How to Judge Learning on Online Learning: Minimum Learning Judgment System

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ABSTRACT
The popularity of online education environment is growing due to the Massive Open Online Course (MOOC) movement. Many types of research in educational data mining (EDM) and Learning Analytics have focused on solving assessment challenges; however, the large number of students enrolled in MOOCs makes it difficult to assess learning outcomes. Thus, it is necessary to develop an automatic learning judgment system. In this study, we designed and developed a minimum learning judgment system that assesses minimal learning using a word game performance measure. In the system, a student watches a video containing educational content and is subsequently tested on information retention by playing a word game that tests the student on the video content. This learning judgment system tests minimal learning of educational content without requiring significant effort from either the instructor or the student. We conducted experiments to show a performance of the system and the result shows about 95% (Pass judgment: 95.1%, Fail judgment: 94.8%) performance.

Keywords
MOOC, Flipped Learning, Judge System, Online Education, Data Collection, Educational Data Mining.

1. INTRODUCTION
Over 10 million people participate in online learning courses, which has resulted in the proliferation of the use of MOOCs. Consequently, the number of online courses that implement online learning platforms, such as Moodle, Coursera, and edX has steadily increased in online education. Online learning platforms provide useful learning data for learner modeling and learning analysis. Learning data provide various types of information that can assess student participation in online courses, such as the number of logins, the number of postings made to discussion boards, and various types of learning outcomes [1]. However, due to the high number of students participating in MOOCs, one critical problem that must be addressed is how instructors can conduct learning assessments that determine learning. Traditional assessment methods are not suitable for online education. Most existing most online learning platforms require a simple quiz and online exam based on traditional assessment methods [2]. Many quizzes and exams can be a burden to both instructors and students. Thus, it is necessary to develop an automatic learning judgment system that can quickly and simply assess learning.

In this paper, we aim to design and develop a minimum learning judgment system. Our approach aims to solve learning assessment challenges in online education in order to minimize the amount of effort required by teachers and learners in assessing learning. Anyone can access and utilize this system [1] at no cost for the purposes of conducting research and collecting educational data. We will present the overall system process and the experiments that were conducted to test the system.

2. MINIMUM LEARNING JUDGMENT
In this paper, we define minimum learning as a behavior state of initial learning, which is automatically determined after a student watches a video and is assessed using a recognition process that measures the frequency effect theory of words used in the video content [3]. In other words, watching video content is the minimal behavior of learning apart from understanding. It does not mean that system can assess understanding of content knowledge.

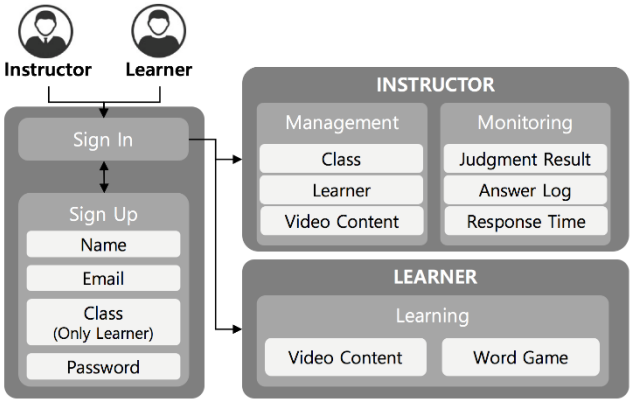

Figure 1. Overall System Process

Figure 1 presents the overall system process for users. After registering an instructor, the instructor can add classes and upload video contents. Words are extracted from the uploaded video content and word frequency is automatically calculated. After registering a learner with a class, the student can learn by viewing video content that the instructor has uploaded. After viewing the video, the student can begin the word game. In the word game, the student decides whether words did or did not appear in the video. The system judges minimum learning by measuring the student's response time and accuracy in the word game. Finally, the

[1] Minimum Learning Judgment System: http://www.mljs.org

instructor checks the minimum learning results, the word game logs and a response time for each word.

The words that appear in the word game use word frequency from uploaded video content and the Sejong corpus (made by www.sejong.or.kr). In order to select words for the word game, words are selected by measuring the weight of each word, which is based on both previous videos that the student learned and on the current video content that student is watching. Each student plays a word game with a different word set in which different weights correspond to different learning logs. The weight of a word is calculated as follow:

$$w_{ij} = tf_{ij} \times log\left(\frac{N}{n}\right) + 1 \quad (1)$$

A weight $w_{ij} > 0$ is associated with each word i in a video content j. Let tf_{ij} refer to the frequency of word i in video content j. Let N refer to the number of video contents viewed by the student in the entire set of video contents. Let n be the number of video contents where w_{ij} appears in N.

In total, 14 words are selected for the word game. The seven highest-frequency words are selected from video content and seven words that have the same word length as the video content words are selected randomly from the Sejong corpus. These latter seven words that do not appear in video content will referred to as "noisy words." The reasoning behind choosing seven words is that the video content is based on short-term memory (STM) [4]. When the word appears, the student chooses the word within two seconds. According to language cognition theory, cognition time of a known word takes between from 700ms to 1200ms [3]. Taking into consideration the conditions that may affect the speed of web environment networks, this system adds and subtracts 500ms to the recorded response time.

3. EXPERIMENTS

3.1 Participants and Analysis

In order to get a criteria score, we conducted an experiment in which we tested 60 undergraduate students. Thirty-two of the students were male, 28 of the students were Female, and the ages of the selected participants ranged from 19 to 27. Each participant viewed video content and then played the word game. Then, participants' attention levels were assessed on a five-point scale using the Likert-type scale. The data collected from the system was analyzed based on the expectation-maximization (EM) algorithm using WEKA. Table 1 presents the results of our analysis.

Table 1. Result of Clustering

Cluster	A	B
Attention	1.004 (SD. 0.027)	3.6084 (SD. 1.0678)
Score	6.0588 (SD. 2.0694)	9.5569 (SD. 2.566)

Cluster A refers to the set of participants who did not pay attention while watching the video content. On average, the members in Group A selected six of the 14 words correctly. Cluster B refers to the set of participants who paid attention while watching the video content. On average, the members in Group B selected 9 of the 14 words correctly. Therefore, the criteria for the minimum learning judgment system correspond to seven correctly selected words.

3.2 Test and Results

Finally, we ran a minimum learning assessment to determine whether learners watched the video content or not. In a test set, 240 undergraduate students participated in the experiment. Participants were divided into two groups: an experiment group, which consisted of 120 students who watched the video content, (Pass) and a control group, which consisted of 120 students who did not watch the video content (Fail). Table 2 presents the results of the test, which measured precision and recall.

Table 2. Result of Test Table

		Real				
		Pass	**Fail**	**Precision**	**Recall**	**F1**
System	**Pass**	118	10	92.1875	98.3333	95.1
	Fail	2	110	98.2142	91.6666	94.8

For the Passing group, the result of minimum learning judgment demonstrated a precision rate of 92% and a recall rate of 98%. For the Failing group, the result of minimum learning judgment demonstrated a precision rate of 98% and a recall rate 91%. Finally, the performance of system shows about 95%.

4. CONCLUSIONS AND FUTURE WORK

This paper presents how a minimum learning judgment system can solve assessment challenges in online education environments by reducing the work required by both instructors and learners. This system shows about 95% performance but it is optimized for the training data set. Thus, we need to conduct further experiments and analyses using machine learning algorithms and educational data mining technologies in order to develop and strengthen our system. Finally, we hope **this system can be utilized by instructors and researchers** for their educational and research purposes.

5. ACKNOWLEDGMENTS

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6. REFERENCES

[1] Fazel Keshtkar, Jordan Cowart, and Ben Kingen 2015. Analyzing Students' Interaction Based on their Responses to Determine Learning Outcomes. In *Proceedings of the 8th International Conference on Educational Data Mining, Poster and Demo Papers*, 588-589.

[2] Shumin Jing 2015. Automatic Grading of Short Answers for MOOC via Semi-supervised Document Clustering. In *Proceedings of the 8th International Conference on Educational Data Mining, Poster and Demo Papers*, 554-555.

[3] Jaechoon Jo, and Heuiseok Lim 2015. A Development of Minimum Learning Judgement System of Online Learner, *Korean Association of Computer Education*, 20, 1, 63-66.

[4] Randall, W. Engle 2002. Working Memory Capacity as Executive Attention, *Current Directions in Psychological Science*, 11, 1 (Feb. 2002), 19-23