

Methods to Measure the Achievement of Learning Using Lecture Contents

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Abstract—In recent years, learning analytics has been attracting attention. Learning analytics is the measurement, collection, analysis and reporting of data about learners and their contexts for purposes of understanding and optimizing learning and the environments. Generally, its information are stored in Learning Management System (LMS) and Course Management System (CMS). However, LMS and CMS did not have the method to measure the achievement of learning using lecture contents. This paper proposes the methods to measure the achievement of learning using lecture contents.

Keywords—Lecture Contents; Learning Analytics; Measurement of Learning Achievement.

I. INTRODUCTION

Recently, many educational institutions offer various mechanism for the educational advance using information communication technology (ICT). A massive open online course (MOOC) [1][2][3] is a model for delivering learning content online to any person who wants to take a course, without any limitation on attendance. MOOC delivers not only text media (syllabus, handout, etc.), but also sound contents and movie contents. Coursera [4] is also the service provider to deliver a lecture of a university as MOOC. Coursera is delivering courses of more than 1000 by 120 universities and has more than 13,000,000 participants. It's learned using lecture contents by open online course. Hori [5] shows the user is viewing only one or two lecture contents by open online course. Hori also shows 80 percent of user view and stopped half of lecture contents and the average viewing hour is 30 minutes. Generally, lecture contents is 90 minutes in Japan. Because lecture contents are generated by recording real lecture. This result shows it is difficult to secure time to view all of lecture contents.

We developed the lecture contents viewing system using lecture contents metadata [6][7]. The system which we developed has three functions, index function, unit/content viewing function and playlist function. The index function can view lecture contents from utterance time of indexing term by using index metadata. The unit/content viewing function can be played back selected unit and learning content of

lecture content by using syllabus metadata generated from the syllabus. The playlist function can view plural units and learning contents continuously. This system provides various mechanism of viewing lecture contents on learning. This system provides the mechanism which the learner views the lecture contents little by little and complete viewing with several days. In recent years, learning analytics [8] has been attracting attention. Learning analytics is the measurement, collection, analysis and reporting of data about learners and their contexts for purposes of understanding and optimizing learning and the environments. Its information stored Learning Management System (LMS) [9] and Course Management System (CMS) [10]. However, LMS and CMS did not have the method to measure the achievement of learning using lecture contents. And the system which we developed has the mechanism to acquire viewing history of learners [11]. However, this system can not measure the achievement of learning using lecture contents. This research proposes the methods to measure the achievement of learning using lecture contents.

This paper is organized as follows. Section II describes lecture contents viewing system using lecture contents metadata. Section III describes method to measure the achievement of learning using lecture contents. Section IV describes conclusion.

II. LECTURE CONTENTS VIEWING SYSTEM USING LECTURE CONTENTS METADATA

This section describes lecture contents metadata and lecture contents viewing system using lecture contents metadata.

A. Lecture Contents Metadata

The lecture contents and lecture contents metadata are stored in the database. Its database is called lecture contents archives. Lecture contents metadata consist of general information, index metadata and syllabus metadata. General information are name of lecture contents, creation date of lecture contents, etc. The index metadata is generated from text data which is converted by teacher's utterance in lecture

```

<contents name="JAD02">
  <index>
    <term name="Encoding">
      <time>00:04:39</time>
    </term>
    <term name="Symbol">
      <time>00:07:32</time>
      <time>00:14:12</time>
      <time>00:46:08</time>
      <time>01:07:29</time>
      <time>01:07:54</time>
    </term>
    <term name="Codeword">
      <time>00:08:03</time>
      <time>00:12:11</time>
      <time>00:46:08</time>
    </term>
    <term name="Length of code">
      <time>00:10:23</time>
    </term>
    <term name="Average code length">
      <time>00:10:37</time>
      <time>00:25:46</time>
    </term>
    ...
  </index>
</contents>

```

Figure 1. The Index Metadata

```

<lecture title="Fundamentals of Telecommunication Engineering">
  <unit id="1">
    <unitstart">00:00:00</unitstart>
    <unitend">00:31:45</unitend>
    <unittitle">Encoding of Information</unittitle>
    <content id="1">
      <contentstart">00:00:00</contentstart>
      <contentend">00:06:41</contentend>
      <contenttitle">Information Transimission</contenttitle>
    </content>
    <content id="2">
      <contentstart">00:06:41</contentstart>
      <contentend">00:09:57</contentend>
      <contenttitle">Symbol and Code</contenttitle>
    </content>
    ...
  </unit>
  <unit id="2">
    <unitstart">00:31:45</unitstart>
    <unitend">00:50:08</unitend>
    <unittitle">Information Content</unittitle>
    ...
  </unit>
  ...
</lecture>

```

Figure 2. The Syllabus Metadata

contents using a voice recognition technology. Figure 1 shows index metadata. In index metadata, the information of lecture contents describes contents tags, indexing term describes term tags and utterance time of indexing term describes time tags. According to Figure. 1, indexing term "Codeword" is uttered 00:08:03, 00:12:11 and 00:46:08 in the lecture content (JAD02).Using index metadata, the contents created by this system don't need the play back from the beginning but from the midstream.The syllabus metadata is generated from the syllabus. Figure. 2 shows the syllabus metadata. Figure. 2 shows the lecture contents (JAD02) consists of various units and learning contents. This unit consists of "Encoding of Information" and "Information Content". This learning content (Encoding of Information) consists of "Information Transmission" and "Symbol and Code". The lecture contents

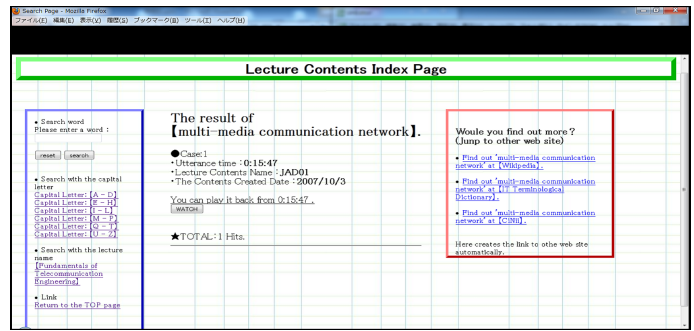


Figure 3. Result Window of index function

```

<smil>
  <head>
    <layout>
      <region id="1" width="480" height="320"fit="fill"/>
    </layout>
  </head>
  <body>
    <par>
      <video src="JAD01.rm" region="movie1"clip-begin=" 3008s" />
      <textstream src="JAD01.rt" region="text1" clip-begin=" 3008s">
    </par>
  </body>
</smil>

```

Figure 4. SMIL generated by indexing function

can be played back selected units and learning contents by using syllabus metadata.

B. Lecture Contents Viewing System Using Lecture Contents Metadata

The lecture contents viewing system has three functions, indexing function, unit/content viewing function and playlist function.

1) *Indexing Function*: The indexing function has three retrieval methods, (a) Input indexing term to input form, (b) Select indexing term from initial letter of indexing term, (c) Select indexing term from indexing list for each lecture. Figure. 3 shows the result window. In indexing function, the lecture contents can be played back the midstream uttered indexing term. This function uses Synchronized Multimedia Integration Language (SMIL) [12]. Using SMIL, the lecture contents created by this system can play back from the scene of indexing term. Figure. 4 shows SMIL file generated by indexing function. The lecture contents (JAD01) uttered indexing term "Entropy" is played back from 3008 seconds.

2) *Unit/Learning Content Viewing Function*: The unit/learning content viewing function can be played back selected unit and learning content of lecture content by using syllabus metadata. This function also uses SMIL. Figure. 5 shows SMIL file generated by this function. Its shows the lecture contents (JAD02) is played back unit of information content from 1905 seconds to 3008 seconds. These information are based on syllabus metadata, which the authors defined in this research. Figure. 6 shows lecture content using SMIL file.

3) *Playlist Function*: The playlist function can view plural units and learning contents continuously. Using SMIL, the

TABLE I. Obtained Viewing History of Lecture Contents

No.	Starting Time	Ending Time	Playback Start Position	Playback Ending Position	Playback Time
1	1/16/2015 10:28:00	1/16/2015 10:31:16	0:06:41	0:09:57	196 seconds
2	1/16/2015 10:31:16	1/16/2015 10:39:31	0:31:45	0:40:00	495 seconds
3	1/16/2015 10:39:31	1/16/2015 10:46:12	0:00:00	0:06:41	401 seconds
4	1/16/2015 10:46:12	1/16/2015 10:49:28	0:06:41	0:09:57	196 seconds
5	1/16/2015 10:49:28	1/16/2015 10:59:38	0:40:00	0:50:08	608 seconds

```
<smil>
<head>
<layout>
<region id="1" width="480" height="320"fit="fill"/>
</layout>
</head>
<body>
<video clip-begin="1905s"clip-end="3008s" src="JAD02.rm"
title="Information Content"region="1"/>
</body>
</smil>
```

Figure 5. SMIL generated by unit/learning content function

```
<smil>
<head>
<layout>
<region id="1" width="480" height="320"fit="fill"/>
</layout>
</head>
<body>
<seq>
<video clip-begin=" 3008s " clip-end=" 4267s "
src=" JAD02.rm " title=" Entropy " region=" 1"/>
<video clip-begin=" 401s " clip-end=" 597s "
src=" JAD02.rm " title=" Length of code " region=" 1"/>
</body>
</smil>
```

Figure 7. SMIL generated by playlist function

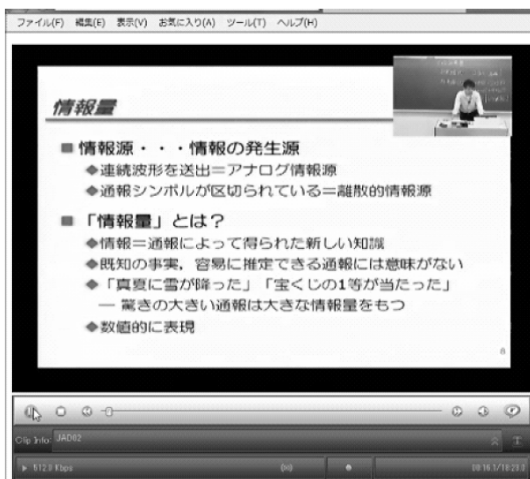


Figure 6. Played Lecture Contents

lecture contents created by this system can play back plural units and learning contents continuously. Figure. 7 shows SMIL file generated by playlist function. According to Figure. 7, the lecture contents (JAD02) is played back from 3008 seconds (00:50:08) to 4267 seconds (01:11:07) and from 401 seconds (00:06:41) to 597 seconds (00:09:57) continuously. The playlist function can play not only the same lecture contents but also different lecture contents continuously.

III. THE METHODS TO MEASURE THE ACHIEVEMENT OF LEARNING USING LECTURE CONTENTS

We developed the function to acquire viewing history of learners [11]. This section proposes the two kinds of method to measure the achievement of learning using lecture contents. It's the method to measure the achievement of each student and the

method to measure the achievement of all students. These are measured based on data which the function to acquire viewing history of learners creates.

A. The Method to Measure the Achievement of each Student

A function which acquires viewing history consists of indexing history acquisition function and viewing time acquisition function. The indexing history acquisition function acquires a total number of views using indexing function. TABLE.I shows viewing history obtained by the viewing time acquisition function. This is a viewing history of lecture content (JAD02) by a certain learner. No.1 of Table.1 means that the learner views lecture content (JAD02) from January 16, 2015 10:28:00 to January 16, 2015 10:31:16. Also, it means that lecture content (JAD02) is playback from 00:06:41 to 00:09:57. Therefore, the learner views lecture content (JAD02) for 196 minutes from 00:06:41 to 00:09:57. As shown in the syllabus metadata of Figure. 2, lecture content (JAD02) is played back about "Symbol and Code" from 00:06:41 to 00:09:57. Therefore, it means the learner views "Symbol and Code" of lecture content (JAD02). Figure. 8 presents the measurement obtained by this method. This is measured based on data which the function to acquire viewing history of learners creates. Figure. 8 shows that Student X is viewing all contents of No.1, 80% of contents of No.2. However, student X is viewing only 30% of contents of No.5.

B. The Method to Measure the Achievement of all Students

Section III.A describes the method to measure the achievement of each student. It is important that a teacher sees the measurement on each all students, and a teacher correspond appropriately to it. And it is also important to grasp the

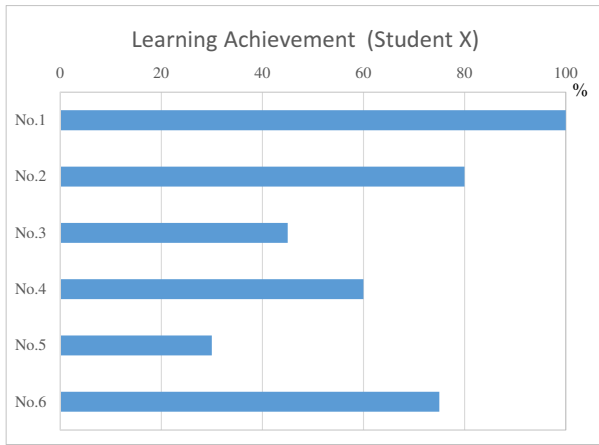


Figure 8. Learning Achievement (Student X) of each Lecture Content

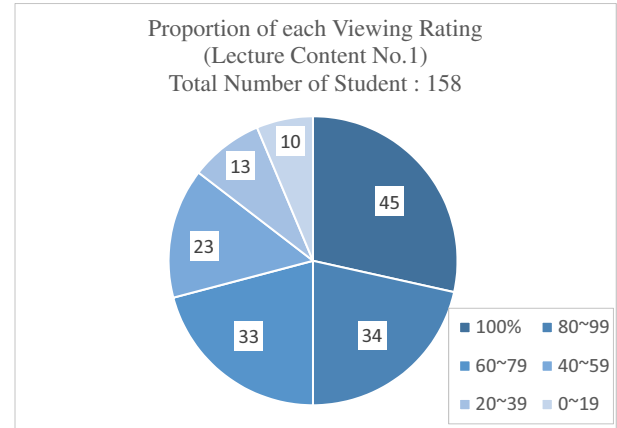


Figure 10. Proportion of each Viewing Rating

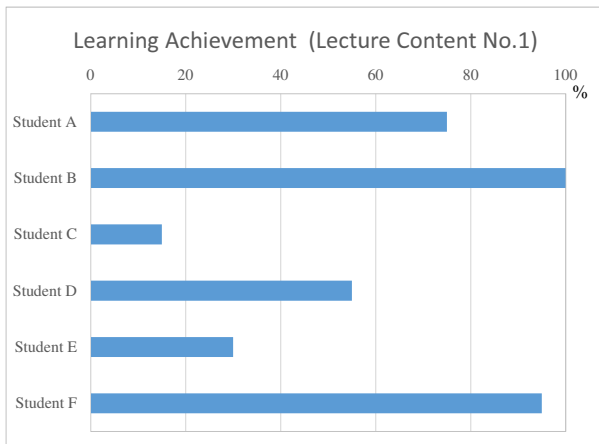


Figure 9. Learning Achievement (Lecture Content No.1) of each User

achievement of all students. This is also measured based on data which the function to acquire viewing history of learners creates. Figure. 9 is indicated the measurement obtained by this method. Figure. 9 shows student A is viewing 75% of contents of No1, student B is viewing all contents of No.1. And student C is viewing only 15% of contents of No.1. Figure. 10 shows proportion of each viewing rating. Figure. 10 shows the students who view 100% of contents of No.1 are 45 students, the students who view more than 60% of contents are 112 students.

IV. CONCLUSION

This paper proposed the two kinds of method to measure the achievement of learning using lecture contents, The method to measure the achievement of each student and the method to measure the achievement of all students. We are conducting an experiment to confirm the effectiveness of this method in Kagawa university.

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