

Investigation of the Relationship Between the Implementation of Pre-Homework and High School Students' Attitude for Flipped Classroom

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Abstract

Students need to do pre-homework for effective flipped classroom teaching (Wei et al., 2020). However, there are problems with class management because some students do not complete the pre-homework. To ensure students do the homework, we find it necessary to clarify why they need to do it (Matsuoka et al., 2021). This study aims to examine the relationship between students' attitude on doing the pre-homework for the flipped classroom and its implementation. We conducted a flipped math class for first-year high school students. Results indicate that to encourage participants to perform the pre-homework in the flipped classroom, it is necessary to inform them of how the content of the pre-homework relates to their future learning and social activities, and to create an environment in which the mastery of the pre-homework content is recognized by the teacher and other students.

Keywords: Flipped Classroom, Mathematics, Pre-Class Learning

Introduction

Flipped classroom is a learning method in which students complete essential learning before class as homework, such as the content of explanatory lectures and learning necessary for retention of knowledge and cultivation of applied skills, such as tutorials and project learning (Bergmann and Sams, 2012). According to Abeysekera and Dawson (2015), implementing a flipped classroom allows time for active and collaborative learning in the classroom. However, prior studies have revealed that some learners do not complete pre-homework, preventing them from fully realizing the benefits of flipped classroom teaching (e.g., Bergmann and Sams, 2012, Yamamoto et al., 2017). Moreover, Wei et al. (2020) argued that teachers need to encourage students to complete pre-homework to make in-class activities more active. Thus, the learner's implementation of pre-homework is necessary for the flipped classroom's success.

Matsuoka et al. (2021) suggested that one way to encourage learners to perform the assignments is by clarifying the purpose. In addition, Tanaka (2015) suggested that informing learners about the meaning of learning enhances their motivation to take the class. Based on these findings, we considered that learners are more likely to perform pre-homework for flipped classroom when they have a purpose for performing the pre-homework.

Therefore, this study aimed to examine students' attitudes that influence the implementation of flipped classroom pre-homework.

Methods

Procedure

This study was conducted in June 2022 along with the procedures in **Table 1**. First, we explained to the participants how to take the flipped classroom. Next, the participants answered a pre-questionnaire about whether they had previously studied a lecture video. Thereafter, they viewed the flipped classroom lesson. Finally, after the lesson, they answered a 19-item questionnaire about their attitudes toward the assignment, based on "Task-Values Evaluation Scale for High School Students" (Ida, 2004).

We surveyed thirty-five first-year high school students who had registered for the required first-year high school course called "Mathematics I," at a private high school in Tokyo, Japan. The lesson unit covered in this study was "quadratic functions." Ten participants had never studied with video materials before, and the remaining twenty-five had studied with video materials at least once. Therefore, to eliminate the novelty effect, the participants received a flipped classroom lesson one week before the survey.

Table 1. Research Procedures

Before Lesson		Pre-Questionnaire Survey
	Face-to-face Class (10min.)	Explanation of Flipped Classroom Announcement of Homework
Lesson	Pre-Homework (20~30min.)	Watching Lecture Video Engaging in a Worksheet
	Face-to-face Class (20min.)	Testing the content in homework Discussion about the test and homework
	Face-to-face Class (30min.)	Solving Application Problems
	After Lesson	Post-Questionnaire Survey

Lesson Content

The lessons were conducted in the scope of "quadratic functions" in Mathematics I. The flipped classroom approach used in this study was created based on the Guidelines described in Lo.et.al. (2017).

First, the participants received pre-study homework. The homework comprised a worksheet and a lecture video we created based on the textbook. Thereafter, in the face-to-face class, participants attempted a test on the homework content at the beginning of the lesson. After the test, we discussed the homework and the test. Thereafter, the students solved application problems that made use of the content of the homework.

Results

In this study, we compared means for responses to a questionnaire to determine if there was a significant difference in learning content that are perceived as valuable toward the assignment between students who completed the pre-homework (implemented group) and those who did not attempt/complete the homework (non-implemented group). The analysis was based on the responses of thirty-three of the thirty-five participants (94%) who answered the questionnaire without any deficiencies. **Table 2** reveals the results of the post-questionnaire survey.

As a result of Mann-Whitney's U test, there was a significant difference between the implemented group ($M_{\text{implemented}} = 3.86$, $SD_{\text{implemented}} = 1.24$) and the non-implemented group ($M_{\text{non-implemented}} = 4.67$, $SD_{\text{non-implemented}} = 0.65$), and the non-implemented group had higher points on content usefulness for post-secondary professional study (16), $p < 0.50$. Furthermore, there was a significant difference between the implemented group ($M_{\text{implemented}} = 3.43$,

$SD_{\text{implemented}} = 1.16$) and the non-implemented group ($M_{\text{non-implemented}} = 4.17$, $SD_{\text{non-implemented}} = 0.94$), and the non-implemented group had higher points on content recognition by others (17), $p < 0.10$. Moreover, there was a significant difference between the implemented group ($M_{\text{implemented}} = 3.95$, $SD_{\text{implemented}} = 1.16$) and the non-implemented group ($M_{\text{non-implemented}} = 4.50$, $SD_{\text{non-implemented}} = 1.00$), and the non-implemented group had higher points on content usefulness for solving future work problems (19), $p < 0.10$.

Table 2. Questionnaire items for high school students on their attitudes toward assignments

		Implemented (n=21)		Non- implemented (n=12)		$M_1 - M_2$	U	r
		M_1	SD_1	M_2	SD_2			
1	I want to learn what is important for college entrance or employment examinations.	4.19	1.21	4.58	0.67	-0.39	106.00	0.16
2	I want to learn something that I can boast to others about what I have learned.	3.52	1.29	3.92	1.08	-0.40	107.50	0.15
3	I want to study contents that are useful for understanding social issues related to my future job.	4.14	1.11	4.42	1.24	-0.28	97.00	0.23
4	I would like to study contents that are interesting to me.	4.33	0.97	4.58	0.67	-0.25	108.50	0.14
5	I want to learn something that will lead me to study after I graduate from high school.	4.24	1.14	4.67	0.65	-0.43	101.00	0.20
6	I want to learn about things that others will respect if I know more about them.	3.38	1.40	3.83	1.19	-0.45	103.50	0.18
7	I want to learn something that I can use outside of school.	4.10	1.18	4.33	1.15	-0.23	109.50	0.13
8	I want to learn what is necessary for my professional study after graduation.	3.86	1.31	4.50	0.67	-0.64	92.50	0.27
9	I want to learn what I can use in my work in the future.	4.10	1.14	4.67	0.49	-0.57	92.00	0.27
10	I want to study the contents that I can learn with interest.	4.33	0.97	4.58	0.67	-0.25	108.50	0.14
11	I want to learn what I feel will be useful when I get a job or go on to higher education.	4.24	1.04	4.58	0.67	-0.34	104.50	0.17
12	I want to learn something that will be useful in my daily life.	4.00	1.22	4.42	0.79	-0.42	104.00	0.18
13	I want to learn something that will make me smarter than others.	3.67	1.20	4.17	1.03	-0.50	94.00	0.25
14	I want to learn something that makes me curious.	4.14	1.20	4.50	0.80	-0.36	105.00	0.17
15	I want to learn what I think is required when I go on to higher education or get a job.	4.10	1.22	4.33	0.99	-0.23	112.50	0.11
16	I would like to study contents that are useful for understanding advanced contents after entering a higher level of education.	3.86	1.24	4.67	0.65	-0.81	74.50*	0.41
17	I want to learn what I can do if I know it.	3.43	1.16	4.17	0.94	-0.74	82.00†	0.35
18	I want to learn what I can enjoy learning.	4.19	1.21	4.67	0.65	-0.48	97.00	0.23
19	I want to learn something that will help me solve problems I will face in my work in the future.	3.95	1.16	4.50	1.00	-0.55	80.50†	0.36

n=33, 5-point Likert scale

* $p < .050$, † $p < .100$, r : effect size

Discussion

The results of “content usefulness for post-secondary professional study” suggest that the participants in the non-implemented group are likely to perform the pre-homework if it is useful for their future professional study. Furthermore, the result of “content usefulness for solving future work problems” suggests that the participants in the non-implemented group are likely to perform the pre-homework if it is useful for solving a problem in their future work. These two results suggest that the participants in the non-implemented group consider the relationship between the learning content of the pre-homework and their future activities to be important.

The result of “content recognition by others” suggests that participants in the non-implemented group are likely to perform the pre-homework if the content of pre-homework is something that others would recognize if they mastered it. This result suggests that students in the non-implemented group consider it important that the content of the assignment is something that others would recognize.

Based on the above, to encourage participants to perform the pre-homework in the flipped classroom, it is necessary to inform them of how the content of the pre-homework relates to their future learning and social activities, and to create an environment in which the mastery of the pre-homework content is recognized by the teacher and other students.

In future research, we would like to clarify the validity of the findings of this study and implement more effective flipped classrooms.

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