Report on Practice of Note-Rebuilding Support System

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Abstract. Lectures in recent years have increasingly incorporated presentation software. Such lectures are problematic in that effective note taking is precluded because lecture slides present content in a preformed structure, reducing the need for thought during the note taking process. In presentation-type lectures, it is therefore necessary to propose tasks that confirm student understanding. Here we propose a "note-rebuilding" method, an adaptation of a kit-build method. We also report the results of constructing a learning support system with note-rebuilding and its experimental evaluation.

Keywords: Learning of structure, presentation software, lecture, learning support system.

1 Introduction

Lectures in recent years have increasingly incorporated presentation software. Such lectures are problematic in that effective note taking is precluded because lecture slides present content in a preformed structure, reducing the need for thought during the note taking process [1-3]. There are various learning support system for note-taking[4-7]. Especially, it is effective to reflect and rearrange the note. The reflection is called note-reflection[8-11]. In presentation-type lectures, it is therefore necessary to propose tasks that confirm student understanding as note-reflection. Here we propose a "note-rebuilding" method expanding note-reflection, an adaptation of a kit-build method[12-14].

In kit-build method, teachers divide prepared learning materials into parts, which learners reconstruct. This allows teachers to easily check learners' work by comparison with the original material. Here we propose a note-rebuilding method as follows. First, the teacher uses presentation software to create structured slides as he/she always does for his/her class . Second, the slide is divided into several parts. Third, learners are require to reconstruct the original slide based on the parts The third step is designed on the assumption that the lecture is complete. This method promotes learner understanding of the lecture structure. We present the details of our note-rebuilding method. We also report the results of constructing a learning support system with note-rebuilding and its experimental evaluation.

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2 Design of Learning Support System with Note-Rebuilding

2.1 Note-Rebuilding Method

Lectures present a variety of information. When confirming understanding of the lecture structure, it is inappropriate to make students summarize all the data presented; understanding the information and its structure is sufficient. We refer to structures in lecture data as "structure notes." In our note-rebuilding method, students construct structure notes, examples of which are shown in Figs. 1, 2, and 3.

Structure notes include important informational elements and the important informational structures. In the proposed note-rebuilding method, pieces of information (mainly words and phrases) included in a structure note are called elements, and the informational framework of the structure without elements is called a skeleton. The two together are called parts. A skeleton and an element are given to a student, who assembles them appropriately, thus promoting understanding of the lecture. Figure 4 shows an example of structure note parts with a layered structure for the skeleton and its elements.

	Teacher	Learner
Task	Make slide	Rebuild notes
Aim	Improving lecture	Understanding lecture

Fig. 1. Tabular form

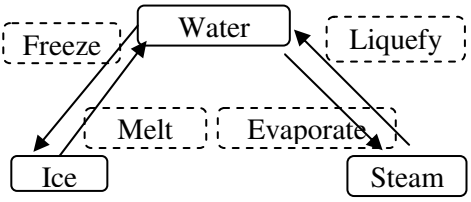

Fig. 2. Concept map form

1 Background
2 Development
  2.1 Model
  2.2 Structure
  2.3 Functions
3 Practice
  3.1 School A
  3.2 School B

Fig. 3. Layered structure form

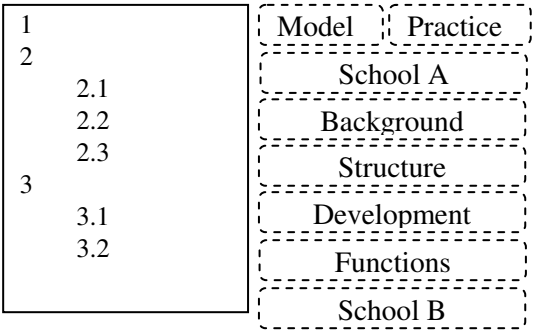

Fig. 4. Skeleton and elements

2.2 Learning Support System with Note-Rebuilding

We next described the design of a learning support system with note-rebuilding method. The system is composed of an interface that learners use to construct elements and a skeleton, and a comparison function to show the differences between notes built by different learners. We developed this system as a web application using JavaScript on the client side and PHP on the server side. The developed system supports PC mouse operations and tablet PC touch operations.

Data of Structure Note

Structure note data contain information on correct answers about the structure notebook prepared by the teacher and reconstructed by students. These data include the kind of structure (tabular, concept map, layered, etc.), and their elements. Figure 5 shows an example of structure note information about a layered structure. In this example, the data describe a figure (number) and a figure-free (dot) itemized statement, and each phrase and the depth (level) of a class. The present system uses JSON forms, allowing compact descriptions. In future research we will develop an authoring function that can be used like presentation software.

```
{"ClassStructure":[
{"level":1,
"sentence":"Start MySQL ",
"type":"number"},
   {"level":2,
   "sentence":"mysql -u j**** -p -tee='filename.txt'",
   "type":"dot"},
{"level":1,
"sentence":"Confirm Database",
"type":"number"},
   {"level":2,
   "sentence":"SHOW DATABASES;",
   "type":"dot"},
```

Fig. 5. Example structure note about a layered structure

Note-Rebuilding Interface

Learners use this interface to rebuild the deconstructed note. Items can be easily manipulated with drag-and-drop functionality using a mouse or touch panel. This interface shows element cards at random by loading element information from structure note data. Reconstructed notes are sent to the server by pressing the "Send" button. Figure 6 shows an example layered structure in the interface of the actually developed system.

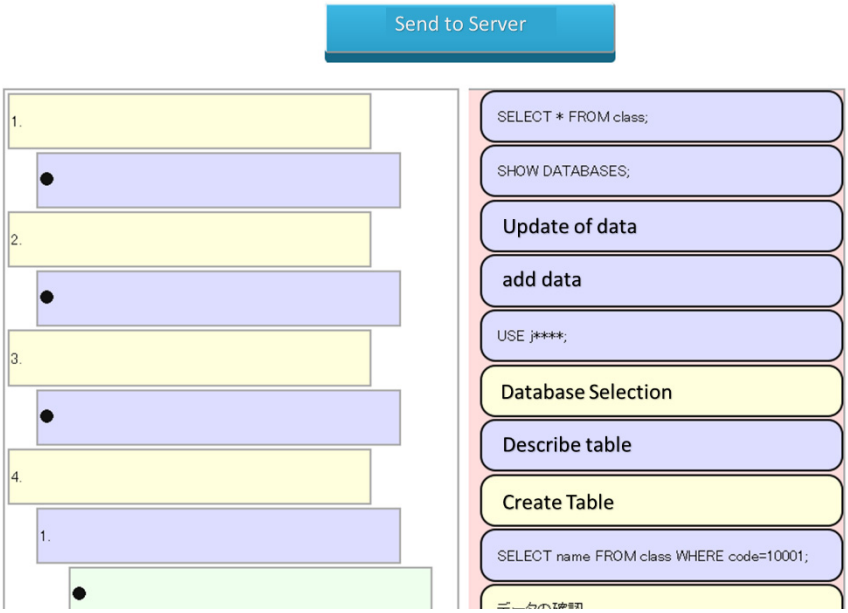

Fig. 6. A layered structure in the developed interface

Comparison Function

Learner answers are sent to and collected at a server. The result of having superimposed two or more student notes and the answer as prepared by the teacher are accumulated and displayed. Learners can then reflect on their own answers by comparison with other answers and the correct answer. In addition, teachers can reflect on their lecture to improve teaching. Moreover, teachers can immediately respond to inadequate learner understanding immediately following a lecture by providing supplementary explanation. Figure 7 shows an example of collected student answers in the layered structure.

Advantage of Note-Rebuilding Method

In this section, we refer to advantage of note-rebuilding method based on comparisons with multi-choice question method and fill-in-the-blank question method. Note-rebuilding method requires teachers to create structured slides as he/she always does

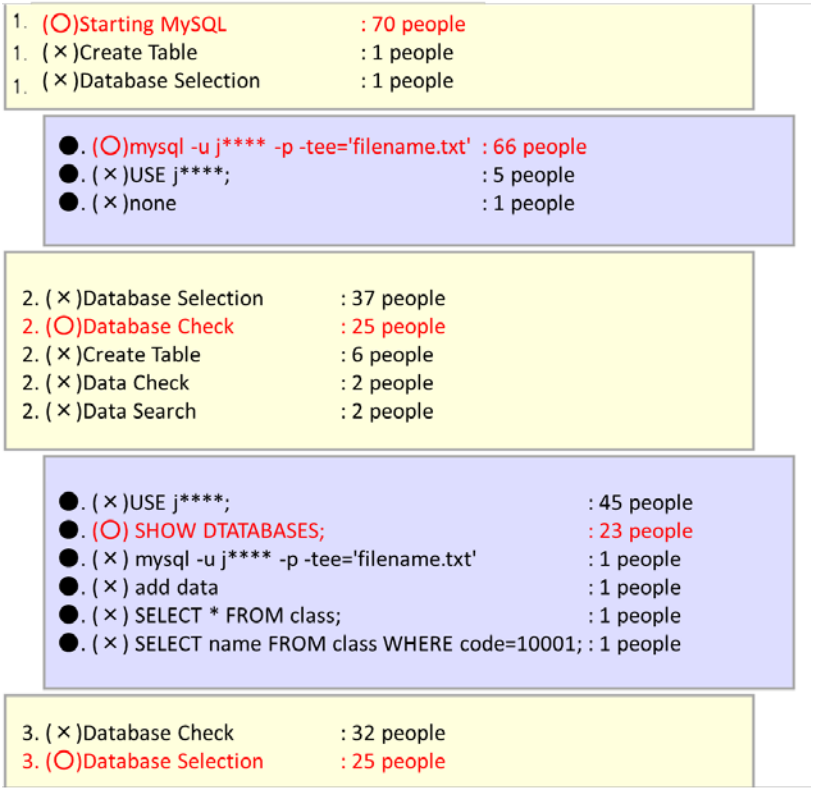

Fig. 7. Collected answers

for his/her class. And then, the slide is divided into several parts. Finally, learners reconstruct the original slide based on the parts. In contrast, multi-choice question method requires teachers to prepare problems that confirm student understanding and feasible wrong choices. Learners are required to select adequate choice. Fill-in-the-bank question method requires teachers to consider where they should make blank in various sentences. Learners are required to fill a blank by selection or description.

From viewpoints of simplicity of preparation, note-rebuilding method doesn't require teachers to do additional task if they prepared well-structured teaching slide. And it is easy to check whether learners' answers are right or not by comparison their answers to the original slide. In multi-choice question method, teachers are required to consider various adequate problems and feasible wrong choice. These are uneasy additional tasks. In fill-in-the blank question method, they are required to consider adequate sentences and blank. In addition, diagnosis function is necessary in free description.

From viewpoints of covering contents of lecture, learners are required to answer individual elements in fill-in-the-bank question method and especially multi-choice problem method. In note-rebuilding, teacher creates slides that include all of lecture. From viewpoints of structural understanding of lecture, note-rebuild method requires learners to be aware of the structure of lecture. The other methods usually don't require learners to understand the structure of lecture strongly.

3 Use in Practice and Evaluation

3.1 Procedure and Objects

We report the results of experimental use of the proposed system in lectures for a university programming course. The lectures concerned following two contents: how to use MySQL and how to control MySQL with PHP, which was content for review. We conducted two experiments. We, first, used our system for 70 university undergraduates majoring in engineering in 2012. We call them experimental group. The procedure was as follows:

1. The teacher taught a lesson using presentation software for 6 min. This corresponds to a usual class.
2. Pre-test for 6 min.
3. The experimental group learned with our system for 12 min(construction for 6 min., explanation with comparison function for 6 min.).
4. Post-test for 6 min.
5. Questionnaire for 5 min.

Next, we teach same contents for 71 university undergraduates who majoring same course in 2013. We call them control group. The procedure was as follows:

1. The teacher taught a lesson using presentation software for 6 min. This corresponds to a usual class.
2. Pre-test for 6 min.
3. The teacher taught for the control group using presentation software in detail for 12 min.
4. Post-test for 6 min.
5. And then, control group also use our system as experimental group for 12 min.
6. Second Post-test in control group for 6 min.
7. Questionnaire for 5 min.

The items on both pre-, post- and second post-tests were the same: subjects freely described the process of manipulating MySQL alone and manipulating MySQL using PHP. Adequate description of the procedure was scored as a right answer. We call the problem order problem. In addition, subjects are required to describe command corresponding to the procedure. Adequate description of the command was scored as a right answer. We call the problem command problem.

From the result of two experiment, we will consider the effect of our system. In the difference between pre-test and post-test in both experiment is our system and normal class with presentation software. So the result of them will reveal the effect of our system. Furthermore, in the second experiment, control group is required to learn using our system after post-test and to answer second post-test and questionnaire. It means that they learned two ways of normal lecture and using our system. The difference between post-test and second post-test in control group also reveal the effect of our system.

3.2 Result and Consideration

The table 1 and table 2 show the result of our two experiments.

First, we report the difference between experimental group and control group in order problems. We ran an analysis of variance (ANOVA) with group (Experimental group (a1), control group (a2)) as a between-subject factor A, and Timing (pre-test (b1), post-test (b2)) as a within-subject factor B. ANOVA results that an interaction were significant, with $p < .001$. The simple main effects within this interaction indicated that the effect of group was significant in post-test, but was no significant in pre-test. Scores in the experimental group were higher than the scores in the control group for the post-test, even though pre-test scores are same in pre-test. The same results are produced in both area about MySQL alone and PHP + MySQL. The result shows our system is effective for learning of order structure.

Secondly, we report the difference between experimental group and control group in command problems. We ran ANOVA with same conditions. In MySQL area, ANOVA results that an interaction were significant, with $p < .05$. In MySQL + PHP area, an interaction were no significant, with $p>.1$. The results shows our system may not be effective for memorizing of command.

Next, we report the difference between post-test and second post-test which is conducted after using our system in control group in order problems. We ran ANOVA with Timing (pre-test, post-test, second post-test) as a within-subject. ANOVA results indicate that all main effects were significant, with $p < .001$. In addition, multiple comparisons for Timing by Ryan's Q test indicated significant differences between three pairs of (post-test, pre-test), (second post-test, pre-test) and (post-test, second post-test) ($p < .001$). The same results are produced in both area about MySQL alone and PHP + MySQL. The result also shows our system is effective for learning of order structure.

Finally, we report the difference between post-test and second post-test in command problems. We ran ANOVA with same conditions. ANOVA results indicate that all main effects were significant, with $p < .001$. In addition, multiple comparisons for Timing by Ryan's Q test indicated significant differences between three pairs of (post-test, pre-test), (second post-test, pre-test) and (post-test, second post-test) ($p < .01$). The same results are produced in both area about MySQL alone and PHP + MySQL. The result shows our system is effective for learning of order structure.

Table 1. The average of order problems

	MySQL(Max:8)			PHP+MySQL(Max:7)		
	pre	post	2nd. post	pre	post	2nd. post
Experimental Group	1.97	5.36		0.40	3.39	
Control Group	2.22	4.15	5.41	0.49	1.18	3.70

Table 2. The average of command problems

	MySQL(Max:24)			PHP+MySQL(Max:21)		
	pre	post	2nd. post	pre	post	2nd. post
Experimental Group	4.61	8.10		0.36	1.33	
Control Group	4.43	9.82	11.3	0.75	1.85	2.97

Two results of order problems indicate that our system is useful for learning the order structure of information. Two results of command problems, however, indicate that our system is not always useful for memorizing of command. We guess that result is produced by the reason that learners are only required to consider the structure of information by reconstruction using cards. They are not required to memorize the contents of the card alone. They may memorize correspondence relation between command and procedure, but they could not memorize the command sentence.

Subjects were asked whether they could use our system effectively, and responded using a four-point Likert scale. Table 3 showed the questionnaire results.

Table 3. Questionnaire results

	Experimental Group	Control Group
Lecture content is easier to understand when using the system than when not.	3.3	3.2
It is easier to see what parts of the lecture I understand well when using the system than when not.	3.2	3.0
It is easier to see the point of the lecture when using the system than when not.	3.1	3.2
It is easier to understand the structure of the lecture when using the system than when not.	3.2	2.8

Table 3 shows that almost all subjects found the system useful for understanding lecture content, confirming well-understood parts, understanding the point of the lecture, and understanding the structure of the lecture. The results were that scores increased in both post-tests. Positive results were obtained despite adding time to use our system for 3 min and to explain to explain its comparison function.

4 Conclusion

We focused on lectures that use presentation software. In such lectures learners are not required to conduct tasks for understanding the lesson structure. We therefore proposed a note-rebuilding method and developed a learning support system for implementing the method. We focus on slides that many teacher make usually in lectures using presentation software. In note-rebuilding method, the slide is divided into several parts. Learners are require to reconstruct the original slide based on the parts. Actual implementation revealed that the method promotes the learner understanding of lecture structure.

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