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A Study on the Factors Affecting Academic Achievement in Non-face-to-face Teaching-Learning

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Abstract

In non-face-to-face teaching-learning, a survey was conducted on 55 students in the department of chemistry education at university A on the variables (behavioral control, instructor-learner interaction, cognitive learning) affecting learning satisfaction and academic achievement. There were relatively large positive correlations between variables. The positive correlation between them was found to be the factors that influenced learning satisfaction and academic achievement in non-face-to-face teaching-learning. The average values of non-face-to-face teaching-learning for each variable were lower than the corresponding values of face-to-face teaching-learning, respectively. As a result of the perception survey on the detailed factors of each variable, negative responses were relatively high in factors such as 'concentration of behavior' in behavioral control, 'level-considered explanation' in instructor-learner interaction, and 'knowledge understanding' in cognitive learning.

Keywords: *Aacademic Achievement, Behavioral Control, Instructor-Learner Interaction, Cognitive Learning*

1. INTRODUCTION

Due to COVID-19, exchanges between various fields such as education, society, culture, etc. have been cut off. In particular, social distancing between individuals and groups has brought about great changes in not only individual values and emotions but also daily life. Due to this social distancing, the Ministry of Education decided to conduct non-face-to-face teaching-learning because it was determined that normal academic management in school education was difficult [1].

As school education suddenly changed to non-face-to-face teaching-learning, the teaching-learning environment of students changed significantly. There was no preparation or sufficient discussion for these

changes, and no educational environment for non-face-to-face teaching-learning was established. Due to maladjustment to non-face-to-face teaching-learning, many problems such as difficulty in understanding content, lack of teaching content and poor quality (online quality and level), limitations of communication, delay and disconnection due to online access, etc. have occurred [2-4].

On the other hand, some studies have suggested the autonomy, individuality, repeatability, etc. of teaching-learning as advantages of learning satisfaction and academic achievement in non-face-to-face teaching-

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learning [5, 6]. In other words, the convenience of learners to listen to lectures regardless of location, the connectivity to share knowledge and information between instructors and learners online, and the accessibility to immediately and repeatedly access desired learning materials were presented.

In the case of non-face-to-face teaching-learning, learning can be successfully performed by the learner's autonomous and active teaching-learning. It can lead to differences in academic achievement depending on the learning concentration at which learners can actively participate in learning and manage/control learning [6, 7]. In this situation of non-face-to-face teaching-learning, the learner's willingness to self-directed teaching-learning is absolutely necessary, which can greatly affect learning satisfaction and academic achievement.

Based on these points, various studies have been conducted on the relationship between non-face-to-face teaching-learning and academic achievement based on self-directed teaching-learning [8, 9]. In particular, learners with high ability to utilize self-directed learning strategies have high participation in teaching-learning. In addition, when learning management and behavioral control for learning were high, academic achievement was high [10]. Therefore, it emphasizes the variables that influence self-directed teaching-learning. As the necessity of self-directed teaching-learning is emphasized in this open learning space, research on variables such as learner behavioral control, instructor-learner interaction, cognitive learning, etc. that affect learners' learning concentration and academic achievement has become more important [8-10].

In order for learners to engage in learning activities on their own, efforts are needed to achieve learning without being swayed by academic concentration and surroundings. To do this, behavior must be controlled in teaching-learning. Learners who are good at "behavioral control" in non-face-to-face teaching-learning do not give up despite various difficulties, can manage or control their behavior to continue teaching-learning, and focus on learning without being tempted or disturbed by others. In previous studies [11, 12], it was found that the better the behavioral control while taking non-face-to-face lectures, the higher the immersion in learning, and finally the higher the willingness to continue learning. Therefore, it was found that good self-regulated behavioral control in non-face-to-face lectures increases learning satisfaction and academic achievement.

In particular, the 2015 revision of the curriculum emphasizes learners' self-directed teaching-learning, such as student-participating classes, student-centered inquiry experiments, etc. [13]. In the case of autonomous and active self-directed teaching-learning, behavioral control can be a variable influencing teaching-learning. Therefore, there is an urgent need for research on behavioral control on learning satisfaction and academic achievement in non-face-to-face teaching-learning.

In non-face-to-face teaching-learning, instructor-learner interaction (communication) is one of the most important factors to improve the quality of instruction in the teaching-learning process [14, 15]. This interaction stimulates the learner's intrinsic motivation, strengthens and promotes teaching-learning, and finally can lead to teaching-learning successfully [16, 17]. In particular, feedback during the interaction leads to efficient overall learning such as teaching-learning process, learning outcome, etc. As such, the effectiveness of teaching-learning depends on the interaction between instructors and learners, and the interaction can be a criterion for judgment that affects learning satisfaction, academic achievement, etc., so it is selected as a variable in several studies.

In the 2015 revision of the curriculum, 'communication ability' is emphasized as a core competency. It emphasizes student-participating teaching-learning in which instructors-learners communicate with each other [13]. Therefore, more research is needed on learning satisfaction and academic achievement according to instructor-learner interaction (communication).

During non-face-to-face lectures, it was reported that cognitive learning, in which learners understand their learning content well and immerse themselves in their learning situations, affects academic achievement [2, 5]. In non-face-to-face teaching-learning, if the learner's will to cognitive learning is lacking, the motivation

for self-directed teaching-learning is lowered, and finally learning satisfaction and academic achievement are lowered. The will of cognitive learning is a major factor that increases the educational effect of non-face-to-face teaching-learning, and can be a major variable that can increase academic achievement. Therefore, research on cognitive learning is needed in a non-face-to-face teaching-learning situation.

2. RESEARCH METHODS

2.1 Object of Study

Amid social distancing caused by COVID-19, the form of university classes was also switched from face-to-face lectures to non-face-to-face online. The correlation between variables (behavior control, teaching-learning interaction, cognitive learning) that can affect the environment of non-face-to-face learning and their effect on academic achievement were studied. 55 students enrolled in the Department of Chemistry Education at A University in Gyeongnam were selected as the subjects of the study. A survey was conducted on the selected students, and the research contents were analyzed by 53 people who faithfully responded to the survey.

Students' academic achievement was based on the average grade of general chemistry. Non-face-to-face lectures are from 2020 to the first semester of 2021, and other periods were conducted as face-to-face lectures. 33 students (62.3%) took face-to-face lectures and 20 students (37.7%) took non-face-to-face lectures.

First, the study analyzed the correlation between variables that affect academic achievement of non-face-to-face lectures and the results of students' perception survey shown in the detailed factors of these variables. Second, their influence was analyzed by statistical analysis on these variables according to the difference in lecture type (face-to-face, non-face-to-face).

2.2 Questionnaire Survey

A survey was conducted on variables such as learner's behavioral control, instructor-learner interaction, cognitive learning, etc. that affect the academic achievement of non-face-to-face online lectures. Based on the previous test tools [4, 19, 20], the questionnaire used was modified to match the characteristics of students in the department of chemistry education with detailed questions on behavioral control, instructor-learner interaction, cognitive learning, etc. In addition, the first preliminary survey was conducted on 30 students in the department of chemistry education at University A. Even if the students' survey was conducted based on the preliminary survey, the opinions of professors and experts in the area were synthesized and finally revised.

The questionnaire contents consisted of content on behavioral control, instructor-learner interaction, cognitive learning, learning satisfaction, academic achievement, etc. It consisted of a total of 26 questions, including 4 questions related to behavioral control, 7 questions related to instructor-learner interaction, 5 questions related to cognitive learning, 3 questions related to learning satisfaction, 3 questions related to learning satisfaction, and 5 questions related to academic achievement. Among these, 24 questions were asked to select a score corresponding to their thoughts on a 5-point Likert scale, and the remaining two questions were asked to describe the parts satisfied with and improvements in non-face-to-face lectures. The time spent in the survey was 50 minutes. The student survey was conducted at the end of December 2021.

This study data was analyzed using the SPSS 25.0 statistical program. The correlation between variables such as behavioral control, instructor-learner interaction, cognitive learning, learning satisfaction, academic achievement, etc. was analyzed. The mean, standard deviation, etc. of factors according to the learning type of these variables were analyzed through a t-test according to the learning type (face-to-face, non-face-to-face). The total reliability coefficient (α) for the five variables was 0.866, and the reliability coefficient was relatively high.

2.3 Research Questions

In the case of non-face-to-face teaching-learning, it is a kind of instructor-centered class in which instructors unilaterally conduct lectures. On the other hand, since the learner performs teaching-learning from a passive position, a high degree of concentration of learning is required. In the case of such non-face-to-face teaching-learning, instructors' lectures tailored to learners' learning needs are required, and self-directed variables can be important factors for teaching-learning.

This study attempted to study the variables affecting learning satisfaction and academic achievement in non-face-to-face teaching-learning. Accordingly, the research problems of this study are as follows.

1. What is the correlation between variables (behavioral control, instructor-learner interaction, cognitive learning) that affect learning satisfaction and academic achievement?
2. What are the students' perceptions of the detailed factors of variables such as behavioral control, instructor-learner interaction, cognitive learning, etc?
3. What is the effect of behavioral control, instructor-learner interaction, cognitive learning, etc. on learning satisfaction and academic achievement?

3. RESEARCH RESULTS

3.1 Analysis of Variables Affecting Non-face-to-face Teaching-Learning

The correlation between variables (behavioral control, instructor-learner interaction, cognitive learning) affecting learning satisfaction and academic achievement in non-face-to-face teaching-learning was analyzed, and the results are shown in Table 1. There was a relatively high positive correlation between these variables. These results suggest that these variables are affecting non-face-to-face teaching-learning.

On the other hand, it was found that these variables were not correlated with academic achievement. This result is judged to be due to the change from test tools such as paper-written evaluation, performance evaluation, etc. to test tools such as learning materials, reports, etc. due to social distancing. In addition, it is judged that the evaluation method has changed from the relative evaluation of face-to-face classes to the absolute evaluation of non-face-to-face classes. Therefore, it is interpreted that there is no correlation with these variables due to the change in the test tool and evaluation method of academic achievement.

Table 1. Correlation between variables affecting non-face-to-face teaching-learning

Variable	behavioral control	instructor-learner interaction	cognitive learning	learning satisfaction	academic achievement
behavioral control	-	.503**	.573**	.638**	.023
instructor-learner interaction	.503**	-	.580**	.698**	.064
cognitive learning	.573**	.580**	-	.680**	-.057
learning satisfaction	.638**	.698**	.680**	-	.041
academic achievement	.023	.064	-.057	.041	-

**: $p < .01$

The t-test was conducted by teaching-learning type (face-to-face, non-face-to-face) for variables that affect learning satisfaction and academic achievement, and the results are shown in Table 2. The average value of non-face-to-face classes for each variable was significantly lower than the average value of face-to-face classes. Due to the difficulty of active behavioral control and active communication in non-face-to-face teaching-learning, it is judged that the average value of non-face-to-face classes is relatively low. On the other hand, the average value of non-face-to-face classes was higher in academic achievement. This is judged to be due to the difference between the test tool and evaluation method of academic achievement.

Table 2. Statistics by type of teaching-learning for each variable. face-to-face and non-face-to-face are denoted as f and n, respectively

variable	learning type	N	M	SD	t
behavioral control	f	33	2.8424	.86423	-0.402
	n	20	2.8400	.74155	
instructor-learner interaction	f	33	3.7303	.85165	1.612
	n	20	3.3350	.88809	
cognitive learning	f	33	3.7939	.76401	2.672**
	n	20	3.1700	.91600	
learning satisfaction	f	33	3.1212	.88167	-0.186
	n	20	3.0000	.93584	
academic achievement	f	33	3.6970	.64274	0.368
	n	20	3.8125	.86934	

**: $p < .01$

3.2 Students' Perception of Variables Influencing Non-face-to-face Teaching-Learning

After questioning four questions related to 'behavioral control' in non-face-to-face lectures, the results are shown in Figure 1. As a result of the survey, the positive response of 'strongly agree' was relatively the highest in 'assignment commitment'. In non-face-to-face teaching-learning, students recognized learning tasks as important because they evaluated academic achievement through data such as learning materials, assignments, reports, etc. In order to achieve high academic achievement, positive responses were relatively high because they were obsessed with assignments subject to grade evaluation.

While the negative response of 'strongly disagree' was high in 'degree of participation', 'concentration of behavior', the positive response of 'strongly agree' was very low in 'obstructive factor'. Since non-face-to-face teaching-learning occurs in a personal learning space, it was found that it was difficult to increase academic participation after controlling (academic concentration) the factors that interfere with learning. Since it is learning alone in a social distancing situation, it is a situation in which learners need a willingness to actively participate in learning and manage and control learning. If learners' autonomous and active teaching-learning is not premised, learning satisfaction and learning achievement will inevitably decrease. It means that behavioral control is relatively difficult in non-face-to-face lectures. These results are similar to those of

previous studies [5-7].

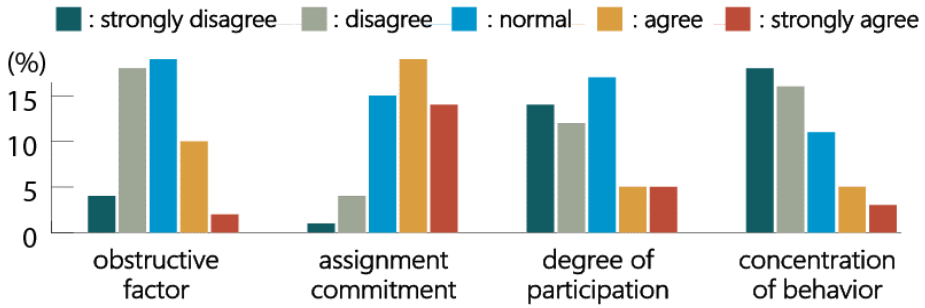

Figure 1. The degree of students' perception of detailed elements of behavioral control

Five detailed questions related to 'instructor-learner interaction' for non-face-to-face classes are investigated and shown in Figure 2. As a result of the survey, the negative response of 'strongly disagree' was relatively high in questions such as 'providing feedback', 'level-considered explanation'. It shows that the interaction between instructors and learners due to non-face-to-face online lectures is relatively low compared to other factors. 'providing information' is basically a teaching-learning content provided by instructors, and 'providing activity' is a teaching-learning activity that is difficult to proceed in non-face-to-face online lectures, so the interaction between instructors is relatively low.

In particular, the interaction between instructors and learners was found to be a variable affecting class satisfaction. The higher the interaction, the higher the class satisfaction, and the lower the interaction, the lower the class satisfaction. If the instructor can sufficiently communicate with the learner, it was found that it had a positive effect on the teaching-learning of the students [3, 17]. It was found that it was difficult to achieve educational effects due to lack of interaction between instructors and learners in non-face-to-face lectures, such as difficulty in grasping learners' learning understanding, unilateral lecture without considering learners' level [16].

In previous studies [2, 5], immediate communication is possible during non-face-to-face online lectures, but communication is not easy due to lack of willingness to learn, differences in personal understanding and limits of Q&A according to learning speed, and lack of preparation for non-face-to-face teaching-learning [6]. As the results of other studies [21-23], when the level of interaction between instructors and learners is low in non-face-to-face teaching-learning, it does not affect academic achievement, and the correlation between them is also low. On the other hand, when interaction promotes and strengthens teaching-learning, academic achievement was found to improve.

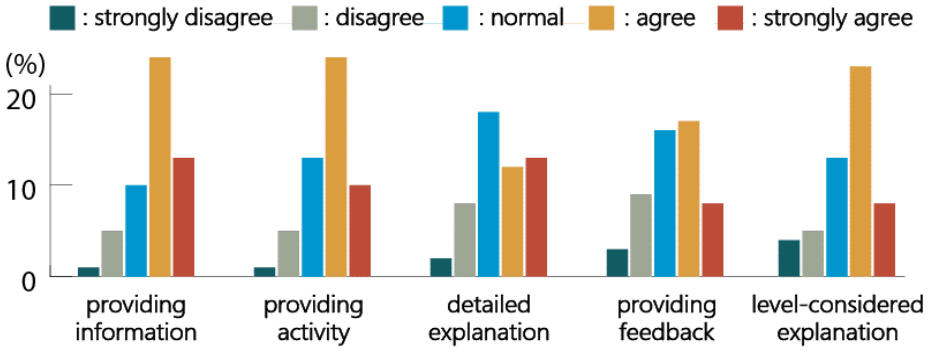

Figure 2. Degree of students' perception for detailed elements of instructor-learner interaction

Five detailed questions related to 'cognitive learning' in non-face-to-face teaching-learning were investigated and are shown in Figure 3. As a result of the survey, since the distribution of the graph in 'knowledge understanding' shows a normal distribution form, it was recognized that non-face-to-face lectures remained at the 'level of delivery of instructor's learning content'. Positive responses of 'strongly agree' were relatively high in 'knowledge expansion', 'knowledge application', and 'knowledge creation'. This is because it was confirmed that face-to-face lectures were changed to non-face-to-face lectures with the development of science and technology, and furthermore, the possibility of creating new knowledge was recognized.

As a result of previous studies [2, 17], it was reported that students preferred passive learning activities (explanatory classes) in non-face-to-face teaching-learning activities, so they lacked the will to self-directed learning activities.

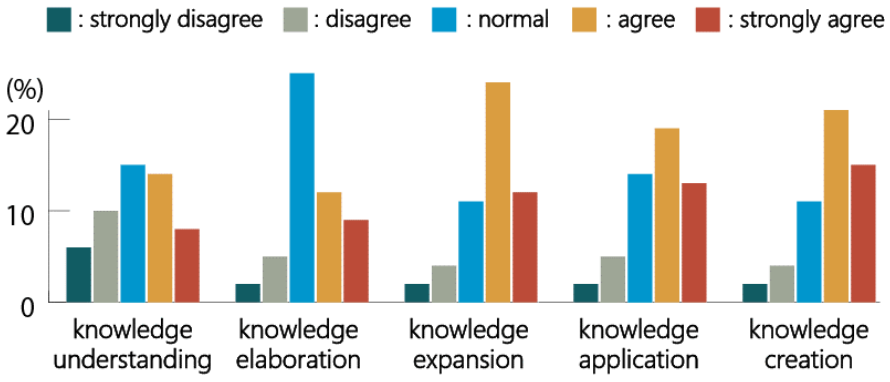

Figure 3. The degree of students' perception for the detailed factors of cognitive learning

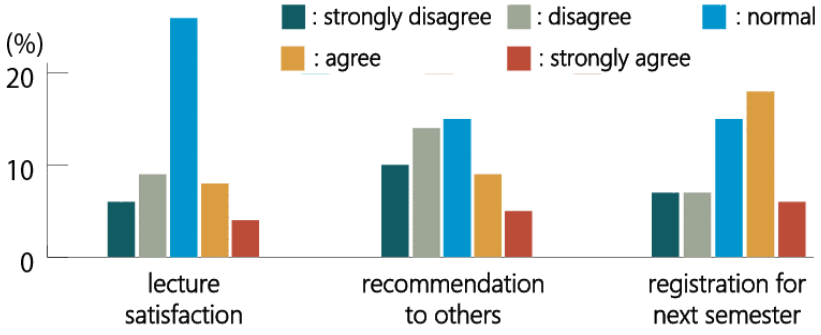

Figure 4. The degree of students' perception for the detailed factors of learning satisfaction

After investigating three questions related to 'learning satisfaction' for non-face-to-face lectures, they are shown in Figure 4. As a result of the survey, the negative response of 'strongly disagree' in 'recommendation to others' was high. It was found that non-face-to-face lectures were not satisfactory to learners and were negative in encouraging other students to take the courses. In other words, it was found that it had an effect on whether other learners took lectures.

In previous studies [2, 3, 5], students' lecture satisfaction with non-face-to-face lectures was found to be below the average level, and were found to be unsatisfactory in lecture preparation such as the quality of lecture videos, difficulty in explaining learning contents, and teaching-learning environment for non-face-to-face classes. As a result of Kang's study [14], it was found that learning satisfaction was significant in non-face-to-

face online teaching-learning, but academic achievement was not significant. As a result of Shim's study [15], online teaching-learning showed no significant effect on academic achievement and learning satisfaction. Depending on the teaching-learning environment, the relationship between learning satisfaction and academic achievement in non-face-to-face online teaching-learning appears differently.

After investigating four detailed questions related to 'academic achievement', they are shown in Figure 5. As a result of the survey, it was found that students who took non-face-to-face lectures had relatively high positive responses in 'content understanding' and 'lecture help', while negative responses in 'satisfaction of learning needs' were relatively high. In other words, in non-face-to-face teaching-learning, the instructor's lecture was helpful in understanding the content, but the satisfaction of learners' needs for learning was low. It was found that instructors did not satisfy learners' learning needs and remained at the level of explanatory lectures that only explained the learning content. It is judged that non-face-to-face online lectures are not mainly learner-centered lectures, but instructor-centered lectures.

Face-to-face lectures can immediately grasp learners' responses to understanding the learning content, and through this, the level of lectures can be lowered or raised depending on whether they understand the content. On the other hand, non-face-to-face lectures are difficult to immediately determine whether students respond to understanding the learning content, suggesting that the instructor's lecture is being conducted unilaterally.

As a result of Kim's study [4], it was found that there was a limit to academic performance because it was difficult for instructors to determine whether students actually participated in classes in non-face-to-face online classes. As a result of Park's research [16], it was emphasized that instructors should pay attention to learners' learning activities, and that classes should be conducted after grasping various learning situations.

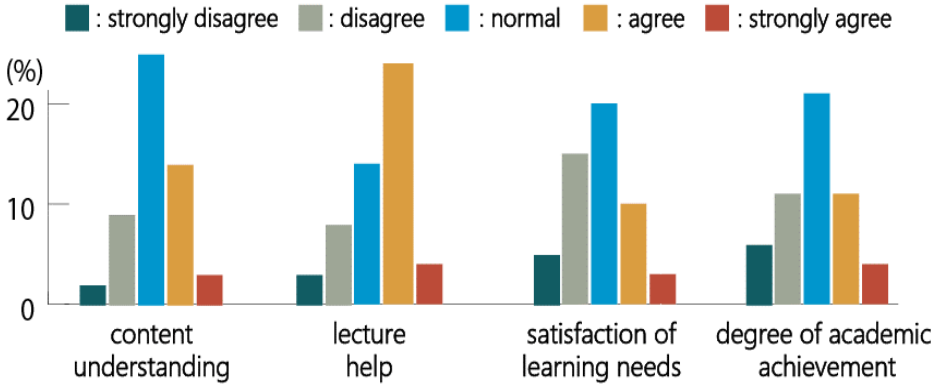

Figure 5. The degree of students' perception of the detailed factors of academic achievement

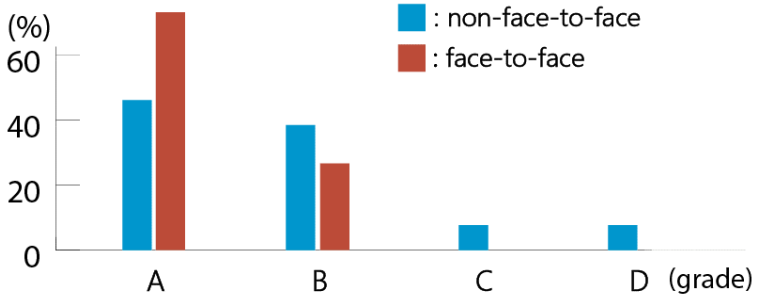

Figure 6. Distribution of grades in general chemistry for lectures through non-face-to-face and face-to-face online

The distribution of grades in general chemistry for students who took non-face-to-face and face-to-face lectures was investigated and shown in Figure 6. As a result of analyzing the grades of general chemistry for the two groups, the distribution of grades of students who took non-face-to-face lectures was low at C and D grades, while those who took face-to-face lectures were high at A and B grades. These results are judged to have failed to effectively respond to variables such as behavioral control, instructor-learner interaction, learning concentration, feedback, etc., which can affect non-face-to-face teaching-learning. As a result, academic achievement was found to be low due to low content understanding. In previous studies [19, 24, 25], it is reported that lectures through non-face-to-face online have low academic achievement due to poor students' concentration in class.

3.3 Descriptive Investigations of Students on Non-face-to-face Teaching-Learning

After investigating the factors of satisfaction and dissatisfaction in non-face-to-face teaching-learning as descriptive questions, the results are shown in Figure 7. As a result of the survey, factors that are satisfied in non-face-to-face teaching-learning were such as 'convenience of time/space', 'possibility of repetitive learning', etc. On the other hand, various negative factors such as less concentration on learning, lack of interaction such as question and answer, low quality of class (lack of preparation of lecture materials, poor lecture content), instructor-centered class, and lack of consideration of learning conditions were described.

As a result of previous studies, non-face-to-face classes not only showed low student participation in classes, but also decreased interaction and learning concentration, and finally showed low academic achievement [4]. In particular, it was reported that the interaction between instructors and learners had the greatest influence on learning satisfaction [16, 17].

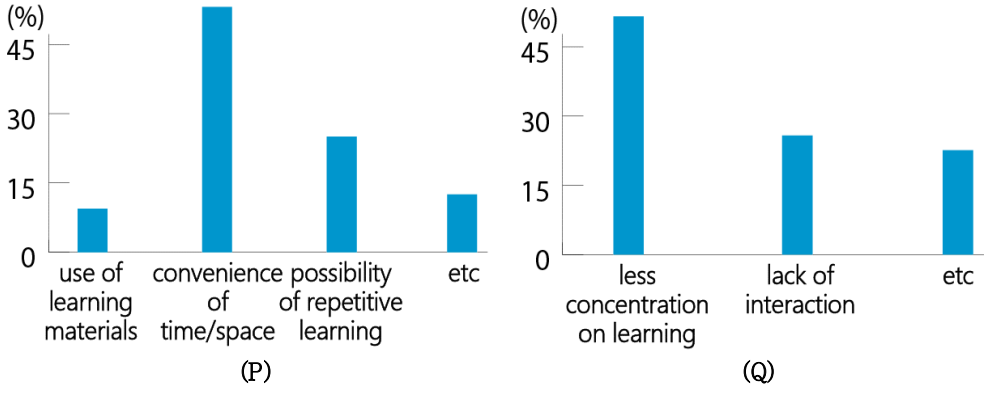

Figure 7. Distribution for factors of satisfaction (P) and dissatisfaction (Q) in non-face-to-face teaching-learning

4. CONCLUSIONS

In non-face-to-face teaching-learning, the correlation was analyzed between variables affecting learning satisfaction and academic achievement, and a relatively large positive correlation was found. This suggests that these variables are highly related to non-face-to-face teaching-learning. On the other hand, it was found that they had no correlation with academic achievement. These results are judged to be due to changes in test tools and evaluation methods for academic performance due to non-face-to-face lectures according to social distancing.

As a result of the t-test for each variable, the average value of non-face-to-face classes was lower than that of face-to-face classes, respectively. In particular, the difference was large in instructor-student interaction and cognitive learning in non-face-to-face classes. It is judged that the difference was large due to difficulties in behavioral control, active communication, etc.

As a result of investigating four detailed questions related to 'behavioral control' in non-face-to-face teaching-learning, positive responses were the highest in the 'assignment commitment'. This is judged as a result of recognizing the importance of learning tasks subject to grade evaluation in order to increase academic achievement. On the other hand, negative responses were quite high in questions such as 'degree of participation' and 'concentration of behavior'. It was found that it was difficult to focus on learning because it was necessary to manage and control the factors that interfere with learning in non-face-to-face teaching-learning. Therefore, it was found that behavioral control was relatively difficult in non-face-to-face lectures.

As a result of investigating five detailed questions related to the interaction between instructors and learners, negative responses were relatively high in 'providing feedback' and 'level-considered explanation'. This implies that communication between instructors and learners is not smooth in items such as difficulty in grasping learners' learning understanding in non-face-to-face teaching-learning, lecture progress without considering learners' level, and difficulty in adding and supplementing students' Q&A. The interaction between instructors and learners was found to be an important variable affecting class satisfaction.

As a result of investigating five questions related to cognitive learning, in 'knowledge understanding', the shape of the graph shows a normal distribution. This means that non-face-to-face lectures remain at the delivery level of learning content. On the other hand, positive responses in 'knowledge expansion', 'knowledge application', and 'knowledge creation' were relatively high, and it is judged that the change to a non-face-to-face learning environment was returned to society by combining science knowledge with technology, and further recognized the possibility of creating new knowledge.

As a result of the descriptive survey related to learning satisfaction, it was found that the convenience of time and space, possibility of repetitive learning, learning speed adjustment, etc. were satisfied in non-face-to-face lectures. On the other hand, unsatisfactory contents were described such as less concentration on learning, lack of interaction such as question and answer, instructor-centered classes, etc. In particular, the quality of the class was low due to the lack of interaction such as content feedback, and the dissatisfaction with the fact that the situation of non-face-to-face teaching-learning was not considered was quite large. Therefore, it was found that learners were not only unable to adapt to non-face-to-face classes, but also had low learning satisfaction.

As a result of investigating four questions related to academic achievement, 'strongly disagree' was relatively high in learners' 'satisfaction of learning needs' in non-face-to-face teaching-learning. It was found that instructor-centered lectures did not solve learners' learning needs and problem perception, and remained at the level of explanatory lectures that only explained the learning content. In other words, in the case of non-face-to-face lectures, it is difficult to immediately grasp whether the students understand the contents, so it can be seen that the instructor's lecture is being conducted unilaterally.

In the academic achievement of general chemistry of students who took non-face-to-face lectures, C and D grades were relatively high. As such, the low academic achievement of non-face-to-face teaching-learning was found to be less effective due to factors such as learning concentration, behavioral control, and interaction.

In non-face-to-face teaching-learning, variables related to self-directed teaching-learning are important, and in order to achieve successful teaching-learning, more research on variables that affect academic achievement is needed in the future.

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