

Original Research

## Derived learning from the observed outcomes in a “flipped” classroom

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### Abstract

The flipped classroom is a method in which a lecturer provides a video recording for learners to watch prior to the lecture and discusses the contents of the recording during in-class time. It has attracted attention as a method of active learning. Although explicit introduction of active learning is required in university education, there exists a gap in home-study time that needs to be rectified. In order to examine how students' outcomes change via flipped classroom learning, we utilized a questionnaire and confirmed the results by comparing them. We conducted a flipped classroom to let students lead the class in classes offered at the university. We analyzed the results via a questionnaire and changes in the students' grades. Comparison of the grades achieved demonstrated that the flipped classroom resulted in overall grade improvement and the number of students receiving lower grades decreased. Moreover, the questionnaire indicated that learning time outside the classroom markedly increased. As students prepared for flipped lessons via group learning, both the preparation time and motivation for classes increased. The aim of improving motivation to learn was achieved. However, due to the rapid increase in the home-study time, the learning time for other lessons decreased, and disassociation with other students also exposed negative aspects.

**Key words:** flipped classroom, active learning, IT technology

### Introduction

The flipped classroom is a method in which a lecturer provides a video recording of the class content for learners to watch prior to the lecture, and discusses the contents during in-class time (Lage et al., 2000). This is one method of active learning that shifts the focus from the didactic transfer of knowledge to student-centered learning by reversing the usual practice of “lecture at university, homework at home” to “lecture at home, homework at university”, thus more effectively promoting student learning. The idea of the flipped classroom was proposed in 2000, and educational approaches involving

learning using multimedia and teaching materials at home, with group learning occurring in the classroom, have been tested. It is a method that began to attract attention around 2010, predominantly in Europe and the United States (Bergmann, 2012). In addition, the flipped classroom is aimed at solving problems by utilizing abundant knowledge, and it is a higher level of active learning.

With the development of IT technology, it became easier to create digital course content, deliver lessons, and watch lectures. Even without special equipment for video shooting and editing, teachers can easily distribute videos to students using a smartphone or personal computer by

registering on YouTube or iTunesU. Additionally, most students now possess smartphones and personal computers and can easily view the provided videos. The Ministry of Education, Culture, Sports, Science, and Technology promotes active learning not only as “education suitable for the 21st century”, but also recommends classes using video content as a part of individual learning, collaborative learning, and review of work at home. In the flipped classroom, “students must preview the video in advance”, since students who have not watched the video might not be able to participate in “mastication of knowledge”. This is an important problem in flipped classrooms, necessitating measures to ensure that students watch lessons in advance.

In this study, we conducted a flipped classroom at our university. By having learners create some of the lessons instead of watching lessons in advance, our purpose was to encourage higher quality learning. Students (groups) needed to watch the provided content video in advance and understand it as much as possible, as well and answer questions during the class. By requiring students to listen to content in advance, study and understand it, and answer peer questions, we activated the students’ active learning. In order to measure how students changed via this process, we performed a questionnaire survey and confirmed the results by comparing student grades before and after the flipped classroom intervention.

## Method

A total of 98 junior physiotherapy students undertaking a clinical reasoning class participated in the flipped classroom (third-year physical therapy students in 2015). In order to understand clinical reasoning, problem-solving thinking is necessary. The lessons could be difficult for students, as they were required to not only memorize the content but also understand and explain it to others. To compare grades, we used the class questionnaire and class exam results of students who did not experience the flipped classroom among third-year physical therapy students in 2014 as a control group. To reduce variance in the comparison between the two grades, the data were tracked for 3 years.

### (1) Class Preparation

We divided students into nine groups (approx. 10 people per group) and they prepared 15-minute lessons as group work, focusing on

presenters. Each group presented 15-minute lessons in each lecture. The 15-minute lessons prepared by the students were based on lecture recordings from the previous fiscal year and content and cases examined through their work, and had to be their own original work. Lecture recordings from the previous year were made available to students using Apple’s iTunesU. In addition, because iTunesU requires an Apple device, we lent iPads to students who did not have them to prevent any disadvantage.

The groups had 15 minutes to present material and participated in a question-and-answer session of 10 to 15 minutes. Questions were predominantly posed by 4th year students as teaching assistants and the teacher of the subject. The teacher asked questions that could supplement the students’ content with necessary clinical knowledge that was missing.

### (2) Collected Data (see Figure 1)

The data used in this study were: (1) class questionnaire (third-year physical therapy students in 2015: valid responses: 96 and third-year physical therapy students in 2014: valid responses: 81), (2) questionnaire regarding the flipped classroom conducted at the end of the lecture (effective responses: 93), and (3) class exam results (third-year physical therapy students in 2015 and third-year physical therapy students in 2014) from three subjects over a three-year period. Overall scores and average scores of individual grade point averages (GPA) were considered. The score for the three subjects was not only evaluated at the end of the term; three kinds of handwritten reports (30 to 50%), a midterm test (20%), and an end-of-term test (50%) constituted the total grade for each student. In addition, We explained the purpose of the research to the students. By treating the grade data carefully, we avoided any identifiable information being shared. We also explained that this study would not adversely affect individual performance, and obtained their consent.

## Results

### (1) Class Questionnaire (see Table 1)

We focused on ‘attitude towards teaching’ compared with the department’s average, and compared the difference from the previous year’s class. As a marked difference, it was found that the preparation time students dedicated to the subjects increased. In the questionnaire 7.2 points represents “60 to 90 minutes” preparation time

Questionnaire for the flipped class on the clinical reasoning exercise in the previous term

A, I will ask about all aspects of the flipped class.  
B, I will ask about impressions of the flipped class.  
(Please answer A and B)

1, Do you think it was good to have a flipped class?  
1. Strongly agree, 2. Agree a little, 3. Neither agree nor disagree,  
4. Disagree a little, 5. Strongly disagree

2, Has your understanding of the whole course increased due to the flipped class?  
1. Strongly agree, 2. Agree a little, 3. Neither agree nor disagree,  
4. Disagree a little, 5. Strongly disagree

3, Has your attitude toward lessons improved because of the flipped class?  
1. Strongly agree, 2. Agree a little, 3. Neither agree nor disagree,  
4. Disagree a little, 5. Strongly disagree

4, Has your study at home improved because of the flipped class?  
1. Strongly agree, 2. Agree a little, 3. Neither agree nor disagree,  
4. Disagree a little, 5. Strongly disagree

5, Would you like to continue to attend flipped classes in the future?  
1. Strongly agree, 2. Agree a little, 3. Neither agree nor disagree,  
4. Disagree a little, 5. Strongly disagree

6, Please describe the merits of the flipped class.

7, Please describe the demerits of the flipped class.

Figure 1 Questionnaire for the flipped class on the clinical reasoning exercise in the previous term

and 2.30 points as “less than 30 minutes”. Although there was little difference from the previous year’s class, the review number was more than twice as high as the department average. There was also a difference when compared with the department average regarding the presence or absence of students dozing in class.

## (2) Flipped Classroom Questionnaire

Students were asked about the positives and negatives aspects from the perspectives of those who participated in the group lesson and those who presented the lesson. The most significant merit perceived by students was a “deepened understanding of the content (27.7%)”, followed by it being “easy to ask peers questions (18.0%)”. The

Table 1 Questionnaire on classes

	Third-year physical therapy students in 2014			Third-year physical therapy students in 2015			Comparison of differences
	This class	Department	Difference11	This class	Department	Difference	
Reading the syllabus	6.2	5.5	0.7	6.3	5.3	1	0.3
Preparation	6.1	2.9	3.2	7.2	2.9	4.3	1.1
Review	7	3.3	3.7	7.5	3.6	3.9	0.2
Absence	9.3	9.2	0.1	9.6	9.4	0.2	0.1
Dozing	9.1	7.9	1.2	9.5	8.3	1.2	0
Interface	9.5	8.8	0.7	9.5	9.1	0.4	-0.3

most common disadvantage was “not understanding students’ lessons (58.3%)”; this disadvantage markedly exceeded the merit of a deeper understanding of the content. There was also a negative opinion that “there was no credit for explanation by the student (8.3%)”.

The most significant merit for the students presenting the lesson was a “high-level understanding of learning (80.0%)”. In addition, students noted that they “began to study things, began to study actively (15.2%)” and positive influences on other classes were seen. The most significant disadvantage identified was “too much time required to prepare (42.3%)”. For that reason, there was also a statement that other review classes were affected. Another potential disadvantage was noted through some students’ statements “the relationships within the group got worse (21.1%)”.

**(3) Subject Results (see Table 2)**

We compared clinical reasoning subject performance and GPA, and found that there was a difference in the overall score/GPA. The average grade for the clinical reasoning subject was 4.0 points higher in third-year physical therapy students in 2015 than third-year physical therapy students in 2014, and the average GPA was also 0.4 points higher than in third-year physical therapy students in 2014. GPA also grades the overall score from 90 to 100 points: A, 80 to 89 points, B, 70 to 79 points, C, 60 to 69 points, and D. The difference in the proportion of the grade (the value obtained by subtracting third-year physical therapy students in 2015 from the ratio of each grade) was A · 3.0, B · 9.9, C · 9.8, D · -8.5, F · -10.6. That is, the number of students achieving a higher grade in the nth period increased and the

number of students achieving lower grades decreased.

Because cross-studies of comprehensive performance comparison by year involve different students, it is necessary to keep data constant. For that purpose, we conducted a longitudinal comparison between the overall average in the other subjects (clinical reasoning, physiotherapy evaluation) conducted by the instructor (The first author) and the average GPA. The average overall score was about -4.7, the GPA average was -0.3, and the 1st and 2nd grades were low for nth-year students. In other words, the scores achieved in the clinical reasoning subject, conducted as a flipped classroom, were higher than the scores of the third-year physical therapy students in 2015 as the base.

**Discussion**

The data show that, because of the flipped classroom, the students’ learning volume increased and their grades improved as a result of deepened understanding of the content. Shigeta reported that the effects of the flipped classroom are markedly increasing the learning time, increasing opportunities to use learned knowledge, and accelerating the progress of learning (Shigeta, 2013). The results of this study reflect these effects.

The questionnaire results demonstrate that the amount of preparatory work undertaken by students increased from the previous year, and the amount of preparatory/review time was also 2 to 3 times longer than the department average. It can be considered that the flipped classroom succeeded in facilitating and encouraging learning outside the lecture times. Additionally, the grade results for the whole period increased, especially GPA, and the flipped classroom succeeded in reducing the number of students achieving D or F grades. Thus, it can be said that the flipped classroom succeeded in improving the performance of students with lower as well as higher

Table 2 The score and GPA differences between third-year physical therapy students in 2015 and those in 2014

class	Physiotherapy evaluation	Clinical reasoning	This class
Score	-4.7	-4.8	4.0
GPA	-0.3	-0.3	0.4

ranking. However, not all of the students’ opinions were positive, there were many negative opinions. Many students indicated that they could not understand lessons presented by their peers. There are differences among the groups in the subjects the students’ study, and it is a fact that the difference in quality confuses students’ understanding. In order to further explore this impact, it would be necessary to conduct detailed investigation their involving such as tracking reports and quizzes. In addition, there were conflicts of opinion due to differences in attitudes among groups during group work, and there were also cases where friendships between students worsened for a considerable time. Therefore, it was suggested that it is difficult to convert all classes to the flipped classroom style, which is not realistic. This occurred not only due to academic differences among students, but also due to differences in the volume of work performed by each student. Students who took a lot of time to create lessons were sometimes exhausted. There is no doubt that this led to an increase in the amount of work for students.

The common purpose of both teachers and students is to understand. In order to achieve this, faculty members need to understand lessons and learning time in order to understand the students’ learning capabilities. This initiative increased the burden on students’, encouraged learning, and had a certain effect on the understanding of the lesson. Increasing student learning time is not easy. Funamori states that students who are not motivated do not learn, no matter how refined the lessons are, and they do not always succeed in flipped classrooms (Funamori, 2014). This is a fundamental issue in education. Learning habits

from school age are often poor, and many students do not begin taking responsibility for their own learning even after entering university. Also, the academic ability of learners is not the same across each year. Teachers need to develop lessons and encourage understanding while grasping these differences in advance. Regarding the effect of the flipped classroom as an active learning method, the Faculty of Education at Stanford University says active learning after first transferring knowledge is more effective than listening to explanations explicitly (David, 2013). There is content that the flipped classroom deepened understanding of for many students, and this research demonstrates that students’ learning can be improved by requiring them to deliver and direct their own lessons.

#### **Conflicts of Interest Statement**

The authors declare no conflicts of interest.

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