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ABSTRACT

A study comparing test scores of a cooperative learning class and a traditional lecture-oriented class was conducted at a university in Japan. Two lecturers were assigned each class and teaching skill of these lecturers were confirmed to be practically equal from their previous performance.

For the cooperative learning class, LTD (Learning Through Discussion) with some modifications, revised LTD, was employed. In this class, students were grouped together in fives. They had to prepare the content of statistics and make a Mind Map (Buzan and Buzan, 1993) in advance. At the beginning of each class, students were given a mini-test of 15 to 20 minutes about the content of previous class. Because some of their evaluation was decided on the average mini-test scores of his/her group, the members of the group were interdependent. After the mini-test, using the Mind Map, students made a presentation of her/his preparation each other in his/her group.

For the traditional lecture-oriented class, a teacher lectured on statistics to all students each class, and students took notes.

At the end of the term, all students of both classes were tested about the content of statistics. This was the initial test. Three months after this initial test, the students took a second test, which was nearly identical to the previous one. Although the difference in initial test scores between the cooperative class and the traditional lecture-oriented class was not significant, comparing these scores with the scores of the second test did show a significant difference. The test scores of the students in the traditional lecture-oriented class declined significantly more than those of the students in the cooperative learning class. These results demonstrate that the students in the cooperative learning were able to retain more of the content of the class in a long time. Furthermore, these results indicate that ,for detecting the effectiveness of cooperative learning, researchers are required to evaluate it from longitudinal point of view.
key words: Cooperative learning, LTD(Learning Through Discussion), Mind Map

INTRODUCTION

In Japan, a decrease in academic scholarship has become a controversial problem. In 1998, the Japanese government introduced “education without cramming” (*Yutori* Education) and reduced classroom hours in

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Both authors can have full access to all the data in the study, and take responsibility for the integrity of the data and the accuracy of the data analysis.

public elementary schools, junior high schools and high schools. In this change, class content was decreased, and schools changed to a five-day week. Some integrated studies and absolute evaluation systems were also introduced.

However, the results of the international survey of PISA (Programme for International Student Assessment) indicated a decline in academic ability among Japanese students. Furthermore, due to a falling birthrate and ceaseless increase of universities and colleges, the era of free university/college admissions has opened. That means that overcoming the hurdle of entrance examinations has become easier than in previous generations. This resulted that many students without basic knowledge and academic literacy are admitted to enter universities and colleges in Japan.

Given this situation, many lecturers in university and college confront new teaching challenges, and have struggled to adapt their teaching methods accordingly.

One new teaching method put forth by professors in Japan is Uda's BRD, or Brief Report of the Day, method (Uda, 2005). In this method, students must plan and make a brief report based on what they did in their class on a given day. They receive their corrected report from the instructor in the next class.

Oda(1991) developed the Daifuku-cho (Shattle Card "DAIFUKU" ; an old-fashioned account book) method. In his method, students write their impressions, thoughts, or sentiments for five or ten minutes at the end of the class and submit this to a lecturer. The paper is returned to the students in the next class, and is used in this way as an ongoing interaction record between lecturer and students.

Tanaka (1999) proposed the Shitsumon-sho (written inquiry) method. In his method, students write questions about each class lecture during the last 15 minutes of the class. They have to write not only questions but also some background to their questions, or the reason they ask such questions. In the next class, the lecturer selects some questions and discusses their answers.

While these methods focus on the interaction between lecturer and students, they are still traditional lecture classes, that is, one lecturer facing a group of students.

Other learning methods introduced from United States were characterized by more of a cooperative learning atmosphere. The works of Johnson, Johnson and Smith (1991) and Rabow, Charness and Kipperman (1994) were translated into Japanese. In these methods student group members interact and teach each other. This cooperative learning, known as LTD (Learning Thorough Discussion) in Western countries, was developed by William Fawcett Hill in 1962 (Yasunaga, 2006).

Even in Japan, Nishikawa (2000, 2002, 2003) proposed "Manabi-ai," a kind of cooperative learning method. He published many books and reported many successful experiences with this method in elementary schools. In "Manabi-ai", it is emphasized that teachers have often been guilty of teaching poorly in the past. Teachers are encouraged to employ new strategies, acting skills, "humanism," amusing materials, and new and profound theories of learning and teaching. Teachers are encouraged to abandon some control of the class, and trust the students for their own learning. There are some similarities and differences between "Manabi-ai" and LTD methods.

In this article, we examine the effectiveness of the revised LTD in a Japanese university by examining the difference in retention of knowledge between the traditional lecture method and the cooperative learning method (revised LTD). We focus on the first three months of a class.

Past research clearly showed that the students displayed a high degree of enthusiasm and satisfaction in cooperative group learning (Johnson, Johnson & Smith, 1991; Boling & Robinson, 1999; Johnson & Johnson, 2002; Gillies, 2003). Furthermore, the results from group work indicated that the students improved their communication ability, leadership, cooperative working, sense of unified community and sense of self-development. There was abundant evidence of the superiority of cooperative work methods in participants' subjective responses, questionnaire responses, and the observation of bystanders and teachers.

However, objective studies of the differences between a cooperative group work method and a traditional lecture are scarce, and the results are not so clear. This is likely the result of teachers' busy schedules and other practical matters. Because teachers have their own teaching styles and beliefs, it is difficult to persuade skillful teachers to employ different teaching methods. Fortunately, in this study, we were able to overcome such practical obstacles, and were able to get teachers who were willing to cooperate.

In this study, We adjusted the focus to an objective index of performance, the examination scores, and hypothesized that 1) the revised LTD method would be more effective for low achieving students, 2) the difference in academic performance between the revised LTD method and the traditional lecture method would not be so great, and the examination scores would not show any significant statistical significant, and 3) the difference in academic performance between the revised LTD method and the traditional lecture method would be greater in test scores taken three months after the class.

Both the students in both the traditional lecture class and in the revised LTD method would be encouraged to study hard for the first examination. It was felt it would be difficult to see any significant difference because of ceiling effect. However, it was felt that a surprise examination three months after the class would show more significant differences between the two groups. It was felt that the act of preparing presentations to other group members in the Revised LTD method would help students better retain the class content.

METHODS

Two university lecturers in two separate Statistics classes employed two different learning methods (traditional teacher-centered lecture and revised LTD). The students were randomly assigned to the two classes. The skills of the two lecturers were ascertained to be equal using the past three years' test score data. Table 1 shows the means and standard deviation for the students test scores of the previous three years.

TABLE 1 Means and SD for past three years (Exam. Scores)

	Lecturer A	Lecturer B	significance
3 years ago	81.90 (16.75)	85.82 (15.00)	n.s.
	n=71	*n*=78	
2 years ago	81.13 (21.46)	85.91 (17.60)	n.s.
	n=71	*n*=66	
1 year ago	88.06 (15.01)	85.01 (16.89)	n.s.
	n=63	*n*=62	

Note. Standard deviations in parenthesis.

The two lecturers used the same textbook and curriculum. In addition to this, the same examination was carried out for the students in both classes. No statistical differences were discovered, so we can conclude that the skill of the two lecturers was equal. In our study, lecturer B employed the same teacher-centered teaching lecture method used in previous years, delivering a 90-minute lecture before the class. Lecturer A, on the other hand, employed a revised LTD method (revised learning through discussion method) for the 90-minute class. It should be noted that some aspects of the revised LTD were changed from the original LTD method. The students were randomly assigned to the groups, although an effort was made to have a balance between the two groups in gender and individual student grade history. One week before the beginning of class, all group members of group were assigned the different parts of a Statistics textbook. They were asked to summarize the content in a one-page Mind Map. Mind Map was developed by Tony Buzan (Buzan, T. & Buzan, B, 1993) and can be used as presentation tools. The reason we employed the Mind Map was to prevent students from only reading the textbook or information on the Internet. To make a Mind Map, students had to read and mentally process sections of their textbook and prepare to present the information from those sections. The Mind Map mainly consisted of graphics and keywords. In most cases, students would not have been able to acquire the appropriate graphics necessary for their presentation even using the Internet. So, the process of making a Mind Map forces students to read and process the information from the textbook.

At the beginning of each class, students were given a mini-test of 15 to 20 minutes about the content of previous class. After the mini-test, the students moved into their groups and discussed how they felt on that particular day and what their motives were for learning. Next, a leader and a time clerk were selected by the members of the group. The leader controlled the direction of discussion and reminded the group members of the purpose of the presentation when the discussion strayed from the subject. The time clerk also had the role of warning other members to be mindful of time during presentations. Each member was given eight minutes to teach the other group members the content which he/she prepared using a Mind Map, and the time clerk saw to it that the full eight minutes were used.

The lecturer circulated among the students. He suggested ideas for better presentations and gave positive feedback on especially good Mind Maps and presentations. He also sometimes warned members who did not

participate well in the group, either by not presenting their material well or by not listening to others' presentations.

In the remaining class time, the lecturer marked the mini-tests. After all members finished their presentations, the lecturer gave the scored mini-tests to the students. And the members of the group discussed the faults in their mini-test with each other.

When all groups finished the discussion about the mini-test, the lecturer wrote the average-scores for each group on the blackboard. These scores were also given to each member of the group. This made it clear that, to get a better score, each member had not only to get a good score for him/herself but also had to promote the level of understanding of the content for other members. This system encouraged interdependence among the members of the group.

During the 15 classes of the Revised LTD method, eight mini-tests, one lecture, and one final examination were conducted. In the traditional lecture method class, all classes except for the term-end examination in the final class consisted of lectures by the teacher. In the final examination, the students were given an examination with a top score of 100 points. The examination included hand-calculations of mean, median, mode, standard deviation, variance, and one-way ANOVA in simple illustration and in scores. Also, knowledge about standard scores and understanding of the significance of two-way ANOVA were tested. The same content, with for minor differences, was measured in the surprise examination given three months later.

RESULTS

Table 2 shows the basic descriptive statistics of the final examination.

TABLE 2 Means and Range for Examination Scores

	Lecturer A (Revised LTD method)	Lecturer B (Traditional lecture)	significance
Mean	83.13	83.02	n.s.
SD	17.57	21.47	
MAX	100	100	
Min	40	15	
Range	60	85	
N	56	58	

The result of ANOVA showed no significance. As noted earlier, most students prepared for the final examination and studied hard. Furthermore, in this final examination, the students were allowed to refer to the class textbook, so there would be a ceiling effect.

Although there was a difference in standard deviation, it was not significant. It should be noted, however, that range statistics showed that the lowest score in the Revised LTD method to be much higher than in the traditional lecture class.

Three months after the final examination, the surprise examination was given. Students were not allowed to refer to the statistical textbook during this exam. Table 3 shows means and standard deviations. The decrease in scores was likely the result of two factors: the exam was testing information that was three months old, and the students were not allowed to use their textbooks during the exam. What is most notable here is that the decrease in scores was significantly different between the two groups.

The repeated measure ANOVA indicated a main effect of period ($F(1,95)=421.103$, $MSE=247.852$, $p<.001$) and an interaction effect of period×two lecture methods ($F(1,95)=6.854$, $MSE=247.852$, $p<.01$).

TABLE 3 Means and Range for Surprise Examination

	Lecturer A (Revised LTD method)	Lecturer B (Traditional lecture)
1st (Final Exam.)	81.44 (18.11)	87.22 (15.30)
2nd (3 months later)	40.87 (18.81)	34.78 (18.62)
n	52	45

Note. Standard deviations in parenthesis. Because all students could not participate in the surprise exam, the number of cases (*n*) and means were different from those of Table 2.

The significance of the main effect of period of time was due to the drop of achievement after three months. In first examination, the students were ready to take the examination and permitted to refer the textbook, so their memory of the learned content was fresh. On the other hand, in three months later examination, they could not permit to use the textbook and the preparation for the examination was not enough at all for them. Therefore, the drop of achievement was reasonable result. The significant interaction was caused by the difference of dropping between two methods. The decrease in the test scores of students in the traditional lecture class was significantly greater than those of students in the Revised LTD method.

DISCUSSION

The results support the three hypotheses stated earlier in this paper. Hypothesis 1, Revised LTD method is more helpful for lower achievers, is supported by the fact that the lowest score in the revised LTD method group are higher than those in classical lecture group.

As for hypothesis 2, we could not detect any statistical difference between the Revised LTD method and the traditional method from the scores of the first examination. These findings provide support for why researchers could not indicate clear and direct differences in performance in the field of cooperative group learning.

Finally, regarding hypothesis 3, statistical significant differences were detected after three months. In this study, it does not seem that the minor revised points for LTD method exerted a great influence on the results. Therefore, it is possible that cooperative, group learning is more effective over a long period of time. In short

term studies, a ceiling effect prevents researchers from detecting the differences. Many studies might overlook this point, and miss detectable achievement.

The subjects who did not actively participate, and just listened, had difficulty remembering. On the other hand, the subjects who were more active in group discussion were much better able to retain the information.

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