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Can a Collaborative Note-taking Method Facilitate External Connections between Lecture Material and Students' Prior Knowledge: An Experimental Study

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Abstract: The authors designed a collaborative note-taking method and experimentally examined whether it could facilitate external connections between lecture material and students' prior knowledge. Results showed no significant difference in the number of external connections between the Pairs condition and the Singles condition. However, significant difference was observed in their variance values. Hence, the Pairs condition was divided into two: those who succeeded in making external connections through collaborative note-taking (high-performance group) and those who were not successful (low-performance group). Analysis of notes of the high-performance pairs showed that the Note-Takers in those pairs were good at recording important points of the lecture in a sentence form, and that the Note-Monitors had rich background knowledge and experience and other flexible relating skills. In conclusion, the authors present three different approaches for improving the collaborative note-taking method.

Keywords: Higher education, active learning, lecture comprehension, one-to-one computing

1. Introduction

1.1 Lecture Comprehension in Higher Education

In recent years, active learning is emphasized as a key factor in improving higher education courses in Japan [1]. According to Mizokami [1], active learning is not only mainly adopted in seminar-style classes, but also significantly adopted in lecture-style classes. Mayer [2] criticizes that constructivist teaching tends to be regarded as purely discovery methods and insists that students must be "cognitively" active instead of only being "behaviorally" active. Therefore, active learning in lecture-style classes at universities needs greater attention.

Kiewra [3] outlines the following three steps for lecture comprehension:

i. Selections
ii. Internal connections
iii. External connections

The first step "Selections" requires selecting the important components from the lecture material. The next step is "Internal connections" that involves integrating the selected components. The last step "External connections" includes relating the lecture material to the students' prior knowledge apart from the lecture topic. The last step is particularly important for lecture comprehension since it is a process in which learners make the lecture material personally meaningful.

According to Armbruster [4], note-taking is a widely accepted learning strategy used during university lectures. She emphasizes that the note-taking method that maximizes both internal and external connections enables best learning for students. However, Kiewra [3] shows that students do not make external connections spontaneously while taking notes during lectures, and he lists the following three reasons for it:

i. Cognitive overload during lectures
ii. Neglect of making external connections
iii. Inactive prior knowledge during lectures

Since personal note-taking results in limited success, a collaborative note-taking method is needed to reduce the cognitive overload.

1.2 Research Question and Research Method

Accordingly, the aim of this research is to examine experimentally whether a collaborative note-taking method would facilitate external connections between lecture material and students' prior knowledge. The authors designed a collaborative note-taking method and developed a collaborative note-taking system for the same.

2. Collaborative Note-taking Method

2.1 Design of the Collaborative Note-taking Method

The authors designed a collaborative note-taking method as an in-class activity performed by paired learners. During a lecture, the paired learners divide their roles into two: the "Note-Taker" who takes notes by selecting and making internal connections with the lecture material, and the "Note-Monitor" who monitors and modifies the Note-Taker's notes and takes his own notes by making external connections between the lecture material and his prior knowledge. In regard to external connections, Note-Monitors are provided with concrete instructions to make elaborations, such as citing examples, analogies, and applications [5] and self-explanations [6]. After the lecture, students edit their notes individually by examining the record of the lectures (selections and internal connections) and external connections.

2.2 Development of "Akinote"

The authors developed a web application called "Akinote." Akinote has real time co-editing functions and an exportable function to Google Docs. This enables collaborative note-taking during the lecture and individual note editing afterward.

During a lecture, the Note-Taker is instructed to take notes on what he/she thinks is important in the lecture. The Note-Monitor, on the other hand, monitors the notes taken by the Note-Taker and modifies them and makes external connections between the lecture material and his/her prior knowledge.

After the lecture, students edit their own notes individually. By exporting the notes to Google Docs, students are able to own their notes separately and edit them individually. Students are instructed to integrate the record of the lecture (selections and internal connections), and to examine external connections that involves eliminating and adding notes on external connections.

3. Experiment

3.1 Method

An experiment was conducted to examine whether this collaborative note-taking method would facilitate external connections as compared to a single note-taking method or taking notes alone with Akinote.

Thirty undergraduate students participated in the experiment. The only requirement for the participants was their ability of touch typing. On applying for the experiment, the participants answered a questionnaire consisting of four-choice questions regarding their prior knowledge of the lecture topic and their regular note-taking behavior during daily classes. The authors randomly divided the participants into two groups so that the answers of the two questions would be equal. As a result, 14 students served in the Pairs condition group and the remaining 16 served in the Singles condition group.

One of the authors, also a university instructor, gave a 60-minute mock lecture on "instructional design that uses technologies." She gave a power point presentation consisting of 17 slides. No handouts were provided to the participants. Before the mock lecture, the authors showed a free e-learning movie on "introductory biology" as a tutorial phase. Each participant was provided with an internet-connected laptop and a mouse. Students in the Pairs group attended the lecture using the collaborative note-taking method and edited their notes afterward individually, while students in the Singles group used the single note-taking method during the lecture and edited their notes afterward individually. The role of the note-taking was randomly assigned to the participants in the Pairs group. The authors referred to the notes made immediately after the lecture as "original notes," and the notes made after note editing as "integrated notes".

The original and the integrated notes were analyzed with respect to external connections. First, the authors categorized each set of notes into sections corresponding to the 17 slides shown in the mock lecture. Next, the authors counted all types of external connection made in each section, such as examples, analogies, applications, and self-explanations. The authors counted each type of external connection made, regardless of the amount of its description. They compared the two conditions with respect to the number of external connections made in the notes of each pair. The Singles condition students, who participated individually, were now paired virtually by the authors to facilitate comparison. The authors averaged the number of descriptions of external connections between the pairs' notes in the Pairs condition, while they considered the maximum number of descriptions of external connections among the virtual pairs' notes in the Singles condition.

3.2 Results

The number of external connections in each note is described in Figure 1 and Table 1.

First, it was observed that the distributions of the data both from the original and the integrated notes were significantly different between the Pairs condition and the Singles condition. The differences between them are mentioned as follows: Original notes (Pairs: $SD = 6.13$; Singles: $SD = 2.45$, $F(6, 7) = 6.27$, $p < .05$), Integrated notes (Pairs: $SD = 5.45$; Singles: $SD = 2.75$, $F(6, 7) = 3.94$, $p < .05$).

The Mann–Whitney U test was used to study the comparisons between the two condition groups. It showed no significant difference between the Pairs condition and the Singles condition in either the original notes or the integrated notes.

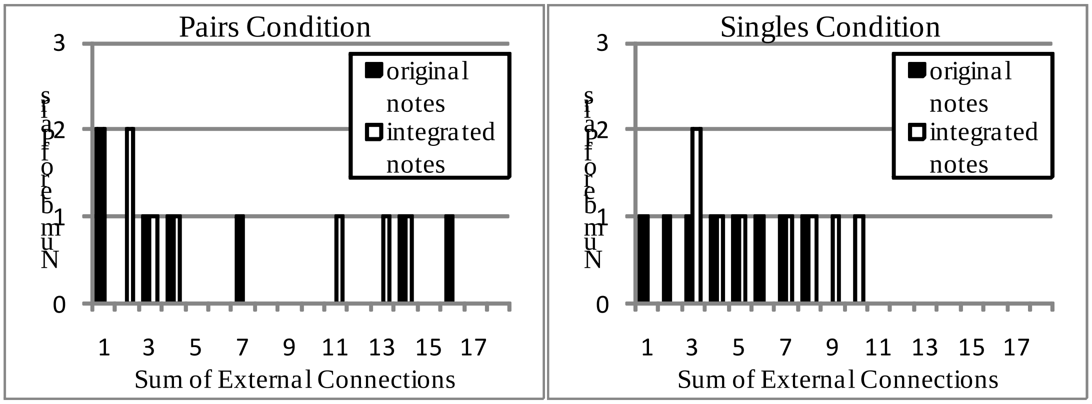

Figure 1: Frequency Distribution of Each Note

Table 1: Number of External Connections in Each Note

		Original Notes		Integrated Notes	
		Pairs (n = 7)	Singles (n = 8)	Pairs (n = 7)	Single (n = 8)
Examples	$\bar{X}$ (*SD*)	3.29 (3.95)	2.25 (1.83)	3.29 (3.64)	3.00 (1.69)
Analogies	$\bar{X}$ (*SD*)	0.71 (1.11)	0.38 (0.74)	0.71 (0.99)	0.63 (0.92)
Applications	$\bar{X}$ (*SD*)	0.14 (0.38)	0.13 (0.35)	0.36 (0.56)	0.25 (0.46)
Self-explanations	$\bar{X}$ (*SD*)	1.43 (1.72)	0.75 (1.17)	1.29 (1.41)	1.25 (1.17)
Sum	$\bar{X}$ (*SD*)	5.57 (6.13)	3.50 (2.45)	5.64 (5.45)	5.13 (2.75)

3.2.1 Analysis of the High-performance Pairs Compared with Low-performance Pairs

Data of the Pairs condition was divided into two: high-performance group (the upper three pairs) and low-performance group (the lower four pairs) (Figure 1). In order to examine why the high-performance group succeeded in collaborative note-taking, the authors qualitatively analyzed and compared the characteristics of the high-performance group with the low-performance group.

First, the authors focused on the record (selections and internal connections) of the notes. The Note-Takers of the high-performance pairs tended to take their notes in the sentence form unlike those of the low-performance pairs who tended to take their notes in forms of short phrases of words. In particular, the sentence-form description of the high-performance pairs' notes formed an average of 83.6% as compared to an average of 69.5% for the low-performance pairs' notes. The Note-Takers of the high-performance pairs seemed to be aware of their partners and tried to explain the lecture contents to them through note-taking.

Second, the authors focused on the content of external connections made in the notes. The Note-Monitors of the high-performance pairs tended to take their notes by connecting the wide range of their knowledge and experiences to the lecture content unlike those of the low-performance pairs who did not do the same. In particular, the Note-Monitors of the high-performance pairs already seemed to have rich background knowledge and experience and flexible relating skills, since external connections were made not only with academic knowledge (for example, an external connection was made by relating the lecture topic "motivation" to one's own educational knowledge on motivation), but also with familiar things (for example, an external connection was made by relating the lecture topic "affordance" to the architectural design of the experimental room on that day).

4. Discussion and Conclusions

In the present research, the authors designed a collaborative note-taking method and examined experimentally whether it could facilitate external connections. Results showed no significant difference between the Pairs condition and the Singles condition in the number of external connections between lecture material and students' prior knowledge. However, significant difference was seen in their variance values, and hence, the Pairs condition was divided into two: those who succeeded in making external connections through collaborative note-taking (high-performance group) and those who were not successful (low-performance group).

From the above analysis, three approaches for improving the collaborative note-taking method are presented.

i. Facilitating note-taking for selections and internal connections.

This approach includes improving the instructions for the Note-Takers, such as making them aware of their partners by instructing them to take notes in the form of sentences that can be easily understood. Another suggestion includes giving the Note-Takers a minimum lecture outline so that they can take notes more easily without being passive.

ii. Facilitating the content of external connections.

This approach includes expanding the available lecture material on external connections to the Note-Monitors by allowing them to use their own notes taken in past classes, whether related to the present lecture topic or not.

iii. Facilitating relating skills for external connections.

This approach includes improving the viewing of others' external connections during the class. Since several external connections common to different pairs were observed (for example, different participants referred the lecture topic "ADDIE model" to be analogous with the same concept in business plans), there is a possibility that the Note-Monitors would be able to come up with more types of external connections by viewing others' external connections. This implies that expanding collaborative note-taking from pairs to a group of learners (i.e. expanding the note-taking activity for the use of backchannel) would be more effective in making external connections.

In this research, the authors were unable to focus on the issues of the learning effect of the lecture topic itself, and of teachers' involvement in the collaborative note-taking activity. The authors are willing to approach these issues in their future work.

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