대한물리치료과학회지

The effects of the online team project-based learning on problem solving ability, cooperative self efficacy and cooperative self regulation in students of department of physical therapy

Jung Hee Kim, Ph.D., P.T. · Woo Hyung Lee, Ph.D., P.T.

Dept. of Physical therapy of Andong Science College

Abstract

Background: The purpose of this study is to investigate the effect of the online team project based learning on problem-solving, cooperative self-efficacy, and cooperative self-regulation of college students.

Design: Single group pre-post design.

Methods: The online team project based learning was conducted for a total of 92 college students for 8 weeks. A survey was conducted on problem-solving ability, cooperative self-efficacy, and cooperative self-regulation. In the online team project-based class, two projects were performed. It consists of video lectures and real-time video conferencing. Through the real-time video conference, the project was carried out based on discussion among learners and feedback was provided.

Results: There was a significant difference in the change in problem-solving ability compared to before learning ($p<0.05$). As a result of the evaluation of cooperative self-efficacy, there was a significant difference ($p<0.05$). There was a significant differences in cooperative self-regulation compared to before learning ($p<0.05$).

Conclusion: The online team project-based learning are effective in improving learners' problem-solving ability, cooperative self-efficacy, and cooperative self-regulation.

교신저자

김정희 교수
경북 안동시 서후면 서선길 189 안동과학대학교
T: 054-851-3555, **E**: mirrorneuron98@gmail.com

Ⅰ. Introduction

Over the past two years, whole the including Korea has brought about great changes in society, not only in daily life, but also in the working environment and educational environment due to COVID-19, which threatens human life with unprecedented strong contagious power. So-called untact is emphasized and social distancing has become a daily routine, and distance learning is becoming a new norm in the educational field (Kim, 2021). However, due to Corona 19, it was operated without sufficient prior preparation, and there are many doubts about the quality and effectiveness of online classes. As a representative example, communication between professors and learners, which can be expected in face-to-face classes, and learning of problem-solving ability and coordination of opinions through communication between learners were difficult to expect (Hwang and Kim, 2021). The recent trend of education is characterized by the shift from teacher-centered to student-centered, from one-way lectures by instructors to teacher-student interaction, from competition to collaboration, and from uniform to individually tailored learning. In line with these changes in the educational flow, various teaching methods are being designed and applied in the educational field (Kong et al, 2014). Various teaching methods are applied, such as Team-based learning in which one or more teachers work together (Frame et al, 2015), flipped learning in which students learn through pre-learning before taking classes and then solve problems while discussing them with teachers and students at school, project-based learning in which learners cooperate to solve practical problems (Blumenfeld et al, 1991).

Team project-based learning refers to a learning method in which learners cooperate with each other to solve unstructured problems while reflecting the practical environment (Blumenfeld et al, 1991). In team project-based learning, learners are given a project that reflects actual work and complete the project in cooperation with team members. The project used in team project-based learning is not a simple and clear type of task, but an unstructured and complex task. It encourages students to explore and analyze practical problems related to their major and to come up with solutions (Park, 2019; Jwa, 2019). These process of the team project-based learning can be expected to improve cooperative ability with the effect of self-directed learning, and it has been confirmed through previous studies that there is a significant correlation between project-based learning and learning achievement (Bilgin et al, 2015). In addition, Lou (2001) conducted a meta-analysis of studies related to cooperative activities in a web-based learning environment, and argued that cooperative attitudes can affect the learning process and achievement. It has been reported that project-based learning has a significant effect on learners' learning achievement and cooperative attitude (Lou et al, 2001).

After the COVID-19 outbreak in 2019, the educational environment is required to increase the learning effect in the online classroom environment in addition to face-to-face classes. Moreover, in a situation where social distancing has become a new daily routine and opportunities for non-face-to-face communication are decreasing, it is important to provide a cooperative learning environment where students can coordinate their opinions and solve problems through active communication with each other. Therefore, the purpose of this study is to investigate the effects of the online team project-based learning on learners' problem-solving ability, cooperative self-efficacy, and cooperative self-regulation.

Table 1. Composition of the team project-based learning

Contents	Weeks	Types of classes	Professor's Activities	Learner's activities	Time (min)
Orientation	1	LMS	Guide to learning contents and project classes	Preparation for project-based classes	100
Project 1	5	LMS	Lecture on PNF-based treatment plan design	Learning the concepts of PNF-based treatment	30
	5	zoom	Operation of case based pattern, technique analysis	case-based pattern and technique analysis	70
	6	LMS	Feedback on the results of 5th week	Comparison & analysis of the results of 5th week	30
	6	zoom	Operation of case based PNF treatment design	Case-based PNF treatment design	70
	7	zoom	Operation of presentation for Project 1	Team presentation for Project 1	100
	8	LMS	Provide feedback on Project 1	Comparison and analysis for Project 1	50
Project 2	12	LMS	Lecture on PNF based clinical reasoning procedure	Learning of PNF based clinical reasoning procedures	30
	12	zoom	Operation of case based abnormal gait analysis	Case based abnormal gait analysis	70
	13	LMS	Provide feedback on week 12 results	Comparison and Analysis of Week 12 Results	30
	13	zoom	Operation of gait training program design	Case based gait training program design	70
	14	zoom	Operation of presentation for project 2	Team presentation for Project 2	100
	15	LMS	Provide feedback on Project 2	Comparison and analysis for Project 2	50

LMS=video class based on LMS system; zoom=real time video conference based on zoom platform.

Ⅱ. Method

1. Participants

This study was conducted as a single group pre-post design. This study was conducted on 92 college students in the 3rd grade of physical therapy department of A College located in Gyeongsangbuk-do. The 'proprioceptive neuro-muscular promotion practice' class operated in the first semester of the third grade was conducted as a team project-based learning on online, and problem-solving ability, cooperative self-efficacy, and cooperative self-regulation were tested. A total of 92 students took this class, and all of them agreed to participate in the study and performed pre-evaluation. In the ex post evaluation after class activity, 10 people did not participate in the post-mortem questionnaire, so a total of 82 people finally participated in the study. This study was conducted after receiving approval from the Andong Science University Research Ethics Review Committee (2021-HR-002). The researcher obtained consent after fully explaining the purpose of the study and the overall procedure to all participants in the survey.
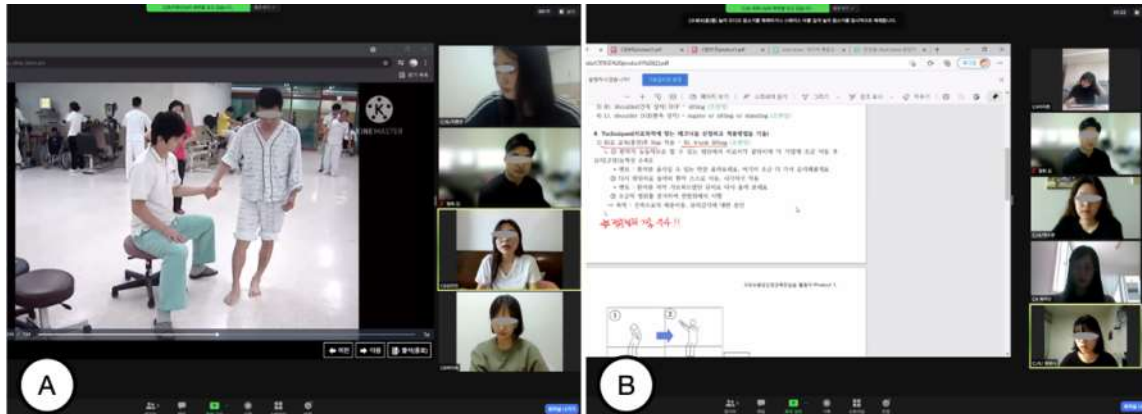
2. Procedure of online team project-based learning

The online team project-based learning were conducted for a total of 8 weeks out of the 15 weeks of the entire semester. There were a total of two projects in this study, the project 1 was conducted in Weeks 5-8, and the Project 2 was conducted in Weeks 12-15Classes operated on a project basis were concurrently applied in the form of LMS-based video lectures and real-time video lectures through online video conferencing platform (zoom) according to the learning plan <Table 1>.

In the first week of class, the learning goals and core activities of this course were introduced. The information about project-based classes, consent to participate in research, and a survey were conducted. In the 3rd week before project 1 started, teams were randomly assigned. The operating period of Project 1 was between 5 and 8 weeks. In the 5th week, an LMS-based video class was conducted on the concept of a PNF treatment plan, which should be studied prior to carrying out Project 1, and PNF pattern and technique analysis activities were performed through a real-time video class. In the 6th week, feedback on the class activity task for the 5th week was provided through the LMS-based video class, and the team project for the PNF treatment program plan was conducted through real-time video class. The real-time video class was conducted by teams of 3 to 4 people in a small meeting room set in advance, and activities related to Project 1 were performed for a set time. The class 7th week was conducted as a team presentation. Project 1 results prepared by each team were presented and Q&A was held for about 10 minutes in a real-time video class. The class in 8th week conducted based on the LMS class, the results of Project 1 written by the professor were presented, providing follow-up activities for learners to compare and analyze the results of each team.

From week 12 to week 15, activities related to project 2 were performed. In the 12th week, the knowledge necessary for the clinical reasoning process was learned through the LMS-based video class, and case-based abnormal gait analysis was performed before project 2 was carried out through the real-time video class. In the 13th week, Participants designed a gait training program through the real time video conference and receive a feedback about project 2. The class 14th week was conducted as a team presentation. The class in 15th week conducted based on the LMS class, the results

of Project 2 written by the professor were presented, providing follow-up activities for learners. During the period when project-based classes were not operated, general lecture-type classes were conducted, and LMS-based video lectures were operated due to non-face-to-face classes due to COVID-19.

A: Team activities for project based on real-time video conference, B: Team presentation on real-time video conference

Figure 1. Online team project-based learning

3. Outcome measures

The Personal-Problem Solving Inventory devised by Heppner and Peterson (1982) was used to measure the change in problem-solving ability according to Team project-based learning (Heppner and Petersen, 1982). 'When something happens, I constantly think to figure out what it is', 'I have the ability to solve even the most difficult problems I see for the first time', 'When I have a problem, I try to know exactly what it is' It contains a total of 32 items consisting of etc. This evaluation tool consists of a 5-point scale and ranges from a minimum of 32 points to a maximum of 160 points. High scores on this test indicate behaviors and attitudes that are related to positive problem-solving. In this study, the reliability coefficient (Cronbach's α) for the problem solving ability evaluation was .792.

Self-efficacy for Group Work Measure was used to measure cooperative self-efficacy (Alavi and McCormick, 2007). This evaluation consists of a total of 21 items. 'I can ask the team members to clarify their ideas when they do not understand', 'I can define the main issues of the team project', 'I can ask questions to improve the quality of the discussion', ' I can efficiently consider the ideas of my teammates for team decisions'. It was measured on a 5-point scale, and the reliability coefficient (Crobach's α) was found to be .921.

The cooperative self-regulation questionnaire was used to measure the change in cooperative self-regulation according to team project-based learning (Heo et al, 2010). The cooperative self-regulation questionnaire consists of a total of 6 questions and includes the following information. 'I understood and confirmed the goals and plans of our team and the roles of each team member while carrying out this project', 'I was well aware of the plans set by our team during this project and managed activities according to them'. In this study, the reliability coefficient for cooperative self-regulation (Crobach's α) was .941.

4. Data analysis

The data was processed using the SPSS Win version 21.0 program. Paired t test was used to compare the effects of online class-based Team project-based learning, and the reliability of the measurement tool was expressed as Cronbach's a. All statistical significance levels of the data were set to 0.05 or less.

Ⅲ. Results

1. Changes in problem solving ability and cooperative self-efficacy

The total score of problem-solving ability before was increased by 3.01 points from 98.54 points to 101.56 points post-test, and there was a significant difference. The total score of cooperative self-efficacy increased by 8.20 points from 74.65 points before to 82.85 points for post-test, showing a significant differences <Table 2>.

Table 2. Comparison of differences in problem solving, self-efficacy (*N*=82)

	Pretest	Posttest	Mean differences	t(*p*)
Problem solving	98.67±7.53[a]	101.56±9.98	3.01±11.03	-2.457(.016)*
Cooperative self-efficacy	74.83±10.78	82.85±11.06	8.20±15.16	-4.902(.000)*

[a]M±SD, **p*<0.05

2. Changes in cooperative self-regulation

The total score of cooperative self-regulation increased by 2.30 points from 22.40 points before to 24.70 points after, and there was a significant differences. Question 1 showed a significant differences with an increase of 0.55 points from 3.60 points before to 4.15 points for post-testing (*p*<.05). Question 2 showed a significant differences with an increase of 0.51 points from 3.63 points before to 4.15 points for post-testing (*p*<.05). Question 3 showed a significant differences with an increase of 0.30 points from 3.79 points before to 4.10 points after. Question 4 showed a significant differences with an increase of 0.27 points from 3.85 points before to 4.12 points for post-testing (*p*<.05). Question 5 showed a significant differences with an increase of 0.30 points from 3.78 points before to 4.09 points for post-testing (*p*<.05). Question 6 showed a significant differences with an increase of 0.38 points from 3.74 points before to 4.11

Table 3. Comparison of self regulation (*N*=82)

	Pretest	Posttest	Mean differences	t(*p*)
Cooperative self-regulation	22.56±3.62[a]	24.70±3.00	2.30±4.32	-4.829(.000)*
Question 1	3.62±0.69	4.41±0.59	0.55±0.84	-5.857(.000)
Question 2	3.66±0.68	4.15±0.57	0.51±0.85	-5.458(.000)
Question 3	3.83±0.69	4.10±0.62	0.30±0.88	-3.121(.002)
Question 4	3.87±0.69	4.12±0.58	0.27±0.85	-2.869(.005)
Question 5	3.80±0.74	4.09±0.30	0.30±0.93	-2.983(.004)
Question 6	3.78±0.78	4.11±0.65	0.38±0.97	-3.397(.001)

[a]M±SD, **p*<0.05

points for post-testing (p<.05) <Table 3>.

Ⅳ. Discussion

This study tried to investigate the changes in learners' problem-solving ability, cooperative self-efficacy, and cooperative self-regulation through the operation of online team project-based learning. Team project-based learning is a learning method in which learners with various levels of learning ability, experience, and knowledge work together to complete a project to solve a common project (Blumenfeld et al, 1991; Scherling, 2011). In a previous study, Long (2006) studied the difference in learning outcomes according to the learning methods of college students and confirmed that the learning style that requires cooperation was a significant factor in learning success (Long and Coldren, 2006). This means that the team project-based learning can induce the cooperation of learners and induce the learning of the knowledge required in the class.

As a result of measuring the changes in problem-solving ability through Team project-based learning, significant changes were found. Problem-solving ability is a complex and organic cognitive skill used to solve problems encountered in daily life environment or in the field. Problem solving ability is based on a knowledge structure consisting of understanding of problem situations, mental models, and personally formed beliefs (Chi and Glaser, 1985).

The team project applied in this study was to identify various problems observed in activities of patient based on clinical cases, analyze the cause, and design a suitable treatment program. Learners had to constantly present their opinions and coordinate in order to identify core problems and suggest solutions in the team meeting space provided in the online environment. In this process, the professor participated in the team meeting to check whether the selected core problems are valid, whether the cause analysis is well done, and whether the design of the treatment program to solve the problem is valid, and continuously check and provide feedback. It is thought that continuous communication between learners and the provision of feedback from professors for problem analysis and solution suggestion for project execution had a positive effect on participants' ability to analyze and solve problems actively and flexibly.

Cooperative self-efficacy refers to the level of self-perceived belief that a person can successfully perform in a task or environment that requires cooperation (Alavi and McCormick, 2007). As a result of the evaluation of cooperative self-efficacy in this study, a significant difference was found from 74.65 points before to 82.85 points after.

Participants in this study had to reconcile opposing opinions during the two projects, and in some cases, even if their own opinions were not well reflected, the attitude to accept the inclusion of the project results according to the majority opinion was also required. This learning process is thought to have experienced much more self-satisfaction through cooperation than the existing lecture-based classes. The higher the level of cooperative self-efficacy, the more likely they are to recognize and participate in projects that they can perform cooperatively well. Therefore, it implies that the participants of this study can actively participate in the project in other tasks or working environments (Lillian and Gregory, 1997).

Today's society is becoming more and more individualized, and the achievement of learning through cooperation is becoming more and more difficult than the previous generation. Moreover, with social distancing becoming a new standard and becoming a daily routine due to COVID-19, expectations for the achievement of learning through cooperation become increasingly difficult (Kim, 2021). Although it will depend on the individual disposition of the learner, it can

be relatively easy for students who find it difficult to freely express their opinions in face-to-face situations to present and coordinate their opinions in an online environment. In fact, in this study, online activities were successfully completed for a long time of 480 minutes, and along with the completion of the corresponding project task, changes in learning attitudes such as problem-solving ability and cooperative self-efficacy were also induced. Self-directed learning can be said to be a process of learning by clarifying the learning goal and selecting an appropriate learning strategy based on the learner's own learning needs (Chung, 2018). Significant changes in problem-solving ability and self-efficacy scores shown in this study can be expected to improve self-directed learning of learners participating in this study.

As a result of evaluating the change in cooperative self-regulation according to Team project-based learning, a significant change was found from 22.40 points before to 24.70 points after. Cooperative self-regulation can be said to be a self-regulation skill in which an individual's self-regulation skills are converted into a form suitable for group characteristics through interaction with fellow learners in the cooperative process for problem solving (Heo et al, 2010). Significant changes in cooperative self-regulation in this study mean that communication skills and related knowledge were acquired more smoothly through project-based learning (김시원 등, 2015).

The ultimate goal of team project-based learning is to approach learning from a social aspect, to collaborate with other learners, and to learn necessary knowledge and performance through shared experiences (Heo et al, 2010). Significant changes were observed in all 6 items included in the cooperative self-regulation evaluation conducted in this study ($p<0.05$). Because learners who have experienced team project-based classes proactively and actively explore and solve problems compared to other learners, they can better understand core principles and concepts and enable more in-depth learning (Garrison, 2007; Yu et al, 2021). It is thought that the participants of this study also participated in learning with a more cooperative and active attitude through Team project-based learning. Because team project-based classes do not simply synthesize and complete the task solutions presented by learners, but rather coordinate and integrate the opinions of team members to obtain more advanced results (Savery and Duffy, 1995; Kim et al, 2018), In a situation that opportunities for face-to-face classes are reduced due to COVID-19, there is a great advantage that it can enhance practical skills and strengthen cooperative learning attitudes for problem solving.

The limitations of this study are as follows. First, it is a method of assigning a team for the progress of the project. In order to assign team that is not biased, it is necessary for the instructor to understand the propensity of the learners in advance and reflect it in the team composition. The second is the role assignment of team members. During the team project, the instructor needs to constantly check and adjust whether the roles are distributed smoothly and whether the team members are actively participating.

Ⅴ. Conclusion

The purpose of this study was to investigate the effect of online team project-based learning to learners' problem-solving ability, self-efficacy, and cooperative self-regulation. As a result, significant changes were found in the participants' problem-solving ability, cooperative self-efficacy, and cooperative self-regulation ability. Through this, we confirmed that online team project-based learning can bring positive learning effect. The online team project-based learning needs to be considered to enhance learners' problem-solving skills.

References

김시원, 김예진, 김영주 등. 협력학습 환경에서 협력적 자기조절의 매개효과 검증. 한국교육공학학회 학술대회발표자료집. 2015;(1):101-2.

Alavi SB, McCormick J. The roles of perceived task interdependence and group members' interdependence in the development of collective efficacy in university student group contexts. Br J Educ Psychol 2008;78(Pt 3):375-93.

Bilgin I, Karakuyu Y, Ay Y. The effects of project based learning on undergraduate students' achievement and self-efficacy beliefs towards science teaching. Eurasia J Math Sci Technol 2015;11(3):469-77.

Blumenfeld PC, Soloway E, Marx RW, et al. Motivating project-based learning: Sustaining the doing, supporting the learning. Educ Psychol 1991;26(3-4):369-98.

Chi MTH, Glaser R. Problem-solving ability. Dalam RJ Sternberg (Ed.), Human abilities: An information-processing approach. SanFrancisco, CA: W.H.Freeman & Co; 1985. p.227−50.

Chung E. The effects of flipped learning on self-directed learning and class satisfaction in a class of college physical therapy students. J Korean Soc Integr Med 2018;6(4):63-73.

Frame TR, Cailor SM, Gryka RJ, et al. Student Perceptions of Team-based Learning vs Traditional Lecture-based Learning. Am J Pharm Educ 2015;79(4):51.

Garrison DR. Online community of inquiry review: Social, cognitive, and teaching presence issues. JALN 2007;11(1):61-72.

Heo H, Lim KY, Kim Y. Exploratory study on the patterns of online interaction and knowledge co-construction in project-based learning. Comput Educ 2010;55(3):1383-92.

Heppner P, Petersen C. The development and implications of a personal problem-solving inventory. J Couns Psychol 1982;29(1):66-75.

Hwang YH, Kim CS. Perceptions toward non-face-to-face online class operations during the COVID-19 pandemic: Focusing on university students' satisfaction and anxiety. Linguist Assoc Korea 2021;29(1):71-91.

Jwa HS. The Study on the exploration of college students' team based project learning to a Child Welfare Class. The Korean Soc School Work 2019;48:79-110.

Kim SG. A Study on the Improvement of Learning Initiative in the Online Non-face-to-face Classes Caused by Covid-19 Pandemic. J Humanit Soc Sci 21 2021;12(1):913-27.

Kim TW, Lee J, In TS. The Study about Undergraduate Physical Therapy Student's Participation in General Sports. J Korean Phys Ther Sci 2018;25(2):62-72.

Kong LN, Qin B, Zhou YQ, et al. The effectiveness of problem-based learning on development of nursing students' critical thinking: a systematic review and meta-analysis. Int J Nurs Stud 2014;51(3):458-69.

Lillian TE, Gregory HD. Collectivistic orientation in teams: an individual and group-level analysis. J Organ Behav 1997;18(3):275-95.

Long H, Coldren J. Interpersonal Influences in Large Lecture-Based Classes: A Socioinstructional Perspective. Coll Teach 2006;54:237-43.

Lou Y, Abrami P, d'Apollonia, S. Small Group and Individual Learning with Technology: A Meta-Analysis. Rev Educ

Res 2001;71:449-521.

Park HY. The Effects of Team-Based Project Learning on Creativity and Self-Regulated Learning Ability of University Students. JOES 2019;25(4):283-97.

Savery JR, Duffy TM. Problem Based Learning: An Instructional Model and Its Constructivist Framework. Educ technol 1995;35(5):31-8.

Scherling SE. Designing and fostering effective online group projects. Adult learn 2011;22(2):13-8.

Yu JH, Bae YH, Noh SH, et al. Analysis of professionalism of physical therapy student who experienced clinical practice. J Korean Phys Ther Sci 2021;28(2):40-5.