different devices.

ACKNOWLEDGMENTS

This research was supported by Ministry of Knowledge Economy(MKE) and National IT Industry Promotion Agency(NIPA) in the e-learning Research & Development Program 2012.

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