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A Study of Learning Strategies in a Flipped Class Based on Logistic Regression Analysis*

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Kim, Nayu & Lee, Heechul. (2018). A study of learning strategies in a flipped class based on logistic regression analysis. *The Linguistic Association of Korea Journal, 26*(2), 87-106. The purpose of this study is to analyze the characteristics of learning strategies of students participating in a flipped English class and to investigate ways to utilize them effectively. To investigate this, questionnaires from 80 students who participated in the flipped class and 80 students in a control group were analyzed. Based on the collected data, an exploratory factor analysis was conducted and four characteristic learning strategies (*inducement, reaction, diffusion* and *application)* were extracted. In addition, a logistic regression analysis was carried out, assigning the four strategies to independent variables and class type to a dependent variable. The logistic regression analysis showed that the four learning strategies extracted classified the students accurately around 65% of the time. In particular, diffusion and application strategies were found to be meaningful learning strategies for the students who participated in the flipped class. These results suggest that in order to increase the effectiveness of flipped classes, it is important for the teacher to develop materials that students can actively respond to and share, to provide ample feedback, and to give students creative assignments and projects.

Key Words: flipped class, English learning strategies, logistic regression analysis

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1. Introduction

Flipped class is being addressed in various names around the world. It is often referred to as a 'flipped class', which has been active mainly from university lectures since the early 2000s (Lee & Min, 2016; Strayer, 2007). The introduction of the flipped class in Korea was around 2012, and has been continuously spreading in a way that complemented the existing offline classes and becomes a new educational trend. In Korea, interest in the flipped class has been steadily increasing and has been adopted and applied in many schools (Rye, 2014; Spino & Trego, 2015). As the flipped class is as innovative as the name is, the research has been done on various aspects of its effect, and it has been reported that students are actively participating and interacting with each other based on their own self-directed learning in the flipped class. In addition, there was a positive change in the emotional perception of the students through the flipped class, and there was also a belief that the teachers had the opportunity to design and proceed the class dynamically (Bell, 2015).

However, there is a relatively lack of research on how students develop a learning strategy and participate in the flipped class. In other words, students who are continually exposed to the innovative teaching methods are more likely to use learning strategies that are different from their existing ones in order to make good use of the lessons themselves (Webb, Dman & Pusey, 2014). Identifying the differentiated learning strategies of students participating in the flipped class and using it for teaching is one of the ways to increase the effectiveness of the flipped class of English (Cockrum, 2014). Based on the identified students' learning strategies of the flipped class, it can be analyzed that how the strategies relate to the characteristics of the flipped class and what features students have of their learning strategies. It also provides a clue as to how the teacher can effectively prepare and proceed English class. Teachers can creatively reconstruct textbooks, prepare individual and team tasks to be designed and provided appropriately, and request various policy considerations from the education authorities to increase the effectiveness of the lessons. For this purpose, this study sets up the following research questions: (1) What are the characteristics of the English learning strategies that students have in the flipped class? and (2) What are the ways to utilize such English learning

strategies to increase the effectiveness of the flipped class?

2. Theoretical Background

2.1. Flipped Class

Flipped class reverses the traditional teaching style by making the teacher's lecture in the classroom as a video, and moving the existing homework activities to the classroom (Bergman & Sams, 2012). The word 'flip' means to reverse the class and homework as opposed to the traditional way (Fulton, 2012). This is a class that allows the teacher to construct the contents of subject by making a video clip and make the students learn at home in advance, and to check the understanding of the students or to operate the deepening learning through the learning activities during the class. The flipped class is recognized for its effectiveness in various aspects. The flipped class provides an opportunity to clarify what the student is vaguely aware of through feedback in the class (Berrett, 2012). In addition, through deepening activities, students can learn concepts more clearly and help new knowledge to be applied in various contexts through discussion (Enfield, 2013). However, it is also true that the class has been criticized in many ways as much as its effectiveness. First, the class was criticized for weakening the role of teachers by inducing the use of advanced devices (Davies, Dean & Ball, 2013). In addition, it has been pointed out that the learning through video lectures can make teachers' class uniform, which can damage the creativity and autonomy of teachers (Elliott, 2014; Leis, Tohei & Cooke, 2015). In addition, it is argued that the class is distanced from the education centered on the entrance examination in Korea, which makes it less realistic (Bishop & Verleger, 2013; Johnson & Renner, 2012).

The researchers, on the contrary, studied various aspects of the impact of the class. examined the perception of English teachers on flipped class of English in secondary school (Musib, 2014). English teachers were more inclined to introduce flipped class as a part of their classroom improvement, rewarding them for encouraging their students to watch videos, and giving them assignments (Correa, 2015). In addition, Lee and Min (2016) confirmed that there

was a tendency to deepen the contents learned in the class, as parts that needed detailed explanation were replaced by video clips. Kim and Shin (2016) investigated the effect of flipped class of English in middle school on the affective domain, found that it had a positive effect on students' interest induction, goal consciousness, and learning motivation, emphasized that flipped class encouraged voluntary learning through interaction with friends and teachers.

Lee (2016) applied flipped class to university English grammar lesson and compared the change of failure tolerance and learning attitude according to learners' motivation and level of learning, and confirmed the correlation. As a result, it was confirmed that flipped class had a positive effect on studying English grammar. Especially, it showed that through flipped class interest in English learning increased and anxiety decreased, which was because the focus was on how to solve the problem (Sung, 2014).

Conversely, Han (2015), Wang and Zhang (2013) discussed the future development of flipped class by integrating the previous researches. According to him, online lecture should include concepts, information and logical thinking activities that are essential for learning so that online lectures can be closely related to offline activities. In addition, in order for effective classroom instruction to take place, teacher should design systematically feedback on each group. Han (2015) also argued for support for the revitalization of the classroom, which included teacher education programs and financial support from the education authorities, and building a learning community for flipped classes.

2.2. Leaning Strategies

O'Malley et al (1990) defined that learning strategies are generally divided into three categories. First, a *metacognitive* performs a general but comprehensive preliminary review of the concepts or principles being organized in anticipated learning activities, and predetermines in advance that it will ignore matters that are largely unrelated to learning tasks. Secondly, *cognitive* can be explained by the imitation of language models including open practice and silent review, using the target language as a reference, using the first language as the basis for understanding or expressing the second language.

Finally, social-mediating activity cooperates with peers to believe in the response, to use information jointly or to model language activities, and then to ask teachers or native speakers for repetition, paraphrasing, explanation and examples. Oxford (1989) categorized learning strategies based on the concept that learners are a holistic human being who utilizes both cognitive, social, emotional, and physical means. Oxford (1990) categorizes learning strategies into direct strategies that directly aid language learning and indirect strategies that indirectly aid language learning. Direct strategy is a strategy that requires the mental process of the language that directly includes the target language. It is divided into three sub strategies: memory strategy, cognitive strategy, and compensation strategy. A memory strategy is a strategy that helps a learner to memorize new information or to reproduce the information needed for conversation. On the contrary, indirect strategy is a strategy to indirectly support language learning, which can be applied to all language learning, and is a strategy that can be helpful in terms of language function.

Schmitt (1995) found that the general classification of language learning strategies in Oxford (1990) lacks a vocabulary learning strategy, so it lacks a variety of strategies for learners to use when they encounter new words, and pointed out that the more direct and inclusive classification of the strategy was inadequate. He extracted five social strategies, memory strategies, cognitive strategies, and upper cognitive strategies that were thought to be related to vocabulary learning among Oxford's six language learning strategies, and then added decision strategies to extract five individual strategies. First, the semantic decision strategy is a strategy used by learners to understand meaning without help of other experts if they do not know the meaning of the word. Secondly, social strategy means learning a vocabulary through asking a familiar person or cooperative learning with friends. As a strengthening strategy, social strategy refers to a strategy of strengthening new words by practicing meaning within the group or communicating with native speakers. Mnemonics refers to organizing or encoding information in a specific way in order to make it easier to memorize, and the contents of the memory-enhancing device described above correspond to this. Lastly, cognitive strategy shows the general function of the learners to deal with or manipulate the target words. This strategy involves mechanical means such as repeating vocabulary and writing vocabulary notes.

As shown so far, the flipped class focuses on securing the participation of students throughout the teaching and learning process and strengthening the role of the teacher as an assistant. In addition, learning strategies can be viewed as various types of intentional actions that students develop themselves to enhance their effectiveness in learning English. Given that the method of instruction is in contrast to existing teaching methods, it can be predicted that students participating in this class will also maintain differentiated learning strategies.

3. Research Method

3.1. Subject and the Flipped Class

One hundred sixty high school students participated in this research. All of them were males, 2nd graders and had the same English curriculum first year of high school. After they had completed the first year of high school, half of them had been taught English in Flipped Class for six months and the others had not. The high school that they studied in was located in a mid-sized city, Cheonbuk province. Students demonstrated a medium level of English proficiency on a regular basis of English achievement assessment, and the average of English achievement assessments in all grades in the school was close to the national average. The subjects were organized based on the English achievement test at the beginning of the semester and showed similar level of English proficiency to the other classes. The students in the flipped class prepared and participated in the classes themselves, based on the help of the teacher. Otherwise, students who are not subject to research participated in classes where teachers were centered as usual.

3.2. Instrument

The subjects were asked to answer twenty items of English learning strategies which were adapted based on vocabulary learning strategies of Schmitt (1995). He categorized vocabulary learning strategies into five

subcategories, which consisted of *determination*, *social*, *memory*, *cognitive* and *metacognitive* strategies.

Table 1. Items of Instrument

No.	Item
1	I read the sentence containing important contents several times in a loud voice.
2	If I do not remember the proper content when I write a piece, I try to use what I already know.
3	I create time schedules so that I invest enough time in English learning.
4	I share the difficulties of studying English with your friends.
5	I ask a native English teacher English in order to study English.
6	I try to find a pattern when listening to English sentences.
7	If I do not understand what I am learning, you study English while I worry.
8	I study English with a clear purpose to improve your English ability.
9	I have studied English and I have written the results like a memo.
10	If I have a content I do not know, I ask my friends it.
11	I try to use the content of learning to practice in various places.
12	If I make a mistake in studying English, I use it as an opportunity to learn something new.
13	When I improve my English, I give myself a reward.
14	If you do not understand the contents, I ask my teacher to explain it again.
15	When someone else speaks in English, I guess what I studied in class.
16	I try to find out how I can do better in English.
17	When I have a trouble studying English, I try to have breath of mind.
18	I look through the internet for content that I do not understand well while studying English.
19	I guess the contents of the English class when I do not understand them.
20	When new English learning contents come out, I write contents in notes.

The items were designed rooted to five subcategories and were revised and improved to make it easy for the subjects to understand. The subjects answered each question according to Likert scales, where step 1 meant 'Not at all' and step 5 directed 'I really do.'

3.3. Data Analysis

In order to find out the dimension of learning strategy, an exploratory factor analysis was conducted. Exploratory factor analysis is a factor analysis that reduces many items to a few components that can give meaning by using

correlation between items (Joseph, Rolph & Bill, 2009). The subjects answered 20 questions of learning strategies, and the data from them were applied to the exploratory factor analysis through SPSS 20. The factors that explained the features of learning strategies of the subjects were extracted by it. In addition, logistic regression analysis was conducted to investigate the correlation between learning strategies and flipped class. Logistic regression analysis is effective when the dependent variable is a nominal one, and the independent variable is an interval one (Joseph, Rolph & Bill, 2009). What makes a difference between logistic regression and multivariate regression analysis is whether dependent variable is a nominal or an interval one.

4. Results & Discussion

4.1. Exploratory Factor Analysis

Most of items had mean values of 2.5 to 3.5 as shown in table 2. Item 18 'I look through the internet for content that I do not understand well while studying English' had the highest mean value and item 3 'I create time schedules so that I invest enough time in English learning' had the lowest mean value of total 20 items. Many subjects used internet for his studying English, which reflected the fact that they could access to web circumstance more easily compared to past. In the same vein, it showed that the change could affect learning strategies of the students. Otherwise, the tendency of systematic learning strategies including scheduling, planning and organizing as shown in item 3, which meant that the students tended to have features of individuality and personality more strongly based on the change of learning environment rooted to communicative language teaching, task based instruction and filled class.

Table 2. Descriptive Statistics

item	Minimum	Maximum	Mean	Std. Deviation
item1	1.00	5.00	2.91	1.225
item2	1.00	5.00	3.21	1.185
item3	1.00	5.00	2.48	1.207
item4	1.00	5.00	3.00	1.210
item5	1.00	5.00	2.50	1.243
item6	1.00	5.00	3.08	1.156
item7	1.00	5.00	3.40	1.117
item8	1.00	5.00	3.41	1.129
item9	1.00	5.00	2.59	1.275
item10	1.00	5.00	3.41	1.204
item11	1.00	5.00	2.90	1.166
item12	1.00	5.00	3.25	1.122
item13	1.00	5.00	2.71	1.161
item14	1.00	5.00	3.00	1.160
item15	1.00	5.00	3.08	1.112
item16	1.00	5.00	3.40	1.128
item17	1.00	5.00	3.28	1.144
item18	1.00	5.00	3.51	1.154
item19	1.00	5.00	3.36	1.102
item20	1.00	5.00	2.91	1.215

As shown in table 3, in finding out the reliability of instrument, Cronbach's Alpha based on standardized items was .958 and Cronbach's Alpha was .957, which was statistically significant. When Cronbach's Alpha is reported on more than .8, the items have statistical power (Joseph, Rolph & Bill, 2009).

Table 3. Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items
.957	.958

Exploratory factor analysis was conducted in order to extract English learning strategies of the subjects including 80 students who had flipped class and 80 students who did not. In order to make sure the validity of factor analysis in this research, KMO measure and p-value of Bartlett's test of the items were investigated, which were .937 and .01 individually as shown in table 4. The value of two index represented that factor analysis of this research was statistically significant. When KMO measure is more than .5 and p-value of Bartlett's test is less than .05, the factor analysis is statistically meaningful

(Joseph, Rolph & Bill, 2009).

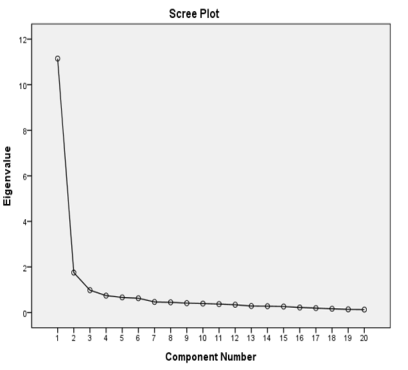
Table 4. KMO & Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.937
Bartlett's Test of Sphericity	Approx. Chi-Square	2512.896
	df	190
	Sig.	.001

Four dimensions were extracted based on the exploratory factor analysis, which was one of the ways of factor analysis. The dimensions could explain 73.09% of total variance as shown in table 5, which meant that four dimensions could be regarded as key components that could explain most of features of 20 items (73.09%). When the cumulative percentage of total variance is more than 60%, the components extracted are statistically significant (Joseph, Rolph & Bill, 2009). Component 1 had the highest percentage of total variance as 28.05%, and component 4 had the lowest one as 9.67%.

Table 5. Total Variance Explained & Scree Plot

Comp-onent	Initial Eigenvalues			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	11.147	55.737	55.737	5.610	28.050	28.050
2	1.751	8.755	64.491	5.008	25.040	53.091
3	.980	4.899	69.390	2.078	10.389	63.479
4	.741	3.705	73.095	1.923	9.616	73.095
5	.663	3.313	76.408			
6	.625	3.127	79.535			
7	.465	2.323	81.859			
8	.447	2.237	84.095			
9	.412	2.062	86.157			
10	.392	1.961	88.118			
11	.370	1.852	89.970			
12	.342	1.708	91.678			
13	.285	1.424	93.103			
14	.276	1.381	94.484			
15	.262	1.309	95.793			
16	.220	1.099	96.892			
17	.193	.963	97.855			
18	.165	.823	98.678			
19	.137	.685	99.364			
20	.127	.636	100.000			



First component was involved in seven items, which meant item 7, 8, 12, 16,

17, 18 and 19 as shown in table 6. When an item is loaded on a component in more than .6 load value, that is statistically significant(Joseph, Rolph & Bill, 2009). The component was named *inducement* strategies since the subjects strived to create incentives and motivations for learning English by achieving specific goals and tangible achievements. By using *inducement* strategies, students studied English with a clear sense of purpose. When there was a content that they did not understand, they tried to solve it by using various ways and have an attitude to think about improved English learning methods. In addition, second component was connected to seven items strongly including item 3, 5, 9, 11 and 14. Based on the features of items involved, the component was named *reaction* strategies. With *reaction* strategies, Students actively asked for help in learning about vague contents and tried to react actively by reviewing and practicing in another place their contents in class. Students valued both their own reactions to themselves and their responses to oneself.

Third component was named diffusion strategies since the items was concentrated on the feature that when students studied English, they valued the presence of their friends and tended to actively ask for help and shared the results with their friends. Through this process, students shared their knowledge and tried to achieve their goals by spreading them. The component was related to two items containing item 4 and 10. The last component was linked to four items which were item 1, 2, 6 and 15. The component was named *application* strategies since students tended to study English on the basis of what they already knew and tried to find a common type when applying for learning. Likewise, when other students were speaking to them, they tried to find out how contents were included and could be used in the utterance, using *application* strategies.

The above mentioned components including *inducement, reaction, diffusion* and *application* strategies generally reflects changes in English teaching methods and environment. Due to the universalization of student-centered class, students have made various efforts to set and achieve their own learning goals, and the development of information and communication technology has prompted the tendency to solve problems and ask for help immediately by using internet or smart-phones.

Table 6. Rotated Component Matrix

item	component named	Component 1	2	3	4
item19	Inducement	**.816**	.183	.188	.156
item18		**.803**	.162	.254	.155
item8		**.777**	.358	.177	-.026
item16		**.774**	.321	.072	.263
item7		**.772**	.173	.277	.198
item17		**.695**	.340	-.048	.418
item12		**.655**	.451	.238	.177
item13	Reaction	.297	**.814**	.153	.138
item9		.163	**.796**	.100	.210
item14		.324	**.747**	.301	.032
item3		.185	**.727**	.210	.293
item20		.468	**.695**	.093	-.002
item5		.136	**.627**	.195	.513
item11		.340	**.600**	.247	.410
item10	Diffusion	.418	.210	**.780**	-.003
item4		.173	.339	**.736**	.378
item6	Application	.477	.239	.167	**.666**
item1		.185	.411	.451	**.418**
item2		.505	.226	.271	**.415**
item15		.509	.559	.272	**.214**

4.2. Logistic Regression Analysis

Based on four components extracted by the factor analysis, a logistic regression analysis was conducted in order to find out what dimensions of learning strategies the subjects who learned English in flipped class had. The dependent variable of the logistic regression analysis used in this research was implement of flipped class, where the subjects who experienced it were coded as '1' and ones who did not were coded as '0.' Independent variables were dimensions of learning strategies extracted through exploratory factor analysis. Through this procedure was how implement of flipped class affected learning strategies of the subjects analyzed. In making an assessment of the overall fit of a logistic regression model, statistical measures including −-2 Log likelihood (-2LL), Cox & Snell R Square and Nagelkerke R Square were investigated as shown in table 7. R^2 values in this analysis were .138, which meant that the logistic regression model accounted for at least 13.8% of the variation between the group of flipped class and the group of non-flipped class. The R^2 values of the two-variable model showed substantive improvement over the single-variable model and indicated good model fit when compared to the The

R^2 values usually found in multiple regression (Joseph, Rolph & Bill, 2009).

Table 7. Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	204.378[a]	.103	.138

In addtion, Hosmer and Lemeshow Test was investigated to make sure the overall fit of logistic regression model, the p-value of which was .937 as shown in table 8. The model fit was statistical significant since it is acceptable when the p-value of the test is more than .05 (Joseph, Rolph & Bill, 2009).

Table 8. Hosmer & Lemeshow Test

Step	Chi-square	df	Sig.
1	2.964	8	.937

It was examined how accurately four learning strategies could classify the subjects into the two groups as shown in table 9. The model categorized 51 of the 80 students who participated in flipped class correctly, and classified 56 out of the 80 students who did not participate in the class exactly, with an average classification accuracy of 65.6%. It was statistically significant because the classification accuracy was almost 70% (Joseph, Rolph & Bill, 2009).

Table 9. Classification Table

Observed			Predicted		
			Flipped Classroom		Percentage Correct
			.00	1.00	
Step 1	Flipping Classroom	.00	54	26	67.5
		1.00	29	51	63.8
	Overall Percentage				65.6

The variables of the equation was analyzed in order to investigate whether or not a strategies has a relatively high influence on classifying students as shown in table 10. In terms of p-values in this model, the strategies for classifying students who had flipped classes among four strategies were *diffusion* and *application* strategies, and the p-values of *inducement* and *reaction*

strategies were not as significant as 0.856 and 0.78 respectively ($p<.05$). Particularly, *reaction* strategy was identified as a rare one for students who had flipped classes. As shown in table 10, if a student uses one more unit of *diffusion* strategy, the probability that the student has been in flipped class increases by about 1.5 times. In addition, if a student uses one more unit of *application* strategy, he or she increases the probability of having flipped class about 1.7 times.

On the other hand, if a student uses *inducement* strategy one more unit, the probability that the student has flipped classes increases by about 1.03 times. Therefore, it is difficult to conclude that *inducement* strategy is a characteristic learning strategy for students who have been taught English in flipped class. In addition, if a student uses *reaction* strategy one more unit, the probability of the student being in flipped classes is reduced by about 0.74 times, so this strategy is not a feature of learning strategies of the students who have been taught English in it.

Table 10. Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1	Inducement	.031	.172	.033	1	.856	1.032
	Reaction	-.308	.175	3.106	1	.078	.735
	Diffusion	.403	.176	5.227	1	.022	1.496
	Application	.537	.182	8.734	1	.003	1.710
	Constant	.000	.167	.000	1	.999	1.000

The figure 1 showed how accurately the flipped and non-flipped groups were classified. As shown in figure 1, most of the subjects of the flipped class were correctly classified by the four factors. '1's were the students belonging to the flipped class and '0's were the students were in the non-flipped class.

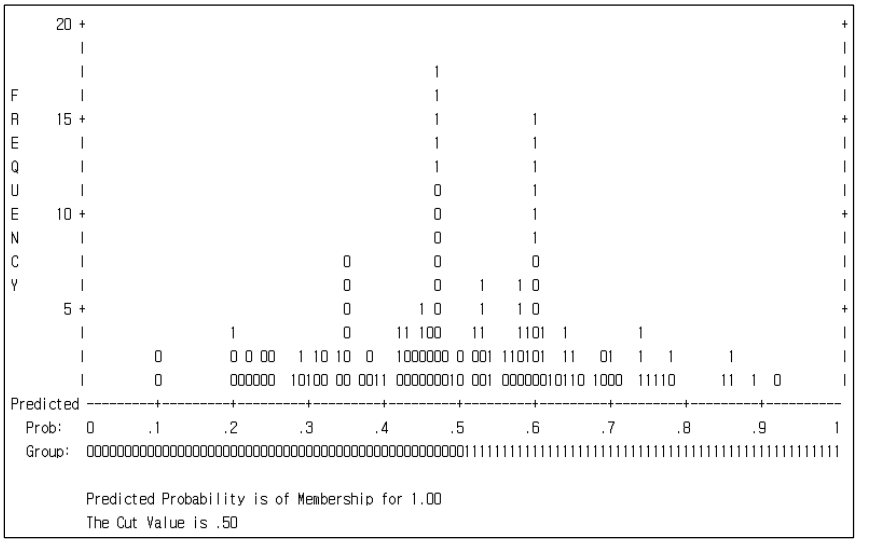


Figure 1. Probabilities Plot

4.3. Discussion

As could be seen from logistic regression analysis, the students who were in the flipped class were using diffusion and application strategy more. In terms of the *diffusion* strategy, students were actively responding to learning materials, friends, and teacher's feedback, and sharing their learning experiences with them. This strategy reflected the resilience of procedure of class and evaluation. In addition, it was also the result of continuous application of student-centered class, which was the nature of the flipped class. In addition, it seemed to derive from the characteristic of students actively responding to teacher's help and sharing consciousness through cooperative learning.

On the other hand, in *application* strategy, students took a position to actively apply their learning contents. Students focused on practical English learning rather than simply memorizing knowledge. This phenomenon was caused by the strengthening of the learning ability of the students through various products in the flipped class, the expansion of opportunities for students to participate in classes, and the introduction of group activities. In addition, as the subject of using the learning materials was shifted from the teacher to the student, it could be seen that the students had the application

ability in the learning strategy. The results of the logistic regression analysis showed that students who were in the flipped class and those who did not had the characteristics of the learning strategy as shown in the figure 2.

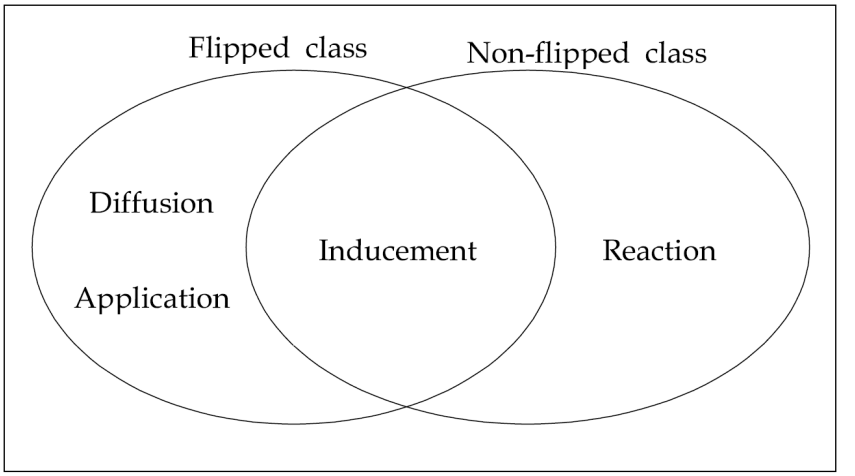


Figure 2. Learning Strategies of Flipped Class

5. Conclusion

This study is meaningful in that it analyzes the way in which differentiated teaching methods affect the students' learning strategies. In addition, through the analysis of such learning strategies, it is possible to provide the opportunity for teachers who are teaching flipped classes to understand the learning strategies of students and to plan effective teaching and learning based on them.

In this study, the results of factor and logistic analysis were analyzed in order to characterize the English learning strategies of the students who participated in the flipped class. In terms of the factor analysis, students mainly used four learning strategies including *inducement, reaction, diffusion* and *application* strategies, whereas students who took the flipped class used the two strategies such as *diffusion* and *application* strategies more actively. This was consistent with the overall characteristics and direction of the flipped class and

attributed to changes in teaching conditions and access to teaching and learning materials.

Students who participated in the flipped class tended to take *diffusion* strategy to actively share and enhance their learning with teachers and friends. In order for teachers to use the learning strategy more effectively, it is important to create conditions so that the strategy is used easily when students perform tasks and collaborate in groups. For this, it is also necessary to develop and present learning materials that can solve problems through flexible learning time, collaboration and sharing activities. It is also essential for the teacher to correct his or her speech and supplement the feedback method so that the students can easily use the strategy, and to develop and apply various evaluation methods. In addition, it is important to provide students with a variety of content in order to facilitate the use of *application* strategy by students. Based on such content, it is possible to induce creative performance and create conditions for students to continuously apply and modify their learning.

This study have limits on the subjects of male high school students who were taught English in flipped class, and the subjects had only six months of flipped instruction. In addition, since factor analysis and logistic regression analysis were used to characterize the learning strategies of the subjects, the results are difficult to be generalized regarding whole students. In order to overcome these limits, it is necessary to extend the scope of study to various levels of students who have participated in flipped class for more than 6 months. In addition, it is necessary to try to capture the characteristics of the learning strategies by using more research methodologies.

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