

# An Online Mastery Learning Method Based On a Dynamic Formative Evaluation

Jeongim Kang, Moon Hee Kim, Seong Baeg Kim

**Abstract**—This paper proposes a novel e-learning model that is based on a dynamic formative evaluation. On evaluating the existing format of e-learning, conditions regarding repetitive learning to achieve mastery, causes issues for learners to lose tension and become neglectful of learning. The dynamic formative evaluation proposed is able to supplement limitation of the existing approaches. Since a repetitive learning method does not provide a perfect feedback, this paper puts an emphasis on the dynamic formative evaluation that is able to maximize learning achievement. Through the dynamic formative evaluation, the instructor is able to refer to the evaluation result when making an estimation about the learner. To show the flow chart of learning, based on the dynamic formative evaluation, the model proves its effectiveness and validity.

**Keywords**—Online learning, dynamic formative evaluation, mastery learning, repetitive learning method, learning achievement.

## I. INTRODUCTION

THE role of formative evaluation is to give feedback to a learner and to improve teaching skills during class. Formative evaluation includes checking the degree of learning through quizzes, queries during class, and assignments to improve the quality of class. It means that formative evaluation emphasizes periodic questions and feedback during learning.

An educational method has to offer high quality interaction elements to learners to provide interest and voluntary active participation in learning [4], [6]. However, in the existing studies on evaluation, there is a limitation to formative evaluations due to the fact that they are always restricted to four or five-choice question forms. When a learner reviews, he/she solves the question and example one more time. In this case, a learner already knows the answer. It means that the learner can choose the correct answer without understanding the full concept [1].

For the instructor or producers of online lectures, it is not easy to prepare diverse formative evaluation in advance. It can also be inefficient in the aspects of using data space to save the materials [3]. However, it will be a problem if students solve

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the same questions that refer to the original online lectures without understanding the learning contents. This means that it is hard to check the progress of the learners, since there is no way to measure whether they are following the course well or just guessing the answers.

Online learning based on the dynamic formative evaluation solves this problem. If an instructor inputs the content of question according to the suggested form, there will be various kinds of questions based on the original question. The changing of the questions demands the complete understanding of a learner. It raises their learning achievement [5] and helps students to retain tension while learning, and prevents them from feeling bored during a class without any mutual interaction. It is also efficient because the instructor does not have to labor by creating each new question. In addition, the method of inputting questions is an efficient method to the store data.

## II. RELATED WORK

Soon-hee Im (2011) uses a dynamic formative evaluation algorithm that allows the students to achieve learning mastery by changing the examples of questions dynamically. Compared with our approach, it is different in that it emphasizes cartoon-based playfulness and causes interest by using edutainment to raise learning achievement through e-learning [1].

Mi-hye Kim (2011) suggests that various teaching-learning methods must be presented to trigger intrinsic learning motivation in online learning. It makes an emphasis on content type rather than evaluation [2].

### A. Problems of the Existing Types of Online Learning

There are some problems in the existing types of online learning. For example, the typical pattern of the existing types of online learning is as follows.

- i. Watching a lecture animation
- ii. Solving a formative evaluation
- iii. Checking an answer
- iv. Watching the lecture animation repetitively if a learner wants to study again
- v. Solving again the same formative evaluation with ii

As you can see in the typical pattern of online learning, the formative evaluation questions are always the same because there is a restriction in the number of questions.

TABLE I  
DEFECTS OF EXISTING ONLINE LEARNING AND IMPROVEMENT GOAL

Defects of Existing Online Learning	Improvement Goal
<ul style="list-style-type: none"> <li>The same formative evaluation questions are repeatedly suggested.</li> <li>The tension of learning is broken.</li> <li>The progress of the learning method is difficult to measure.</li> </ul>	<ul style="list-style-type: none"> <li>Using repetition learning method maximizes learning achievement.</li> <li>Instructors are able to estimate learner easily.</li> <li>It formulates various questions and maximizes the efficiency of data storage space.</li> </ul>

### III. ANALYSIS

This study about the dynamic formative evaluation proceeded on four basic steps: analysis, design, implementation and test, as shown in Table II.

TABLE II  
STEP TABLE OF RESEARCH AND DEVELOPMENT PURPOSE

Step	Purpose
<b>Step 1</b> Analysis	<ul style="list-style-type: none"> <li>Analysis on the online learning status</li> <li>Analysis on the type of formative evaluation items</li> <li>Analysis of skills and environment</li> </ul>
<b>Step 2</b> Design	<ul style="list-style-type: none"> <li>Design of learning flow chart</li> <li>Outline of the estimated scenario</li> <li>Design of user interface</li> <li>Design of database</li> </ul>
<b>Step 3</b> Implementation	<ul style="list-style-type: none"> <li>Database construction</li> <li>Programing of video division</li> <li>Programming of formative evaluation and management system</li> </ul>
<b>Step 4</b> Test	<ul style="list-style-type: none"> <li>Test and trial of error</li> </ul>

#### A. Type of a Formative Evaluation in Online Learning

The online learning system targets many random learners. It enables the learners to get rapid feedback and to easily moderate the question's level of difficulty, reliability, validity and discrimination. Further it can analyze the result for evaluation rapidly.

To receive a more accurate evaluation of the progress, multiple choice questions are more consistent than short answer questions. The former exclude extrinsic factors that can affect fairness or objectivity of the assessment. And it is useful because of its reusability. Additionally, a wider variety of objective problems are needed in order to obviate defects of existing formative evaluation in online learning. They are laid out in the following table.

TABLE III  
THE TYPE OF QUESTIONS FOR DYNAMIC FORMATIVE EVALUATION

Type	Description
<b>Matching Type</b>	This type is to match the main concepts to the related explanations. Building a question is easy and it is possible to make various changes in the questions
<b>Multiple-Choice Type</b>	This type is choosing answer (or answers) of 4~5 examples. There are best answer type which is to choose 1 answer, multiple-answer type which is to choose 2~3 answers. This type is easy for grading and it is possible to adjust level of difficulty as modifying examples.

These two types of questions are appropriate for the dynamic formative evaluation in online learning because of its intrinsic attribute that is flexible.

#### B. Development Environment

Programming languages like HTML, PHP, JavaScript are required to develop an e-learning authoring tool based on the

web and to set the starting time in video file for replaying parts of the video. MySQL is used to register a user account and save the dynamic formative evaluation in a database system.

### IV. DESIGN

#### A. Flow Chart of Dynamic Formative Evaluation

'Unit' means a part of learning animation which includes contents of each formative evaluation question. In dynamic formative evaluation model, after watching a learning animation of Unit 1, a learner solves formative evaluation. If a learner understands completely, he/she will pass Unit 1. Online learning, based on dynamic formative evaluation model, shows a pertinent unit video again, or asks to solve a new question in the case of choosing a wrong answer. In addition, it will allow the learner to choose to be provided with a pertinent unit video again, or asks to solve a new question in case he/she did not fully understand.

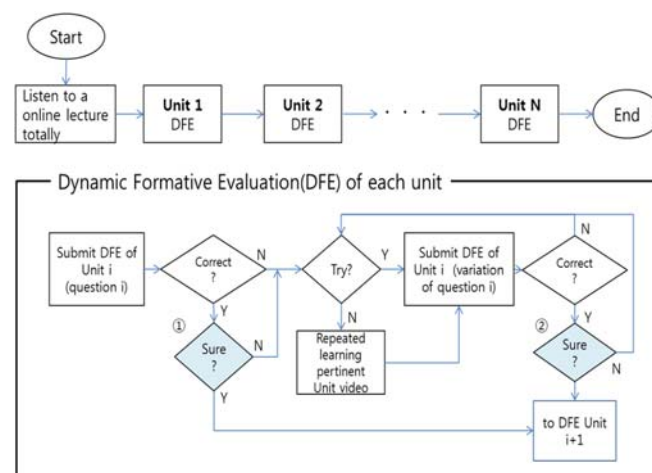


Fig. 1 Flow Chart of Dynamic Formative Evaluation

The flow chart includes two meanings of 'sure' for checking degree of understanding in learning,

- sure ① is the step for checking whether to solve question based on understanding or not.
- sure ② is the step for checking whether the mastery understanding about pertinent Unit has been reached even though the learner chose the correct answers to the questions.

#### B. Dynamic Formative Evaluation Algorithm

Suppose user inputs a main concept (A~C) and explanations (a1, a2, ..., c2, c3) about A, B, C concerning pertinent Unit to build a dynamic formative evaluation question. There are three

types of question which are built through the dynamic formative evaluation model.

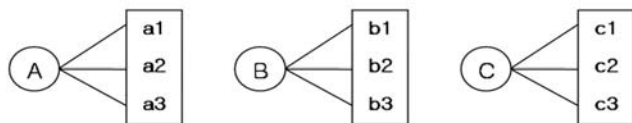


Fig. 2 Main Concept and Explanations of Question

i. Best Answer Type

This method is choosing the correcting answer about ( ). ( ) invokes the dynamic formative evaluation model because one of the main concepts (A, B, C) is able to input ( ). Figs. 3 and 4 show algorithms that dynamically change examples of the question in case of question A or B.

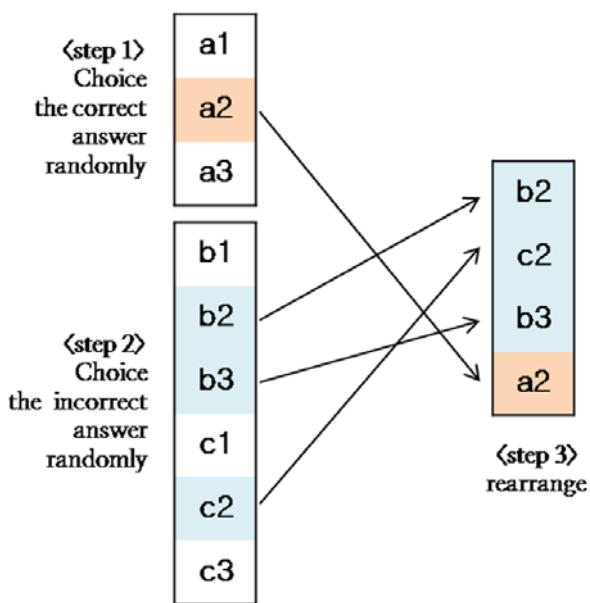


Fig. 3 Creating Examples of Question A

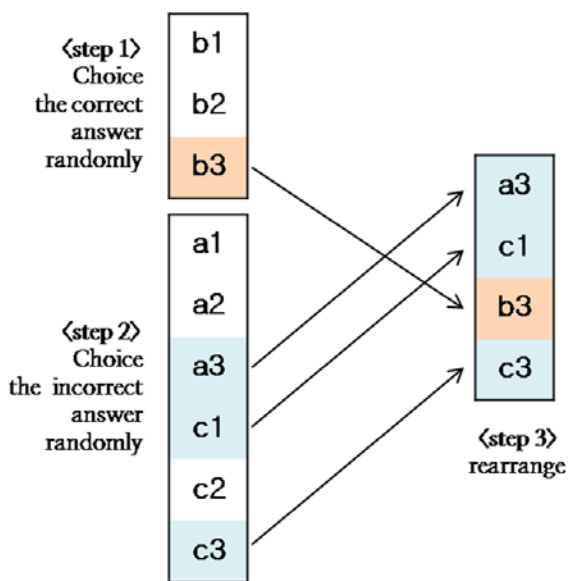


Fig. 4 Creating Examples of Question B

ii. Multiple-Answers Type

This method is choosing all the correct answers referring to ( ). It means that there are two or three answers because a user inputs only three explanations. Figs. 5 and 6 show the algorithms of multiple-answers type.

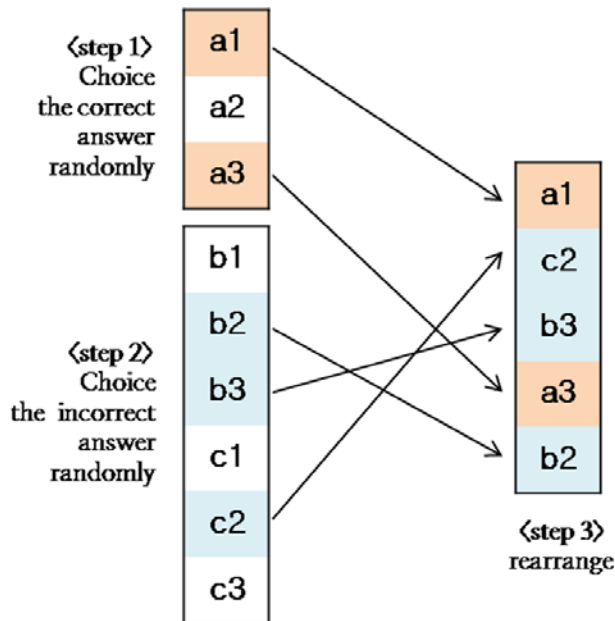


Fig. 5 Creating Examples: 2 Answers

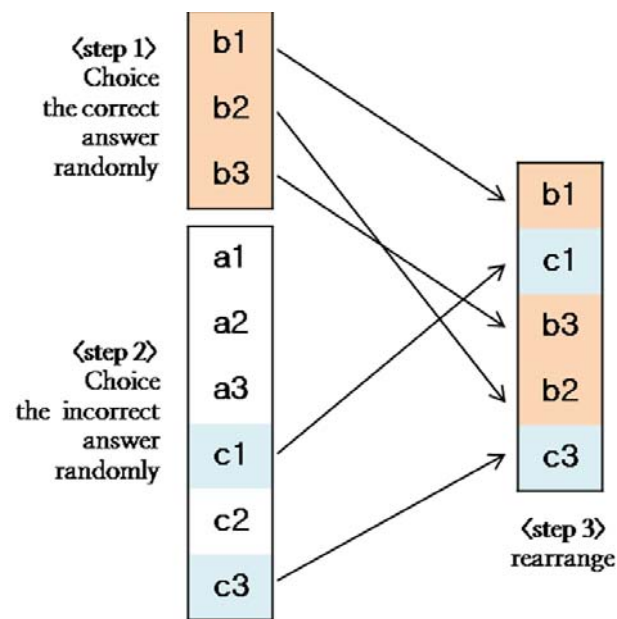


Fig. 6 Creating Examples: 3 Answers

iii. Matching Type

This method is to find out the closely related pairs of elements. In step1 and step2, the examples, which are chosen in each group of examples that represents a main concept, are rearranged. These rearranged examples will be matched to the main concepts, which are arranged randomly.

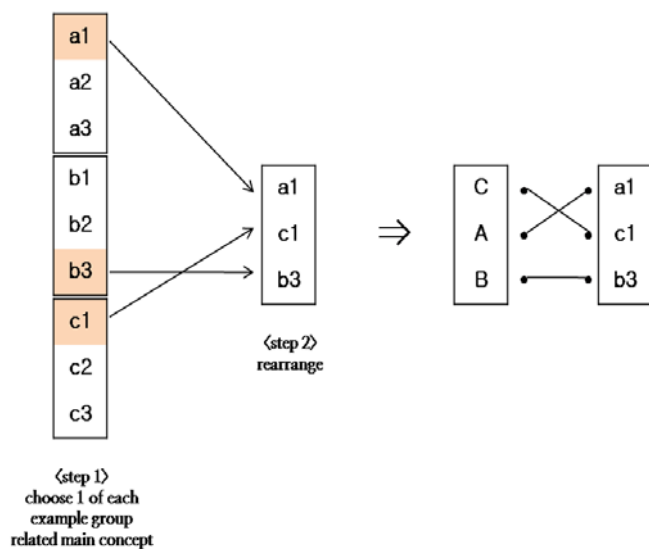


Fig. 7 Creating Examples of Matching Type

## V. CONCLUSION

This study suggests an analysis of situations that can occur during online learning that applies the dynamic formative evaluation. The dynamic formative evaluation model supplements the limitations on existing types of online learning, which cannot increase learning achievements.

It will be less complicated for instructors who are inexperienced with computer to produce an online learning course with an e-learning production tool which is based on the dynamic formative evaluation model. With more consistent use of this tool by the instructors, numerous limitations of the original online learning system will be complemented effectively.

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