Design and Implementation of a Content Model for m-Learning

Jin Gon Shon* and Byoung Wook Kim**

Abstract—It is difficult for mobile learners to maintain a high level of concentration when learning content for more than an hour while they are on the move. Despite the attention span issue, many m-learning systems still provide their mobile learners with the same content once used in e-learning systems. This has called for an investigation to identify the suitable characteristics of the m-learning environment. With this in mind, we have conducted a survey in hopes of determining the requirements for developing more suitable m-learning content. Based on the results of the survey, we have developed a content model comprised of two types: a segment type and a supplement type. In addition, we have implemented a prototype system of the content model for Apple iPhones and Android smartphones in order to investigate a feasibility study of the model application.

Keywords—Content Model, M-Learning, Requirement Analysis of M-Learning Environment, Segment Content, Supplement Content

1. INTRODUCTION

Accompanied by the rapid growth of wireless Internet technology, the development of various kinds of mobile devices, such as smartphones and tablet PCs, has triggered a sharp increase in the amount of mobile users [1]. This trend has brought about many kinds of social change, including significant changes in the field of education [2]. M-learning is an emerging concept that educationists are starting to explore for using mobile technologies practically in teaching and learning environments. Diverse kinds of educational applications have already been developed and implemented for mobile devices, and such applications are largely recognized as efficient tools for effective studies and/or productivity [3,4]. Several universities have recently started introducing smartphone-based m-learning in keeping with the pace of the increasing distribution of smartphones. The e-learning environment of universities has changed into an integrated form of wired Internet-based e-learning and wireless Internet based m-learning [4,5].

As mobile devices and operating systems are becoming more diverse, user requirements for m-learning are increasingly demanding that an m-learning service should not depend on any specific mobile devices, mobile communication networks, or mobile operating systems [6]. With the advancement of mobile technology, the requirements related to the m-learning infrastructure are being solved.

Even though mobile learners are satisfied with the m-learning infrastructure, they are still expecting to use more suitable mobile learning content, with which they can study efficiently

while they are on the move. In fact, m-learning systems still provide mobile learners with practically the same content used in e-learning. The content being used in m-learning is produced without considering how m-learning environments are based on the mobility aspects of the devices used [1]. There is a distinct difference in the learning environments of e-learning and m-learning [7]. This difference is not a concern if e-learning content of more than one hour is provided to learners at home or schools, but it can be significant when the same e-learning content is provided to learners who are moving about. Because the m-learning process is centered on mobility, discontinuity in the learning process has to be considered as one of most important characteristics in m-learning environments.

The discontinuity of learning can be described as a situation where the learner cannot form a meaningful continuity of learning. The discontinuity of m-learning is largely due to environmental disturbances, the learner's lack of concentration, the difficulty of connecting to a network, or the limitations of mobile devices [8]. Therefore, in order for mobile learners to learn efficiently in mobile environments, there is a need to identify suitable learning content for m-learning [1]. To provide more suitable learning content to mobile learners, a model for m-learning content is proposed in this paper.

2. BACKGROUND

2.1 The Features of M-Learning

M-learning is a new style of learning that employs e-learning using a personal mobile device, such as a smartphone, tablet PC, or other wireless technology [9,10]. Even though e-learning includes m-learning in a broad sense, we have defined e-learning narrowly in this paper as being a way of learning with the educational content that is provided on a desktop PC connected to the Internet through a wired network. As such, we can say that e-learning is dependent on a desktop PC that is connected to the Internet. In contrast, m-learning is independent from locations, devices, and mobile operation systems and it provides mobile learners with access to educational resources whenever and wherever learners use mobile technology [7,11].

The key features of m-learning are portability, motivation, collaboration, and mobility [12, 13]. Compared to e-learning, one of the most important aspects of m-learning is mobility. M-learning provides several benefits for students who can utilize their spare time to take lessons while traveling on a train or bus [14]. M-learning should be considered in terms of mobile devices, content, and educational effects [15]. Since the advance of mobile technology has allowed mobile learners to be independent from the variety of mobile devices, it is now necessary to consider the principles of educational effects on content, because m-learning basically takes place through the content.

2.2 The Considerations for Designing M-Learning

Due to the tendency that e-learning content is increasingly reused, a digital form of educational content has been developed as a 'learning object,' which has purposely been designed for reuse [16]. Therefore, reusing e-learning content in m-learning is efficient with respect to the cost. Most universities and educational institutions providing m-learning also offer e-learning, whose content tends to be reused. However, we need to look carefully at whether or not it can improve

the learning effect simply by applying the content of the e-learning environment to the mobile environment. This question has come up because the m-learning environment is different from the e-learning environment, which provides learning material through a wired network system at a fixed place of study.

Even if an e-learning system is providing 60-minute video content to e-learners, there has not been a problem in learners' maintaining their concentration because the e-learning environment is performed on a desktop PC at a fixed place. However, it is a big issue that needs to be considered if a 60-minute video content is provided to mobile learners who are supposedly moving from here to there and trying to learn something via their mobile devices that are connected to a wireless network. Usually, m-learning is conducted by using one's spare time in their everyday life and it is done on the move. All of which is different from e-learning. Accordingly, it is necessary to consider that the m-learning environment might be faced with a discontinuity in learning. As the mobile environment situation is involving 'moving while learning,' learners may occasionally encounter an unexpected disturbance, making concentration difficult to maintain. Therefore, the learning threshold in the mobile environment requires a change in the m-learning content production environment.

3. RESEARCH METHODS

Even though there are numerous research reports regarding the recognition of m-learning and the level of the learning experience, studies on the learner's needs for what the content for m-learning should look like are still scant. To provide more effective learning in the mobile environment, analyzing the learner's preference in m-learning environments is needed (i.e., the preferred time length of m-learning, before the production of the m-learning content). Therefore, we conducted a survey to determine user preferences in regards to m-learning environments and the content for mobile learners. Based on the results of the survey, we have designed a content model for effective m-learning.

3.1 The Features of M-Learning

The survey was conducted from July 2-21, 2012 with 1,251 undergraduate students who attend the Korea National Open University (KNOU). All of the participants have a broad range of experience in m-learning because KNOU provides m-learning to all of its students. The participants were classified as follows: by gender, 423 male students (34.2%) and 813 female students (65.8%); by age, 16 teenagers (1.3%), 196 in their 20s (15.9%), 371 in their 30s (30.0%), 417 in their 40s (33.7%), 191 in their 50s (15.5%), and 45 who are in their 60s or older (3.6%).

3.2 Data Collection Tools

The survey was modified to apply to m-learning items from a questionnaire used in previous research about learners' preference for e-learning content and types of service [17-19]. The questionnaire asked about the participant's m-learning experience, preference in regards to m-learning type, the time spent on m-learning, places for using m-learning, barriers to using m-learning, preference in regards to the length of time required for m-learning, and so on.

Table 1. Results of survey

Questions	Possible answers	Respondents	Percentage (%)
Preference of m-learning type	Internet mainly, mobile subsidiary	856	69.3
	Mobile mainly, Internet subsidiary	237	19.2
	Internet only	103	8.3
	Mobile only	11	0.9
	Others	29	2.3
Main learning time	Spare time	555	44.9
	Commuting time	294	23.8
	Specific time depends on personal schedule	256	20.7
	Lunch or dinner time	59	4.8
	Others	72	5.8
Barriers to m-learning (multiple response)	Inconvenience of mobile device using	819	66.3
	Burden of mobile device using fee	526	42.6
	Lack of content for mobile learning	374	30.3
	No personal preference	219	17.7
	Inconsequential effectiveness	196	15.9
	Difficult to study without obligation	130	10.5
	Others	190	15.4
Preference of time length of m-learning	5 minutes or less	24	2.0
	6–10 minutes	92	7.7
	11–15 minutes	168	14.1
	16–20 minutes	308	25.9
	21–25 minutes	321	27.0
	More than 25 minutes	278	23.3

4. SURVEY RESULTS

As summarized in Table 1, the survey results show that 69.3% of participants are using the Internet as their main learning tool and mobile technology as a subsidiary tool. This means that students perceive m-learning as a supplementary method to existing e-learning and traditional lectures. We also discovered that 66.3% of participants have experienced inconveniences in the use of mobile devices, and this discomfort became a barrier to using m-learning effectively. This outcome is in line with the finding that learners prefer to select e-learning rather than m-learning when both options are available to them.

The survey results indicate that mobile learners study while they are in places, such as the subway, bus, or car. The results also show that the learning time is relatively short because mobile learners make use of it during their spare time or when commuting. As expected, it also revealed that concentrating on a lecture of 50 minutes or longer played on mobile devices is very difficult for mobile learners. One of the important findings was that the average time length of m-learning preferred by students is around 20 minutes. In addition, disconnecting from the m-learning service before completing the lesson due to not having much spare time is another barrier to students' maintaining a high level of concentration. These results have caused us to conclude that m-learning content should be developed as short and concisely as possible so that mobile learners can complete the content in a comparatively short time.

5. THE CONTENT MODEL

Based on the findings of the survey, we have developed a content model for m-learning comprised of two types such as segment type and supplement type.

5.1 Segment Type

According to the survey results, m-learning content should be developed and provided to mobile learners in such a way that they can concentrate on the content for no longer than 20 minutes. In order to reuse an existing e-learning content that is approximately 60-minutes long, we developed a segment content model. Complying with this content model, the e-learning content is divided into several segments in order that each segment has its own learning objective and takes less than 20 minutes.

The segment content model (Fig. 1) provides mobile learners with several sub-lectures that have been segmented from a single lecture, rather than providing them with the entire e-learning lecture. The segment content model enables students to focus on a specific concept segment by segment in their learning process. Since the whole lecture is divided into several short sub-lectures, learners can easily manage their learning pace and they can make the best use of their brief amount of spare time to efficiently study while moving about. The m-learning content developed by this segment content model has advantages such as the reusability of existing e-learning content, the enhancement of learners' concentration, and flexibility in regards to learning time and learning sequence.
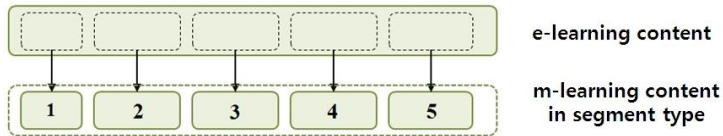

Fig. 1. The content model of segment type.

5.2 Supplement Type

While we were developing the segment content model and implementing it, we discovered that it is not easy to divide the existing e-learning content into meaningful segments without the help of the subject's expert (e.g., the professor). In addition to this problem of segmentation difficulty, there is another problem in which mobile learners are still not interested in the segmented content because the content has simply been segmented from the same e-learning content. Upon first using the segmented content, mobile learners were satisfied with the reasonable time it took to cover the segmented content and the opportunity of convenient learning on their mobile devises. However, they quickly realize that this type of m-learning content is nothing more than the same as the e-learning content, in terms of the content itself. Therefore, it is necessary to provide not only segmented content from an existing lecture but also additional learning materials related to the lecture.

That is why we have also developed another type of content model, which is called a supplement content model. Following this content model, the existing e-learning content can be reused without having to make any of the changes that are usually made for conventional e-learning, but it is complemented by m-learning with supplemental content. In other words, the

supplement content model (Fig. 2) provides additional learning content, such as an introduction, quizzes, tests, an enrichment program, a remedial program, and a summary of the e-learning lecture. The supplemental content can also embrace video materials that hold the answers for FAQs during the regular lectures. The supplemental content includes specific topics that were not dealt with in regular lectures. This is done in order to encourage students to utilize those resources for diverse class activities by providing up-to-date information about a specific field. In order to help students understand class subjects easily and effectively, this model can provide valuable resources that were not handled in regular classes, such as covering subjects more in-depth than those of regular lectures.

The m-learning content developed by this supplement content model not only has the same advantages of the segment content model, but it also has other advantages that allow mobile learners to be able to comprehend the whole lecture with the complementary learning content and they are more interested in the lecture because it is not the same as the e-learning lecture.
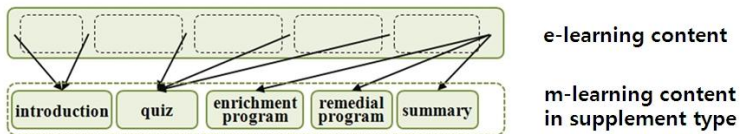

Fig. 2. The content model of supplement type.

6. PROTOTYPE IMPLEMENTATION OF THE M-LEARNING CONTENT MODEL

We developed a prototype system of the m-learning content model for KNOU students with Apple iPhones and Android smartphones in order to validate the content model. We piloted a 'Chinese Writing' course that is currently offered to the students as e-learning content at KNOU, and applied its content to our m-learning content model.

The main menu of the prototype service is shown in Fig. 3(a). Because the prototype system has been implemented in the Korean language, some essential parts of screenshots are given with proper translations in the Figs. 3–7. The Main Menu consists of five components: the Lecture List, My Lectures, Notices, Blog, and Settings. The Lecture List provides the list of available lectures; My Lectures provides the list of lectures the student has enrolled in; Notices provides announcements for the student from the Division of Academic Affairs at KNOU; Blog provides a link to a blog related to the lecture; and Settings provides a setup mode where the student can setup his/her m-learning environment to be as suitable to his/her needs as possible.

By clicking My Lectures in the Main Menu, the student can check on the courses that he/she is enrolled in. In the screenshot of My Lectures, which is shown in Fig. 3(b), the student has Chinese Writing and Advanced Chinese. If the student selects one of them, for example, Chinese Writing, the prototype system provides the student with the Lecture Type Selection menu, where the student can select his/her preferred type of lecture from the Supplement Type or Segment Type (see Fig. 3(c)), as explained in Section 5.

6.1 Prototype for the Supplement Type

Because the segment content model is comparatively easy to understand and its prototype system module is also easy to implement, we will briefly explain after explaining the prototype

system module for the supplement content model.

When the student selects 'Supplement Type' from the Lecture Type, as shown in Fig. 4(a), he/she will be prompted to the total list of lessons for the course. Fig. 4(b) shows that the student selected a lesson called 'Basic Sentence Structure (I),' the first lesson of the course. After selecting each lesson, the student is provided with a submenu of supplementary content for the lesson. Fig. 4(c) illustrates the submenu with the following six components: Lesson Overview, Introduction Video, Enrich Program, Summary, Evaluation Quizzes, and Previous Tests.

Fig. 5 shows a screenshot of the Lesson Overview as one of the supplementary contents, with which the student can not only get the basic information of the lesson, such as lesson structure and the learning object, but also the key words, key expressions, and Chinese proverbs and their explanations that are closely related to the lesson. This kind of supplementary content helps the student become more interested in the lesson rather than just seeing a video lecture or even reading the text version.

When the student clicks Introduction Video, he/she can see a video lecture that is an average of 5 minutes in length and less than 10 minutes. The video lecture explains the overall structure, learning objectives, and keywords of the lesson so that the student can have strong motivation to learn the lesson. For advanced students, the prototype also provides an Enrichment Program, in which they can learn more about the subject in depth with supplementary content, such as famous Chinese literary works and Chinese news articles, in order review the main subject dealt with in the lesson. For slow learners, remedial programs can be also considered for implementation, but they were not implemented in the prototype system.

Once the students have finished one lesson of Chinese Writing with the e-learning content and/or the segmented m-learning content, they can sum up the lesson and catch the main issues to learn. They can do so by using the supplementary content, which they can select with the Summary icon. In order to help students evaluate their class achievements on their own, the prototype system module provides an Evaluation Quizzes option with three types of quiz options: short answers, multiple choice, and true or false, as shown in Fig. 6. When the student responds with the incorrect answer, they are given a second chance. If he/she responds with the wrong answer again, then the correct answer with an explanation is provided. In addition to the quizzes, the prototype system provides the students with Previous Tests in order for them to drill what they learned with some previous tests, such as mid-term exams and final exams, which have been used for real assessments of the course in the past five years.
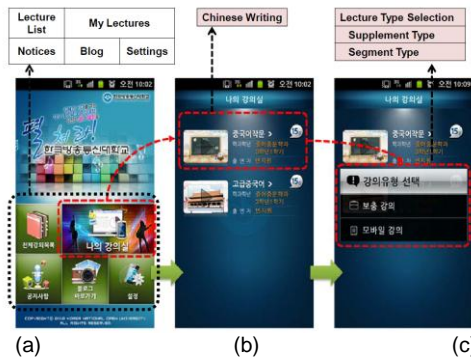

Fig. 3. The main menu of the prototype system and lecture type selection. (a) Main Menu, (b) My Lectures, and (c) Lecture Type.
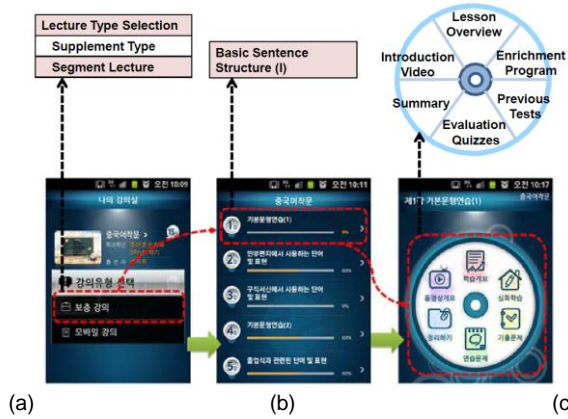
Fig. 4. Implementation of the supplement type content model. (a) Lecture Type, (b) Lesson List, and (c) Content Menu.

Fig. 5. Supplement type content – Lesson Overview.

Fig. 6. Supplement type content – Quizzes. (a) Short answer type, (b) multiple choice type, and (c) true-false type.

6.2 Prototype for the Segment Type

The m-learning segment content model is quite simple because it provides a number of segmented video sub-lectures from already existing content for e-learning. Of cause, it is necessary to consider that the segmentation has to be conducted by an expert from the course with the intention of improving students' learning effectiveness. Keeping a logical harmony amongst all of the the learning objects of each segment, each lesson, and the entire course and by taking account of a sequence of learning activities in the segment and the time limitation of high concentration of the majority of the students, the subject expert should be able to divide one lesson onto several segments. Based on the instructional advice from the subject expert for the Chinese Writing course, the prototype system module of the segment content model has been implemented, as shown in Fig. 7.
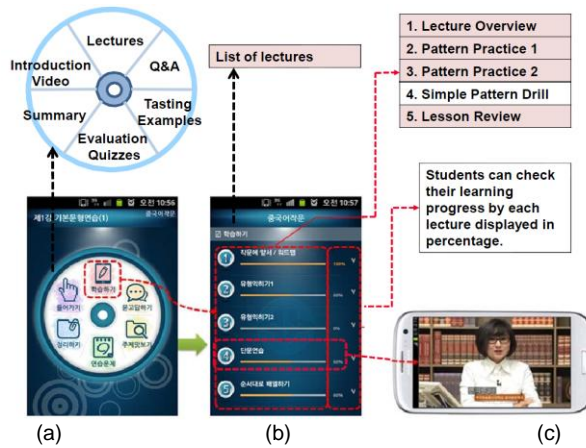

Fig. 7. Implementation of the segment type content model. (a) Content menu, (b) Lecture list, and (c) a video lecture.

If the student selects Segment Type on the screen for Lecture Type, as shown in Fig. 3(c), a submenu for using the segmented content is displayed to him/her, as shown in Fig. 7(a). The submenu consists of the following six components: Introduction Video, Tasting Examples, Lectures, Summary, Q&A, and Evaluation Quizzes. The three components of the Introduction Video, Summary, and Evaluation Quizzes are almost the same as those in the prototype module for the supplement content model. As such, the previous explanations about these items are sufficient. The Tasting Example menu gives the student a couple of examples related to the lesson mainly for encouraging the student's motivation for completing the lesson. The Q&A menu provides a cyberspace for the professor, tutors, and students to ask questions and answer them. The Q&A menu has been implemented in such way as a bulletin board is opened to users in order to upload questions and answers to it when they touch Q&A button. In addition, the Q&A is accompanied by a list of FAQs so that students can consult with it before asking a question.

The most essential component of the submenu for the segment content model is the Lectures menu. When the student selects the Lectures menu, it provides a list of lectures for the lesson. Fig. 7(b) shows the list of five lectures and we can see that the lesson, 'Basic Sentence Structure

(I),' is made up of five segmented lectures, including Lecture Overview, Pattern Practice 1, and so on. For example, when the student wants to study the fourth segment, which is displayed as a Simple Pattern Drill, he/she just touches it, and the video lecture for it will begin (Fig. 7(c)). Each video lecture has been carefully divided and edited from the existing 60-minute video with the help of the professor who made the video lecture for the e-learning content of the Chinese Writing course. Based on the survey results, every segment can be completed by the student in 5 to 15 minutes.

7. CONCLUSION

We have developed a content model for m-learning so that students can concentrate on the content while they move. We have implemented it as a prototype system that complied with Apple iPhones and Android smartphones. We not only have the intention to reuse existing e-learning contents that are available in wired networks, such as the Internet, but we also have strong doubts about the learning effectiveness for mobile students when it comes to watching e-learning content that is 60 minutes long. This is why we conducted a survey targeting 1,251 undergraduate students of the KNOU to figure out the students' requirements for using m-learning content effectively. We have surveyed them with such questions as which style of m-learning they prefer, when they usually learn with mobile devices, how long they can concentrate themselves on learning while they are on the move, and what the barriers are that keep them from using m-learning.

Based on the survey results, a content model for m-learning has been developed so that the content can be completed by the student in 20 minutes or less in an m-learning environment. The content model has two types; segment type and supplement type. The segment content model is comparatively simple because it just requires dividing existing learning content into several segments that are short enough for the student to complete each of them at a time in m-learning environment. It is necessary to consider the learning effectiveness and instructional advice from the subject experts in order to divide a piece of existing e-learning content into a set of segmented contents. In contrast, the supplement content model requires the new development of m-learning content to provide the student with supplementary content that causes him/her to gain much more interest in the course and stronger motivation to learn it. According to the supplement content model, a piece of existing e-learning content can be reused the same as with the segment content model or as via the conventional way.

In order to examine the effectiveness and the applicability of the two types of content models, we have implemented a prototype system providing the students with both types of m-learning content. The prototype system module for the supplementary content has been implemented with the six components of Lesson Overview, Introduction Video, Enrich Program, Summary, Evaluation Quizzes, and Previous Tests. According to the survey results, the students can maintain their learning activities with the supplementary content in an m-learning environment. In addition, the prototype system module for the segmented content was implemented with the six components of Introduction Video, Tasting Examples, Lectures, Summary, Q&A, and Evaluation Quizzes. The survey results revealed that students can study efficiently for a short period of time with the segmented content in an m-learning environment.

In our future research, we will try to verify the validation of the proposed m-learning content

models in the actual mobile learning environment by analyzing users satisfaction rate, class achievements, and educational effectiveness.

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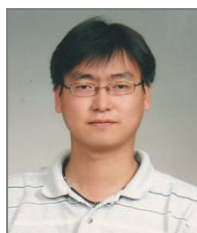
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