

Influences of Physical Education Classes based on Flipped Learning of Self-directed Learning Abilities and Attitude towards These Classes, for Middle School Students

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ABSTRACT

The objective of this study was to analyze the influence of physical education classes based on Flipped Learning on self-directed learning abilities and learning attitude towards these classes, for middle school students. The study selected 90 students as an experimental group (3 classes) and 97 students as a control group (3 classes), among 240 students of the first-year students attending a middle school located at Jeonju City of South Korea, applying convenience sampling, one of the non-probability sampling methods. For the experimental group, 36 sessions of physical education classes were held for 14 weeks, while the control group received teacher-centered classes. Comparing the results with the control group, the experimental group showed significant differences in terms of all sub factors of self-directed learning abilities, namely; desire for learning, learning objective establishment, basic self-management abilities, selection of learning strategy and self-reflection. Moreover, the experimental group manifested significant differences in terms of all sub factors of attitude towards the physical education subjects, namely; positive emotions, negative emotions, health & physical strength, interpersonal relations, physical activities & movements, and active participation & positive performance. From the findings, it can be considered that physical education classes based on Flipped Learning contributed to improving self-directed learning abilities and attitude towards physical education classes. This result can serve as a significant basic material for designing and performing classes in raising the understanding of Flipped Learning and effectively applying Flipped Learning in physical education classes.

Key words: Flipped Learning, Self-directed Learning Abilities, Attitude Towards Physical Education Classes.

1. INTRODUCTION

1.1 The need for research

Education is obliged to reflect the changing era. However, [1] stated that businesses and technology are moving at 100 miles per hour while schools are slowly moving at a mere 10 miles per hour. Moreover, since physical education classes are required to be carried out in broad spaces like playgrounds and gyms, they have been adopting the conventional direct teaching methods in which teachers are the center while students are passive imitators, in terms of class management. However, since the birth of the discipline called "Sports pedagogy," efforts have been made to improve physical education classes in accordance with the rapidly changing society. In particular, to cope with problems of teacher-centered style in PE classes, diverse class models have been adopted in PE classes. As a part

of these efforts, this study intended to adopt Flipped Learning, which is a student-centered problem-solving class method, in physical education classes. The reasons can be summarized as follows:

Firstly, teaching-learning methods to increase self-directed learning abilities are needed. A competent person required by the knowledge-based society of the 21st century is not considered a mere possessor of knowledge and information with geometrical increase but an able person who creatively solves complicated problems confronting him or her in cooperative relations taking advantage of such knowledge and information [2]. Due to the progress of information and communications technology and the arrival of a knowledge-based society, the amount of knowledge is vast and rapidly increasing. Therefore, it is required that one should be able to look for necessary knowledge to learn and appropriately apply it with autonomy. Considering this, it is essential to provide specialized education and customized education suited to a great diversity of students, and to carry out self-formative learning done by the students, away from the unilateral

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instruction of systematized curricula provided by teachers [3]. For instance, it will depend on self-learning abilities of students whether education will provide students with uniform and meaningful experiences. However, through institutionalized time distribution, school education has been training students to passively accept the flow of segmented activities regardless of their own experiences [4]. This means that students have been practicing learning directed by others. In particular, as is characteristic of the subject, physical education classes highly value the faithful imitation of the teacher's motion, and they are practiced as controlled classes without many interactions of student-student and student-teacher. In other words, teacher-centered classes are utilized as effective class methods for achieving educational objectives, distancing students even more from improving their self-directed learning abilities. For this reason, it is indispensable to adopt PE class methods meeting the needs of the time and improving self-directed learning abilities. However, a flipped class can be a student-centered problem-solving class. Students are given enough time and information to help them solve their learning tasks both inside and outside the school. These opportunities are closely related to improving self-directed learning [5]-[8]. So, it is required to carry out studies to evaluate the possibility of utilizing Flipped Learning for PE classes.

Secondly, PE classes satisfying all students are needed. There has been a growing interest in the problems of students who avoid PE and are isolated from PE classes since this topic was studied by [9], [10]. According to the study of [11], about 69.9% of female students and 25.5% of male students have a negative perception of PE in general. Students feel alienated mainly by two different causes: They are caused by internal factors of students such as indifference to PE [12], [13], physical and functional problems [9], [14], dispositional/interpersonal problems [15]-[17], as well as external factors such as lack of understanding of alienation, absence of skilled teaching method and inexperience of class management [18]. A alienation in PE classes as the product of such factors is shown in two different forms. One is that students are meaninglessly seated from the first moment of the class. The other is that students actively participate in the class in the beginning but they are simply seated not doing the assigned activities or become totally indifferent from the second half of the class [18]. The first case is related to the internal factors while the second case is due to the external factors. To solve these problems, it is essential to carry out PE classes based on Flipped Learning, differently from conventional class method. Flipped Learning allows individualized classes and problem-solving classes to focus on peer learning. This makes it possible to reduce the number of alienated students in class and stimulate the rediscovery of the alienated students, by boosting student-student and teacher-student interactions [8], [19]. Moreover, in Flipped Learning, teachers play a changed role as mentors, consultants and facilitators, and not as mere deliverers of knowledge [20]. The characteristics of this flipped class are thought to provide an environment where there are no students who are uninterested or neglected in physical education classes. Therefore, studies

on the application of flipped learning and its influence on attitude in physical education class should be conducted.

Thirdly, it is required to adopt PE teaching methods applying ICT (Information & Communication Technology). Many countries in the world are trying to get reinforced for the information technology era by giving impetus to information literacy education, enlarging the distribution of computers and the Internet and, studying the content of information literacy education [21]. In particular, observing the situation only within the range of East Asia, in South Korea, 23% of all schools of the country are provided with Tablet PCs and 60% with electronic boards, due to the growing level of information literacy of elementary, middle and high schools in the country, according to the governmental policies of smart education promotion and expansion, which started in 2011 [22]. China made more than 90% of elementary, middle and high schools throughout the country have an Internet connection before 2010 [23]. Japan is making efforts to achieve the policy of "Direction for education based on ICT" by 2020, since they published the report of NCER (National Council on Educational Reform) showing great interest in ICT-based education in June of 1985 [24]. Nonetheless, the frequency of ICT-based school classes of South Korea and Japan is still low [25], and considering that China's political efforts for ICT-based education were the latest among the three countries though there are no studies on the frequency of the use of ICT in Chinese education, it is estimated that the use of ICT in education in China is not as high as that of South Korea and Japan. This phenomenon can be interpreted as the product of "natural selection" of education by not following the changing trends of the time. The biggest reason for which ICT is not well-applied in the educational field is that a teaching-learning model applicable to real class environments is absent or deficient [26]. Therefore, it is required to set up new perceptions on teaching-learning methodology based on ICT.

Considering these three reasons, this study inquired into physical education classes applying Flipped Learning. Flipped Learning is recognized as an alternative model of teaching improvement that can realistically overcome restrictions [27]. Flipped Learning is seen as an innovative alternative to the teacher-centered learning by rote, so many different disciplines such as social sciences [28]-[31], languages [7], [32]-[34], sciences [35], [36] and mathematics [37], [38] have considered the application of plans and the meanings of Flipped Learning for these disciplines and analyzed its effects while carrying out a variety of significant studies. However, Flipped Learning related to PE reaches up to only 2.5% of all subjects [39]. The studies aiming at a applying Flipped Learning structure to PE classes have only recently started to emerge lately [40], [41], but the amount is still insufficient compared with other subjects. For this reason, this study will serve as a significant basic material in improving the understanding of Flipped Learning and designing and performing classes to effectively apply Flipped Learning to PE classes, through clarifying how PE classes based on Flipped Learning influence self-directed learning abilities, which are a key competency of the 21st century, and attitude towards PE classes related to avoidance and alienation in PE classes.

For the purpose of this study, the research questions have been selected as follows:

Firstly, will PE classes based on Flipped Learning improve self-directed learning abilities of middle school students compared to teacher-centered PE classes (desire for learning, establishment of learning objectives, basic self-management ability, choice of learning strategy, self-reflection)?

Secondly, will PE classes based on Flipped Learning change the attitudes towards PE classes of middle school students compared to teacher-centered PE classes (positive emotions, negative emotions, health and physical strength, interpersonal relations, physical activities and movement, active participation and positive performance)?

1.2 Comparison between a teacher-centered class and a flipped class

Regardless of country, physical education teachers aimed at teacher-centered classes. Observing classes carried out in the real teaching field, most classes are teacher-centered and function-centered [42]. According to [43], even though many teachers believe that classes should be "student-centered," their real classes are based on the teacher-centered method. In teacher-centered classes, teachers lead in most decision-making processes covering class content, management and participation of students. In other words, with clear learning objectives, teachers propose concepts of techniques and functions, and lead and adjust learning activities of students. It is assumed that students are not able to make many decisions and faithfully follow their teacher's instructions. For this reason, a teacher-centered class has strengths in the sense that it allows maximized effects with the minimum amount of time by structuring learning activities, and it can be helpfully applicable to large-scale groups. On the other hand, a teacher-centered class has weaknesses in the sense that the sole teacher teaches tens of students "the same" learning objectives and contents based on "the uniform" learning methods and speed, while students passively learn and interaction among students is limited [44].

Flipped learning is a very simple trial aiming at promoting learning of students supported by educational technology through changing conventional learning methods [27]. The essence of a flipped class consists in the fact that students study the learning subject at home with a video uploaded by their teacher, and carry out a student-led group study by asking questions to their teacher at school. A flipped class shows strengths in the sense that it contributes to realizing comprehensive learning, overcoming segmentation of knowledge, changing the teacher-student relationship, discovering alienated students and improving learning participation of students [27]. On the other hand, a flipped class is exposed to some weaknesses in the sense that it is difficult to prepare pre-class videos and it is challenging to have thorough design and execution sufficient to induce logical thinking of students during the class [44].

2. RESEARCH METHODS

2.1 Research participants

As for the research participants, 240 first-year students at J Middle School (8 classes) located in Jeonju City, South Korea were selected based on convenience sampling out of non-probability sampling, and this study selected 3 classes as an experimental group (93 students) and 3 classes as a control group (97 students). The reasons for which they were selected can be summarized as follows:

1) As for the research subjects, the first-year students were selected. Since they are not adapted to the physical education format of middle school, they can have fewer objections to a new teaching method when applying physical education classes based on a flipped learning in the beginning of the year.

2) The research subjects consisted of my own students taking my classes at school. The most important thing in pre-testing and post-testing was to control variables influencing dependent variables when dealing with independent variables. In this regard, I chose my own students to identically maintain teaching methods, class contents and program management method to each experiment group and control group.

3) The scale of research subject was selected in consideration of preceding studies. Since preceding studies, which carried out pre-testing and post-testing [5], [45] successfully conducted research by selecting 90 students of three classes for each experiment group and control group, it was estimated that this research would not face problems. Therefore, this study selected three classes for each experiment group and control group.

187 final research participants were selected, after excluding 3 students among experimental group, whose answers were not considered reliable and sincere in the questionnaires of self-directed learning abilities and attitude towards PE classes.

Table 1. General characteristics of research participants

Participant Class	First year students of middle school		
	Male	Female	Total
Class 1*	15	15	30
Class 2*	16	14	30
Class 3*	15	15	30
Class 4	17	14	31
Class 5	19	14	33
Class 6	19	14	33
Total	99	88	187

To verify the homogeneity between the experimental group and the control group participating in this research, the independent sample t-test was used based on preliminary scale values obtained from the questionnaires of attitude towards PE classes and self-directed learning abilities. As shown in Table 2 and Table 3, no statistically significant differences were shown between the two groups in terms of subfactors of self-directed learning abilities and attitude towards PE classes. Therefore, the two groups were considered homogeneous and the experiment was carried out ($p > .05$).

Table 2. Homogeneity test results according to pre-score results of self-directed learning abilities

Factors	Subfactors	Group		t	p
		Experimental group (n=90)	Control group (n=97)		
		M ± SD	M ± SD		
Self-directed learning abilities	Desire for learning	12.46 ± 2.73	12.14 ± 1.84	.939	.349
	Establishment of learning objectives	11.58 ± 3.18	11.21 ± 2.96	.823	.409
	Basic self-Management abilities	10.45 ± 2.14	9.92 ± 1.66	1.868	.064
	Learning strategy	11.98 ± 3.04	11.14 ± 2.87	.053	.053
	Self-reflection	14.56 ± 3.86	14.48 ± 3.44	.154	.878

Table 3. Homogeneity test result according to pre-assessment score of attitude towards physical education classes

Factors	Subfactors	Group		t	p
		Experimental group (n=90)	Control group (n=97)		
		M ± SD	M ± SD		
Attitude towards physical education classes	Positive emotions	10.74 ± 1.69	10.58 ± 1.99	.576	.565
	Negative emotions	7.00 ± 1.57	6.67 ± 1.46	1.479	.141
	Health and physical strength	14.34 ± 2.18	7.11 ± 1.22	-1.325	.187
	Physical activities and movement	7.11 ± 1.22	6.97 ± 1.30	.711	.478
	Interpersonal relations	10.46 ± 1.87	10.76 ± 1.69	-1.135	.258
	Active participation and positive performance	8.70 ± 1.87	8.29 ± 2.32	1.291	.195

2.2 Research model

This study aims to analyze the influences of PE classes based on Flipped Learning on self-directed learning abilities and attitude towards PE classes of students. For this purpose, a Facebook account was opened to facilitate pre-class videos. By making friends with 85 students among 90, excluding 5 students who are not Facebook users, this research was carried out. For those 5 students who are not Facebook users, the group connected them one on one to facilitate viewing through the Facebook accounts of other students in the same class. When the preliminary preparation ended, the pre-class video related to the class content was uploaded on Facebook, at least one week before the class. As a solution to the problem of applying Flipped Learning, Hong Ki-chil (2016) and Park Sang-jun (2015) asserted that teachers should use class videos made by other teachers, such as EBS (Educational Broadcasting System) or Cyber home study videos of Edunet, instead of making individual videos. According to them, for Flipped Learning, teachers are supposed to make 2-3 videos per week, but they must simultaneously handle many other tasks such as student guidance and administrative work. It is inevitable that they will have a hard time making videos and this can negatively influence the application of Flipped Learning. Therefore, for pre-study video materials, this study used and edited videos uploaded to Youtube (www.youtube.com). For instance, there are more than 1,000 videos about badminton skill uploaded on Youtube, but the video directly filmed by Ha Tae-kwon, the badminton gold medalist in the men's doubles from the Athens

Olympic Games of 2004, was considered most suitable to arouse the interest of students in terms of class content and explanation level. For this reason, among 8 total pre-class videos, 7 videos featuring the player Ha Tae-kwon were chosen. The videos were edited to the length of 3-5 minutes for the purpose of the class.

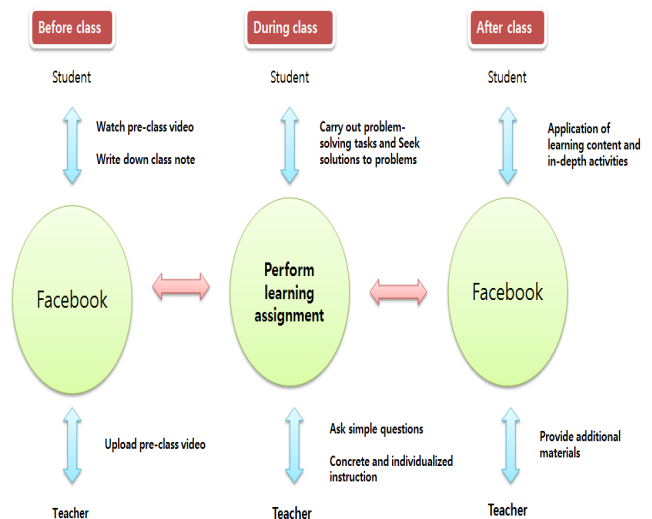


Fig. 1. Research model of PE classes based on Flipped Learning

Students were encouraged to watch the pre-class video before each class, through their Smartphones or computers and write down the key content and some questions to ask in class. For checking their attendance online, each student was instructed to write his or her personal school ID number in the comment section of the pre-class video. In the role of researcher, I started the class by asking questions if they had watched the pre-class video and asking some simple questions related to the video content. For those who did not watch the video at home, they were invited to watch it on the computer of the gymnasium (PE Room). Students were given enough time to solve the problem assigned to each group, and I observed the whole class while giving some individual feedback to students who required more understanding as well as the alienated students in the group. Through the cooperative learning by group, students exercised the functions and inquired into

solutions to the assigned problems. After the class, I uploaded videos of real matches on Facebook, showing the skills taught in class to encourage students to try in-depth activities.

2.3 Selection and organization of learning content

Immediately after the new semester of 2017 started, the learning content was selected through a Curriculum Meeting, and based on the result, the learning content was structured after the process of modification and supplement in the meeting composed of 1 professor who specialized in Sports Education and 2 Ph.D. holders in the field. To be specific, it selected football, badminton and Step Box and composed 12 sessions each with 36 sessions in total. Table 4 shows class content, session number and number of pre-class videos by each event of sport.

Table 4. Class content, session number and number of pre-class videos (number of in-depth activity video) in the control group and the experimental group

Function Division	Control group (Main class content)	Experimental group (Class content of main problem-solving)	Session	Pre-class video	
Football	Kick (Inside, in front, Instep)	Exercise of Kick by one group of 2	Hitting rubber cones put at a distance of 5m, 10m, 15m and 20m	1,2,3	2(1)
	Dribble (Inside, in front, Instep)	One-person Zigzag dribble exercise	By using inside pass, making a goal through efficiently breaking through the fixed defender	4,5,6	3(1)
	Shoot (Inside, in front, Instep)	After one-person dribble, shoot exercise	After dribble and shoot exercise, designing 4 strategies connected to shoot after dribble	7,8,9	2(1)
	Simple game	Full league game by 5 groups	Full league game by 5 groups & Inventing 3 attack strategies and defense strategies respectively	10,11,12	1
Badminton	Grip method & Serve & Underswing	Exercise of short serve and underswing by one group of 2	After short serve and underswing exercise, designing 4 return methods connected to short serve and underswing	1,2,3	2(1)
	Basic high clear & Jump high clear	Exercise high clear by one group of 2	Exercising high clear at the half court by one group of 4	4,5,6,7	3(1)
	Push, drive	Exercising push and drive by one group of 2	Each 2 players use underswing and high clear and invent 4 exercise methods of push and drive	8,9	2(1)
	Step & learned skills	Step exercise and exercising step and the learned skills	Step exercise by one group of 4 and designing 5 attack strategy scenarios using step	10,11,12	2(1)
Step Box	Creative activity - With chosen music, composing Step for 4-5 minutes to the rhythm of music (The unique difference between Step Box class and pre-class video consists in the act of viewing the video beforehand)		1~12	5(2)	

2.4 Research process

To verify the effects of physical education classes based on Flipped Learning, this study carried out classes of 36 sessions for 14 weeks, from March 14th of 2017 to June 21st of 2017, by selecting 3 events of football (12 sessions), badminton (12 sessions) and Step Box (12 sessions). To verify the results, the preliminary questionnaire survey was conducted for 2 days, from March 6th to 8th of 2017, after explaining PE classes and research. After Flipped Learning application ended, post-testing was carried out for 2 days, from June 22nd to 23rd of 2017. PE classes based on Flipped Learning were carried out for the 3 classes selected as an experimental group, while

teacher-centered conventional PE classes were given to the 3 classes selected as a control group. The difference between PE classes based on Flipped learning and PE classes in the control group can be largely found in the fact of having/not having watched the pre-class video, having/not having classes focused on problem-solving, the scale of group when exercising tasks and the main actions of teachers when exercising tasks. To minimize the variables influencing self-directed learning abilities and attitude towards PE classes, the class content was equally taught to both groups: the experimental group and the control group. As for pre-class videos, 8 football videos, 9 badminton videos and 5 Step Box videos had been uploaded. The pre-class videos of football and badminton were all

downloaded from Youtube and edited. On the other hand, for the classes of Step Box, the video of 3 applied movements had been downloaded, edited and uploaded, besides one basic step video and one full video for improving the understanding of students.

Table 5. Differences of class between the experimental group and the control group

Division Group	Watching Video	Task performance	Size of group	Main action of the teacher during task exercise
Experimental group	YES	Focused on exercise of function and problem solving	Group of 4-6	Encouragement for problem solving and individual feedback
Control group	NO	Focused on functional exercise	Group of 2	Control and indication for smooth class progress



Pre-class video of football

Class note

Fig. 2. Pre-class videos and class note materials

Table 6. Sample of questions of Self-directed learning abilities

Subfactors	sample of questions	Number of questions
Desire for learning	I finish, what I want to study, to the end even if I sleep late.	4
Establishment of learning objectives	When I study, I make my own plans first.	4
Basic self-management abilities	I prepare school items of the next day by myself the day before.	3
Learning strategy	I keep thinking about what is important when studying.	4
Self-reflection	I compare scores or results to the level of goals I wanted	5

2.5.2 Attitude towards physical education classes

To measure attitude towards physical education classes of students, and for the purpose of this research. through confirmatory factor analysis, this study modified and complemented the questionnaire of attitude towards physical education classes of [45], which modified and complemented the questionnaire developed based on the multi-dimensional theory of [48]. The questionnaire of attitude towards PE classes was composed of 18 questions of 6 factors in total covering 3 questions of positive emotions, 3 questions of negative

2.5 Research tools

2.5.1 Self-directed learning abilities

To measure self-directed learning abilities of students, and for the purpose of this research, through confirmatory factor analysis, this study modified and complemented the questionnaire of self-directed learning abilities of [45], which modified and complemented the questionnaire created based on the preceding studies conducted by [47]. The questionnaire was composed of 20 questions of 5 factors in total covering 4 questions of desire for learning, 4 questions of learning objective establishment, 3 questions of self-management ability, 4 questions of selection of learning strategies and 5 questions of self-reflection.

Desire for learning is an ability related to self-efficacy regarding self-directed desire for learning and learning abilities as well as will for learning. Learning objective establishment is an ability of setting up proper goals and making plans to achieve the goals with autonomy. Basic self-management ability is an ability of preparing for materials needed for learning and managing oneself for learning. Selection of learning strategies is an ability of selecting study method for learning and applying the class hours in an efficient manner. Self-reflection is an ability of evaluating oneself and modifying their behavior and learning method through this.

Each question of questionnaire was measured based on the five-level Likert scale, applying 1 point for "Strongly disagree". 2 points for "Disagree", 3 points for "Neither agree nor disagree", 4 points for "Agree" and 5 points for "Strongly agree." The higher point students have, the higher self-directed learning abilities they have.

emotions, 4 questions of health and physical strength, 3 questions of interpersonal relation, 2 questions of physical activities and 3 questions of active participation and positive performance.

Positive emotions refer to the emotional aspects like good feelings or emotions experienced through execution of PE or psychological advantages differentiated from physical advantages. Negative emotions refer to the emotional aspects like bad feelings or emotions experienced through execution of PE. Health and physical strength mean positive image aspects of changes of health and physical strength through execution of

PE. Physical activities and movement mean experience aspects of physical activities and movement experienced through execution of PE. Interpersonal relations refers to the aspect of participation in PE classes with active or smooth attitudes along with their friends. Active participation and positive performance mean the active field of students participating in physical activities apart from PE classes. Each question of

questionnaire was measured based on the five-level Likert scale, applying 1 point for "Strongly disagree". 2 points for "Disagree", 3 points for "Neither agree nor disagree", 4 points for "Agree" and 5 points for "Strongly agree." The higher point the students have, the higher attitude toward PE classes the students have, in 5 factors except negative emotions.

Table 7. sample of questions of Attitude towards physical education classes

Subfactors	sample	Number of questions
Positive emotions	Physical education class gives me an exciting experience	3
Negative emotions	When physical education class draws near, I become uneasy.	3
Health and physical strength	Physical education maintains and promotes health.	4
Physical activities and movement	Physical education class creates opportunities for various exercises.	3
Interpersonal relations	I am cooperative when I form a team and exercise	2
Active participation and positive performance	I do activities rather than sitting down in my free time.	3

2.6 Validity and reliability

Exploratory factor analysis was used for verifying validity of the questionnaire regarding self-directed learning abilities and attitude towards PE classes. The Eigen value of factors was set more than 1.0 and the factor loadings of each item was set more than 0.5. To simplify factor structure, it used Varimax rotation among orthogonal rotation methods. Furthermore, to confirm if the normal distribution and the questionnaire of the group are appropriate data for factor analysis, this study inquired into unitary matrix test of Bartlett and KMO by factor. As for reliability test, Cronbach's α test, the internal consistency reliability was carried out, focused on the questions by concept which were confirmed in factor analysis.

2.6.1 Self-directed learning abilities

The explained variation of the whole dispersion regarding 5 subfactors of self-directed learning abilities was 69.465% and KMO turned out to be .917 ($\chi^2=2021.176, p<.000$). As for factor loading by subfactor, it turned out that each subfactor was valid, by showing learning objective establishment with .821-.751, self-reflection with .811-.573, selection of learning strategies with .738-.699, desire for learning with .791-.550 and basic self-management abilities with .819-.791.

As for reliability test of internal consistency, it turned out that self-reflection was Cronbach's $\alpha=.870$, selection of learning strategies was Cronbach's $\alpha=.838$, desire for learning was Cronbach's $\alpha=.792$, learning objective establishment was Cronbach's $\alpha=.900$ and basic self-management abilities was Cronbach's $\alpha=.770$.

2.6.2 Attitude towards physical education classes

The explained variation of the whole dispersion regarding 6 subfactors of attitude towards physical education classes was 76.244 % and KMO turned out to be .823 ($\chi^2 =1652.395, p<.000$). As for factor loading by subfactor, it turned out that each subfactor was valid, by showing health and physical strength with .850-.724, active participation and positive performance with .861-.818, negative emotions with .847-.804,

interpersonal relations with .875-.750 and physical activities and movement with .889-.859.

As for reliability test of internal consistency, it turned out that "health & physical strength" was Cronbach's $\alpha=.842$, "active participation & positive performance" was Cronbach's $\alpha=.843$, "negative emotions" was Cronbach's $\alpha=.787$, "interpersonal relations" was Cronbach's $\alpha=.851$ and "physical activities & movement" was Cronbach's $\alpha=.741$.

2.7 Data processing

After coding the collected data into the computer, the data was processed based on SPSS 20.0K for Windows according to the analysis purpose.

Firstly, as for analysis of validity and reliability of the questionnaire questions, this study used exploratory factor analysis according to the Varimax rotation method and Cronbach's α measuring internal consistency of questions.

Secondly, for homogeneity test regarding preliminary score of self-directed learning abilities and attitude towards PE classes between the experimental group and the control group, the independent sample t-test was used.

Thirdly, to verify the differences between pre-test and post-test regarding self-directed learning abilities and attitude towards PE classes between the experimental group and the control group, this study carried out paired sample t-test. To verify the differences of results between pre-test and post-test regarding self-directed learning abilities and attitude towards PE classes between the two groups, this study carried out independent sample t-test. Statistical significant level was set up to $\alpha<.05$.

3. RESULTS

3.1 Physical education classes and self-directed learning abilities based on Flipped Learning

3.1.1 Changes of self-directed learning abilities of the groups observed before and after the participation in PE classes based on Flipped Learning

To compare the changes of self-directed learning abilities observed before and after the participation in PE classes based on Flipped Learning, t-test was carried out. As shown in Table 8, the results show that the experimental group showed significant differences in all subfactors except basic self-management abilities among subfactors of self-directed learning abilities. The control group turned out to have no significant differences in all subfactors of self-directed learning

abilities. To be specific, the experimental group which participated in PE classes based on Flipped Learning demonstrated significant differences in subfactors of self-directed learning abilities such as desire for learning ($t=-3.098$, $p<.01$), learning objective establishment ($t=-3.428$, $p<.01$), selection of learning strategies ($t=-2.151$, $p<.05$) and self-reflection ($t=-4.910$, $p<.001$)

Table 8. Results of pre and post t-test of self-directed learning abilities in the two groups

Factor	Subfactors	Group	Pre-test M±SD	Post-test M±SD	t	p
Self-directed learning abilities	Desire for learning	Experimental group	12.46 ± 2.73	13.73 ± 2.72	-3.098	.002
		Control group	11.68 ± 2.36	12.25 ± 2.34	-1.677	.95
	Learning objective establishment	Experimental group	11.58 ± 3.18	13.38 ± 3.79	-3.428	.001
		Control group	11.21 ± 2.96	11.02 ± 3.10	.448	.655
	Basic self-management abilities	Experimental group	8.83 ± 1.51	8.53 ± 1.31	1.386	.168
		Control group	10.36 ± 1.88	9.48 ± 2.10	3.029	.003
	Selection of learning strategies	Experimental group	11.98 ± 3.04	12.89 ± 2.58	-2.151	.033
		Control group	11.14 ± 2.87	10.91 ± 2.90	.858	.584
Self-reflection	Experimental group	14.56 ± 3.86	17.40 ± 3.87	-4.910	.000	
	Control group	14.48 ± 3.44	14.93 ± 3.49	-.907	.365	

According to the results, the experimental group which participated in PE classes based on Flipped Learning showed improvement in most of subfactors of self-directed learning abilities as compared with absence of the experiment. However, the control group showed significant negative differences in basic self-management abilities, which is the subfactor of self-directed learning abilities.

3.1.2 Changes of self-directed learning abilities of the groups observed after the participation in PE classes based on Flipped Learning

To compare the changes of self-directed learning abilities observed after the participation in PE classes based on Flipped

Learning, t-test was carried out. As shown in <Table 9>, the results show that there were statistically significant differences in all subfactors. As for self-directed learning abilities by subfactor, there were significant differences in terms of desire for learning ($t=3.964$, $p<.001$), learning objective establishment ($t=4.604$, $p<.001$), basic self-management abilities ($t=3.780$, $p<.001$), selection of learning strategies ($t=4.992$, $p<.001$) and self-reflection ($t=4.465$, $p<.001$). According to the results, the experimental group which participated in PE classes based on Flipped Learning showed improvement in all subfactors of self-directed learning abilities as compared with the control group.

Table 9. Results of pre and post t-test of self-directed learning abilities between the two groups

Factor	Subfactor	Group	M ± SD	t	p
Self-directed learning abilities	Desire for learning	Experimental group	13.72 ± 2.71	3.964	.000
		Control group	12.25 ± 2.33		
	Learning objective establishment	Experimental group	13.33 ± 3.79	4.604	.000
		Control group	11.01 ± 3.08		
	Basic self-management abilities	Experimental group	10.93 ± 2.33	3.780	.000
		Control group	9.79 ± 1.71		
	Selection of learning strategies	Experimental group	12.91 ± 2.57	4.992	.000
		Control group	10.90 ± 2.88		
Self-reflection	Experimental group	17.32 ± 3.92	4.465	.000	
	Control group	14.89 ± 3.49			

3.2 Physical education classes and attitude towards physical education classes based on Flipped Learning

3.2.1 Changes of attitude towards PE classes before and after the test in the experimental group and the control group

To confirm the changes of attitude towards PE classes of students observed after the participation in PE classes based on Flipped Learning, t-test was carried out. As shown in Table 10, the experimental group, which participated in PE classes based on Flipped Learning showed statistically significant differences in all subfactors of attitude toward PE classes. On the other hand, the control group showed significant differences in the subfactors of attitude towards PE classes such as positive

emotions, physical activities & movement and active participation & positive performance. To be specific, the experimental group showed statistically significant differences in the subfactors of attitude towards PE classes such as positive emotions ($t=-6.26, p<.001$), negative emotions ($t=10.72, p<.001$), health & physical strength ($t=-6.99, p<.001$), physical activities & movement ($t=-5.72, p<.001$), interpersonal relations ($t=-8.47, p<.001$), active participation & positive performance ($t=-5.69, p<.001$). The control group also showed statistically significant differences in physical activities & movement ($t=-2.711, p<.01$) and active participation & positive performance ($t=-4.516, p<.001$). However, positive emotions $t=4.417, p<.001$ showed significant negative differences, while the score of negative emotions ($t=-7.188, p<.001$) rose.

Table 10. Results of pre and post t-test of self-elasticity in the two groups

Factor	Subfactors	Group	Pre-test M ± SD	Post-test M ± SD	t	p
Attitude towards physical education classes	Positive emotions	Experimental group	10.74 ± 1.69	12.52 ± 2.08	-6.26	.000
		Control group	10.58 ± 1.99	9.54 ± 1.18	4.417	.000
	Negative emotions	Experimental group	7.00 ± 1.57	4.73 ± 1.57	10.72	.000
		Control group	6.67 ± 1.46	8.06 ± 1.21	-7.188	.000
	Health and physical strength	Experimental group	14.34 ± 2.18	16.96 ± 2.81	-6.99	.000
		Control group	14.76 ± 2.13	15.03 ± 2.00	-.902	.368
	Physical activities and movements	Experimental group	7.11 ± 1.22	8.33 ± 1.61	-5.72	.000
		Control group	6.97 ± 1.30	7.41 ± 0.87	-2.711	.007
	Interpersonal relations	Experimental group	10.46 ± 1.87	13.00 ± 2.13	-8.47	.000
		Control group	10.76 ± 1.69	10.81 ± 1.52	-.222	.824
	Active participation and positive performance	Experimental group	8.70 ± 1.87	10.66 ± 2.68	-5.69	.000
		Control group	8.29 ± 2.32	9.54 ± 1.40	-4.516	.000

3.2.2 Changes of attitude towards PE classes before and after the test between the experimental group and the control group

To confirm the changes of attitude towards PE classes of students observed after the participation in PE classes based on Flipped Learning between the two groups, t-test was carried out. As shown in Table 11, there were statistically significant differences in all subfactors of attitude toward PE classes between the two groups. The experimental group, which participated in PE classes based on Flipped Learning, showed

higher attitude towards PE classes than the control group. Observing subfactors of attitude towards PE classes, there were statistically significant differences in positive emotions ($t=5.027, p<.001$), negative emotions ($t=-7.783, p<.001$), health & physical strength ($t=5.492, p<.001$), physical activities & movement ($t=5.136, p<.001$), interpersonal relations ($t=6.027, p<.001$) and active participation & positive performance ($t=3.076, p<.001$). According to the results, the experimental group which participated in PE classes based on Flipped Learning showed improvement in all subfactors of attitude towards PE classes as compared with the control group.

Table 11. Result of post test of t-test of attitude towards physical education classes between the two groups

Factor	Subfactors	Group	M ± SD	t	p
Attitude towards physical education classes	Positive emotions	Experimental group	12.52 ± 2.08	5.027	.000
		Control group	11.14 ± 1.60		
	Negative emotions	Experimental group	4.80 ± 1.44	-7.783	.000
		Control group	6.43 ± 1.42		
	Health and physical strength	Experimental group	16.96 ± 2.81	5.492	.000
		Control group	14.96 ± 2.07		
	Physical activities and movements	Experimental group	8.33 ± 1.61	5.136	.000
		Control group	7.31 ± .98		
	Interpersonal relations	Experimental group	13.01 ± 2.11	6.027	.000
		Control group	11.38 ± 1.50		
	Active participation and positive performance	Experimental group	10.60 ± 2.67	3.076	.002
		Control group	9.55 ± 1.85		

4. DISCUSSIONS

4.1 PE classes based on Flipped Learning and self-directed learning abilities

The experimental group, which participated in PE classes based on Flipped Learning, showed significant differences in all subfactors of self-directed learning abilities except self-management abilities in the pre-testing and post-testing. Furthermore, it turned out that, as compared with the control group, the experimental group demonstrated significant changes in all subfactors of self-directed learning abilities, such as desire for learning, learning objective establishment, basic self-management abilities, selection of learning strategy and self-reflection. According to these results, it is believed that PE classes based on Flipped Learning promoted the improvement of self-directed learning abilities of middle school students. The reasons for which PE classes based on Flipped Learning gave positive influences on improvement of self-directed learning abilities of students can be explained as follows:

Firstly, learning motivation is closely related to self-directed learning. The approach to Flipped Learning promotes learning motivation of students [8] and each student is motivated to learn at his/her own pace [38], [49]. According to [50]-[52], internal motivations are deeply connected to self-directed learning. Other studies [53]-[55] propose that not only internal motivations but also external motivations are important factors for self-directed learning. In particular, both internal learning motivations and external motivations have the strongest correlation with "planning," the subfactor of self-directed learning abilities [56]. The correlation between learning motivations and Flipped Learning can be explained on the basis of Self-Determination Theory [57]. According to Self-Determination Theory, individual motivations and performance become maximized when the person is provided with social contexts satisfying a desire for abilities, a desire for relations and a desire for autonomy [58]. It is appropriate to say that learning motivations increase, in the sense that the desire for abilities is satisfied when the achievement frequency rises [36], [59], [60] and the desire for relations is satisfied when students perform tasks for problem solving in cooperative group activities [61], while the desire for autonomy is satisfied when students secure psychological freedom and initiative for learning through learning processes of autonomous planning and control [5], [38], [49]. Consequently, it is estimated that PE classes applying Flipped Learning contributed to improving self-directed learning abilities by increasing the learning motivation of students.

Secondly, self-efficacy is closely related to self-directed learning abilities. Students with high academic self-efficacy show strong self-directed learning abilities because they use self-directed learning strategies such as learning strategy, motivation strategy and cognitive strategy [62], [63]. Flipped Learning increases self-efficacy of independent learning [64] and self-cognition awareness [59]. This is because PE classes based on Flipped Learning raises the learning achievement experience of students. In the studies of other subjects applying Flipped Learning [36], [59], [60], the effects of high achievement of students in terms of student learning were also reported. The factors of PE classes based on Flipped Learning

influencing learning achievement experience of students can be summarized in three aspects as follows:

The first is the provision of pre-class videos. It is very probable that the demonstration of teachers in conventional PE classes displays nothing but segmental, uniform and fragmentary functions. On the other hand, pre-class videos provide students with examples of exercise methods of diverse skills, detailed functional explanation and exercise of functions in a relatively open environment. The success probability in task performance during the class increases in the experimental group since students confirm clear preliminary knowledge about the task by watching the pre-class videos. This success can be explained by the study of [65], in that, if the identical learning content that connects language information and visual information is presented, a referential link is formed between the two channels of information, and mental images linking two different forms of information are consequently established, raising the reproducibility and promoting learning.

The second aspect is structured class methods. Students easily understand PE classes based on Flipped learning, but the tasks assigned to students and teachers before/during/after the class are structured. By leading students to clearly understand what actions are needed to achieve the results [66], structured classes help students establish goals to achieve and set up strategies to achieve such goals. The studies carried out by [67] also report that the class environment based on Flipped learning contributes to improving the achievement experience of students by providing them with comfort, encouraging their clear understanding and increasing task participation time. Consequently, it is thought that the provision of pre-class videos and structured environment contributes to raising achievement experience, improving self-efficacy and increasing self-directed learning abilities.

The third aspect is that reflective thinking is closely related to self-directed learning abilities. Flipped learning promotes reflective thinking [68] and reflective thinking facilitates systematic preparation [69]. In other words, reflective thinking is closely and literally related to self-reflection, a subfactor of self-directed learning abilities, and makes it possible to establish learning objectives and promote the search for strategies to accomplish given objectives. The factors of PE classes based on Flipped Learning influence the reflective learning of students in two ways:

First is the presence of individualized feedback. The frame of Flipped Learning boosts reflective learning of students by increasing teacher-student feedback and providing individualized feedback [70]. The reasons for these results can be found in the structured characteristics of Flipped Learning. PE classes based on Flipped Learning make it possible to reduce the time for explanation and demonstration as compared with the conventional classes. Instead, it allows more time not only for functional exercises given through cooperative learning but also for task participation required for problem solving. The changes in time distribution contribute to enlarging the opportunity of not only exchanging feedback among students but also the teacher's providing individualized feedback to students. With increased feedback, students consider their teacher and peers as facilitators of problem solving in learning [71], and this helps them cope with rejection

of PE classes and strengthen reflective learning with the ability to find errors in physical performance and improve correction functions accompanied by a comfortable state of mind.

Second is the provision of in-depth videos. In-depth videos are provided to give students motivation for the following classes and to polish or refine the learned functions, by showing how the functions learned in the class can be applied to real situations. In-depth videos promote self-reflection after the elaboration process, the thinking strategy of deepening and expanding the meaning and range of the information [72]. The studies of [67] reveal that more than 50% of students participating in Flipped Classroom reconfirm the parts which are hard to understand by watching pre-class videos and in-depth videos more than once while preparing the classes. In sum, it is judged that the provision of individualized feedback and in-depth videos contributes to promoting reflective thinking of students and this reflective thinking leads students to increase their self-directed learning ability.

4.2 PE classes and attitude toward PE classes based on Flipped Learning

The experimental group, which participated in PE classes based on Flipped Learning, showed significant differences in all subfactors of attitude towards PE classes in the pre-test and post-test. As compared with the control group, the experimental group showed significant changes in all subfactors of attitude towards PE classes, such as positive emotions, negative emotions, health & physical strength, physical activities & movement, interpersonal relations, and active participation & positive performance. Observing these results, it is thought that PE classes based on Flipped Learning promoted the improvement of attitude towards PE classes in middle school. The reasons for which PE classes based on Flipped Learning influences attitude towards PE classes of students can be found as follows:

Firstly, the structure of Flipped Learning provides enlarged opportunities of learning for students. [7] points out that students participating in a Flipped Classroom actively take part in the learning environment and learning process, while teacher-centered classes focus on the acquisition of functions. For this reason, students lack time to display their performances and abilities and they are consequently separated from learning environment. Two causes of student alienation in PE classes are a lack of self-confidence caused by weak task achievement in PE classes, and limitation of participation due to the class development centered on students with excellent physical functions [10], [73], [74]. This unavoidably transforms many students into "marginal people" and leads to the "cornerization of physical activities" [75] in PE classes. In other words, since teacher-centered PE classes do not give students enough learning opportunities, this alienation phenomenon occurs. However, PE classes based on Flipped Learning provide students with opportunities of active learning. This is because PE classes based on Flipped Learning help increase task participation time. The structure of Flipped Learning makes it possible to watch class-related videos prior to classes and inquire into learning materials in a free way. This structure helps reduce part of the teacher's demonstration and explanation during the class, and increases the task

participation time of students allowing their function exercise and problem solving [5], [60], [76]. According to [77], the achievement level of learners varies depending on the amount of time required for achieving learning tasks and the amount of time input for accomplishing learning tasks [78]. Therefore, it is estimated that the rise in learning opportunities of students in PE classes based on Flipped Learning is connected to the increase of learning achievement, leading students to actively participate in PE instead of being alienated during the class.

Secondly, PE classes based on Flipped Learning promote student-student and student-teacher interactions. According to [7], 64% of students who participated in classes based on Flipped Learning, showed an increase of interaction with their peers and teacher. The harmony and encouragement among peers and positive feedback of their teacher are important factors influencing the achievement of physical activities in PE classes of middle school [79]. Students are able to accomplish more when they learn with their peers, and through this process, their sociality improves and more enjoyable participation in PE classes is encouraged [80]. PE classes applying Flipped Learning induce students to spontaneously participate in tasks with their peers through cooperative learning while the teacher plays a role as a facilitator, creating bilateral communications, not unilateral communications, offering freedom to students during the class and leading to active participation and positive performance. The argument of this study is supported not only by the study of [31], in that students react positively to Flipped Learning because the teacher guides students to cooperate with peers to solve a problem, but also by the studies of [38], in that students are content with the teacher's help while they are solving the problems in Flipped Learning. Therefore, it is judged that PE classes based on Flipped Learning contribute to not only reducing students' sense of rejection of PE by promoting student-student and student-teacher interaction, but also increasing active participation of students in PE by producing positive emotions.

Thirdly, the authority and autonomous responsibility of students increase their learning motivation and participation. The structure of Flipped Learning is a student-centered class development method [27]. In general, the teaching method applied by PE teachers influences learning motivations and class participation of students. In particular, when students have a higher perception that the class is carried out with a focus on students, they show greater positive changes in learning motivations and participation [81]-[83]. PE classes based on Flipped Learning put emphasis on authority and autonomous responsibility of students. For PE classes based on Flipped Learning, students should watch the pre-class videos before classes and confirm learning objectives and class content. Then They must develop the learned content after confirming the in-depth videos. In particular, students should manage most of the time during the class. This is because in PE classes based on Flipped Learning, students spend more time in exercising functions through cooperative learning and solving the given problems through reducing the explanation and demonstration of their teacher. In the enlarged task activity time, students carry out tasks by applying the content learned from the pre-class videos while exchanging immediate feedback and cooperating with one another. It is thought that

this experience increases learning motivation and participation of students. This coincides with the research results in that problem-solving through discussion, the main learner-centered teaching method, contributes to improving situational interests as compared with an individual problem-solving, and the situational interests influence individual interests and active class participation [84]. In other words, the authority and autonomous responsibility of students in PE classes based on Flipped Learning are thought to increase learning motivation and participation of students.

5. CONCLUSIONS AND SUGGESTIONS

Inquiries of new class methods for improving PE classes have been constantly carried out. In other words, many efforts have been made to effectively accomplish learning objectives and induce class participation of students by searching for diverse class methods such as teaching styles by [85] and physical education model by [86]. However, we are living in an incessantly changing world. Physical education lags behind, and is not helpful for fostering proper competencies of students required by the times. As a result, students avoid PE classes and underestimate the importance of PE. Therefore, with the belief that educational innovation to solve these problems can be brought about, this study applied Flipped Learning, which is in the limelight, to PE classes and inquired into the influences of Flipped Learning on self-directed learning abilities, which is a key competency of the 21st century, and attitude towards PE classes related to avoidance and alienation of PE classes. For the purpose of this study, as for research participants, this study selected 90 students of experimental group (3 classes) and 97 students of control group (3 classes), while practicing convenience sampling out of non-probability sampling, among 240 students of the first-year middle school students (8 classes) of a school located at Jeonju City of C Province. For the experimental group, 36 sessions of physical classes were given for 14 weeks, while the control group was given conventional teacher-focused classes. As a result, as compared with the control group, the experimental group showed significant differences in terms of all subfactors of self-directed learning abilities, namely, desire for learning, learning objective establishment, basic self-management abilities, selection of learning strategy and self-reflection. Moreover, the experimental group manifested significant differences in terms of all subfactors of attitude towards physical education subject, namely, positive emotions, negative emotions, health & physical strength, interpersonal relations, physical activities & movements, and active participation & positive performance. On the basis of these results, the 3 reasons for applying Flipped Learning to PE classes can be explained as follows:

Firstly, PE classes based on Flipped Learning are able to increase self-directed learning abilities. Self-directed learning abilities can be considered one of the abilities required for the 21st century. As the results of this study show, it was not possible to find significant changes in all subfactors of self-directed learning abilities in teacher-centered conventional PE classes. In addition to that, conventional PE classes rarely conduct research to change self-directed learning abilities of

students by applying new class methods, such as the teaching styles of [85] or the physical education model of [86]. Contrariwise, PE classes based on Flipped Learning to PE classes showed significant differences in all subfactors of self-directed learning abilities except basic self-management abilities. To be specific, PE classes applying Flipped learning contributed to raising learning motivations of students by satisfying the desire for abilities, the desire for relations and the desire for autonomy, improving their self-efficacy by increasing achievement experience through pre-class videos and structured class methods, and promoting their reflective thinking by providing them with individualized feedback and in-depth videos. The improvement of learning motivations and self-efficacy and the promotion of reflective thinking strengthened self-directed learning abilities of students. Therefore, to foster the self-directed learning abilities evaluated as a key competency of the 21st century, it will be indispensable to apply Flipped Learning to physical education.

Secondly, PE classes based on Flipped Learning can contribute to decreasing avoidance and alienation of classes. Though some studies showed that many students actively participate in PE classes with enthusiasm and they prefer PE subject to other subjects [87], [88], most of the students regarded physical education as a subject for a simple play and a stress reliever [89], [90]. In other words, even students who actively participate in PE classes comment that they do so not with educational purposes but with ludic purposes. Considering that plenty of studies cover the problems of alienation and avoidance in PE classes, this issue is thought to be an urgent problem to solve immediately. However, students who had participated in PE classes based on Flipped Learning showed changed attitudes toward PE classes, in terms of opportunity of sufficient learning, augmentation of student-student and student-teacher interactions, and authority and autonomous responsibility of students. Furthermore, negative emotions with PE classes decreased, while positive emotions increased. They experienced active interactions and physical activities during PE classes. Since this experience is thought to be the problem-solver to alienation and avoidance in PE classes helping students realize the value of PE, it is essential that PE classes should be actively carried out on student-centered principles.

Thirdly, PE classes based on Flipped Learning are able to contribute to increasing the use of ICT (Information & Communication Technology). Not only the United States and Canada as advanced countries of informatization, but also the U.K. and Sweden strengthen active administrative and financial support and research efforts aiming at vitalizing ICT-based education at the state level [91]. In South Korea, to reinforce ICT education in the 7th Curriculum, the government proclaimed "Operation Guideline for Information & Communication Technology designed for Elementary/Middle/High schools" in December of 2000, and specified the execution of ICT-based education in the teaching-learning process of National Common Basic Subjects. Nonetheless, the teachers in the real educational field go through a great deal of confusion and difficulty over not knowing how to integrate and apply ICT to the teaching-learning process [92]. In particular, the PE subject neglected ICT application because it lacks ICT-based materials, most

classes are given outdoors, and repetitive functional practices can seem to produce effective PE classes. It is assumed that other countries go through the same situation as in South Korea. However, students, who participate in PE classes based on Flipped Learning not only review the pre-class videos and in-depth videos before each class, but also carry out supplementary learning by searching for other videos related to the task when they could not understand the content to meet the deficiency. Personally, as a researcher, I myself came to realize that there are countless video materials that can be applicable to PE classes while applying Flipped Learning. Those who are interested in dance, songs and sports show special interest in the videos uploaded on the Internet. They learn the skill by comparing differences through large numbers of videos. I felt sorry for not having taken advantage of such infinite learning materials so far. For this reason, in PE classes based on Flipped Learning, it is crucial to provide students with the opportunity of searching for diverse materials to solve problems through active utilization of ICT, and applying those materials to their learning.

Based on the discussion and conclusions, the suggestions for the follow-up studies can be summarized as follows:

Firstly, qualitative studies relevant to PE classes based on Flipped Learning are required. Through pre-test and post-testing, this study verified that PE classes based on Flipped Learning gave a positive influence on both self-directed learning abilities and attitude towards PE classes of middle school. In conjunction with this, if detailed observations can be made regarding which experience in particular influenced self-directed learning abilities and attitude towards PE classes, the practical and theoretical base of PE classes based on Flipped Learning will become even more solid.

Secondly, it is necessary to improve awareness of flipped classes and to develop materials to be used for flipped classes. The researcher faced several problems in carrying out this study. In particular, there were students and colleague teachers' rejection of flipped classes, and a lack of data problem solving tasks. First, students were accustomed to teacher-centered physical education class, so there was a feeling of opposition to flipped learning centered on student activities. Also, physical education teachers who were teaching the same grades have repeatedly criticized the researcher for using a different type of teaching, method, which discouraged this researcher from doing research. Therefore, a study aimed at improving students and teachers' awareness of flipped class is needed. Second, considering the study on flipped classes, the biggest constraint is to develop learning materials such as groundwork video clips and to organize various learning tasks oriented to problem-solving. This researcher also experienced this difficulty. Therefore, in order to encourage the practical application of flipped class to physical education classes, various groundwork video clips and problem-solving tasks should be developed.

Thirdly, it will be required to carry out direct studies regarding class alienation and avoidance of students in physical education classes based on flipped learning. This study supposed that PE classes based on a flipped learning would reduce alienation and avoidance of students in PE classes, and applied a questionnaire survey on attitude towards PE classes to see the results. Even though it is possible to consider that there

is a correlation among attitude towards PE classes, alienation and avoidance of students in PE classes, it is not possible to affirm that physical education classes based on a flipped learning can directly reduce class alienation and avoidance of students. Considering this, this study hopes that follow-up studies will be able to inquire into the influences of physical education classes based on a flipped learning on student alienation and avoidance in physical education classes, which is considered the greatest problem in PE classes.

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