International Education Studies; Vol. 16, No. 5; 2023
ISSN 1913-9020 E-ISSN 1913-9039
Published by Canadian Center of Science and Education

Instructional Management Through Project-Based Learning Combined with Collaborative Learning to Enhance Learning Achievement of Undergraduate Students

Ajcharee Pimpimool[1]

[1] Faculty of Education, Ubon Ratchathani Rajabhat University, Ubon Ratchathani, Thailand

Correspondence: Ajcharee Pimpimool, Faculty of Education, Ubon Ratchathani Rajabhat University, Ubon Ratchathani, 34000, Thailand.

Received: April 30, 2023 Accepted: June 12, 2023 Online Published: September 25, 2023

doi:10.5539/ies.v16n5p84 URL: https://doi.org/10.5539/ies.v16n5p84

Abstract

Global citizenship should acknowledge various lessons in global education emphasizing learners as the global citizens. Teaching techniques integration that is suitable for contents and the nature of learners is considered as the heart of instructional management affecting students greatly in the 21st century. This study aims: 1) to determine the quality of the learning achievement test; 2) to compare the pre-test and post-test learning achievement of students through activities of the project-based learning (PjBL) combined with collaborative learning; and 3) to study student's satisfaction toward PjBL activities. Research method includes 4 steps: 1) data study; 2) activity design; 3) tools creation; and 4) learning activity management. A questionnaire and a learning achievement test are implied as tools. The sample comprises 40 undergraduate students and 5 experts who are selected by the purposive sampling and have experienced teaching for more than 10 years from 4 higher education institutes. Data is analyzed with mean, standard deviation, and t-test. Results indicate that: 1) the learning achievement test that has been already qualified is a 5-choice, 65 items, which are a content validity and a whole reliability value of 0.912; 2) the post-test learning achievement is higher than the pre-test with a statistical significance level of .05; and 3) an overall student's satisfaction is at the highest level ($\bar{X}$= 4.72, SD = 0.33).

Keywords: instructional management, project-based learning, collaborative learning, learning achievement

1. Introduction

1.1 Background and Significance

Citizenship of the world has to relate and understand a variety of lessons concerning the world, attitudes, perspectives, values, desirable ethics, and participate in responsible community and social network activities. The educational management concept titled "Global Education" concentrates on the learners as "Global Citizenship". This concept was first applied in the United States and has widespread uses. Many countries promoted this concept to manage a substantial education system (Fernandez et al., 2023). In addition, the world change and the rapid growth of advanced technologies have affected human lifestyle and working in the 21st century. Then, educational management had to emphasize the preparation of learners who could adapt to these changes (Amzil, 2023; Fakkao, 2018). The major ideology of educational management was lifelong learning including pursuing knowledge and learning, getting to know yourself, and understanding others and the world. Therefore, lifelong learning was an important key to reach learning in the 21st century (Dechakupta & Yindeesuk, 2015). Moreover, learner's skills that were important to live in the changing world have affected learners to be good thinking and acting, appropriate decision, solving problems in the suitable way, and welcoming various cultures of people in the world (Sintapanon, 2018). The learning process is affected by many differences of people and a variety of contextual influences including motivation, emotions, and behavior by coaching instructional strategies of teachers to interact with student needs (Dietrich *et al*., 2022). Development of learners who were efficient based on the objectives had to rely on teachers who had skills in learning management, good attitudes to the teaching profession, and learning achievement motivation that were skills in the future to sustainably create innovation of the modern class management for a new generation of learners (Agasisti et al., 2020). Thus, the development of a new generation of teachers has been the main point to drive the education towards the learning management process in the 21st century (Srijumnong & Serthsri, 2017). These skills are integrated with developing curriculum and instruction,

arranging the environment to support pursuits of knowledge using proper digital technologies. Furthermore, providing experiences to learners was operated with activities enhancing systematic thinking process, project creation from learning, and reasonable subsistence in the society (A. Pimpimool & I. Pimpimool, 2021). Teachers are an important role for learner's skills development and inspiration to create sustainable projects, explicit knowledge, and innovativeness (Daosri et al., 2021). Therefore, learning in the 21st century is traversed from the subject matter onto learning skills for living in the 21st century that learners take self-directed learning, and teachers are the learning designer and facilitators for learners who are learning by actual stimulation from mental and physical intelligence of them. This learning has been called Project-Based Learning (PjBL) (Panich, 2012).

Learning management focused on learners was the method that could develop learners in all aspects including the mental and physical body, emotional quotient, society, and intellect (Chitchayavanich, 2019). For the most usefulness to learners, they have willingly participated in the learning activities and utilized various learning processes to achieve real learning (Khaemmanee, 2018). PjBL was a learning method focused on learners that played the role of learning based on the educational reformation concept to enhance learners' skills of knowledge and practices (Tiantong, 2013). Furthermore, Learners have gained direct experiences and perceived planning with scientific ways, communication, and coordination with others affecting better analytical thinking skills, accessibility process, and educational environment creation (Maharma & Abusa'aleek, 2022; Nilsook, 2022). For the principle of PjBL, teachers have to create a positive atmosphere in the classroom to encourage learning methods improvement, teaching techniques adjustment, and self-directed learning toward a variety of uncertain situations (Clark & Chrispeels, 2022). In addition, teaching through PjBL could be integrated with other subjects that related the cooperative education (Asuquo & Onyinye, 2022; Kensang, 2017). Therefore, PjBL has emphasized students who are able to choose their interesting topics operated by teamwork, and teachers functionally manage environment and facilities to enhance learning skills achievement.

For collaborative learning, teachers had to select an appropriate instructional technique for learners, and learners had to be ready for collaborative activities and team responsibility (Vallaeys et al., 2022; Huang & Do, 2021). Instructional management consisted of small groups (4-6 members per group) to learn, help each other, work together, and be responsible for the group's success (Gordon & Hart, 2022). In addition, creative interaction and collaborative problem solving were the important elements of education in the 21st century. Educational institutes needed to develop students with lifelong learning because collaborative learning was the dimension of actual education development from theoretical learning to practical work (Boonumpai & Peerapattanapong, 2016). To discuss learners, they who were the different capabilities were separated into a little group for helping and motivating each other and responsible working on the same goal (Tumnanchit, 2022). From the collaboration of students, the interaction between peers to achieve goals was considered the criticality to the success of working together (Haataja et al., 2022). This collaboration was the basic relationship between teachers and students which was considered to be a high quality and a positive relation for promoting collaborative behaviors rather than antagonistic behaviors (Vemde et al., 2022). Moreover, the positive perception of students about learning in an inclusive environment helps to enhance better learning outcomes (Guo et al., 2023). In the learning community, students also shared their knowledge which could strongly influence their academic performance (Brouwer et al., 2022; Shava & Heystek, 2021). Therefore, collaborative learning emphasizes learners by sharing knowledge and experiences collaboratively in various formats, and learners can study anywhere and anytime by taking learning activities to reach the same goal of the group.

1.2 Importance of the Problems

Problems encountered in the instructional management of the contents of data flow diagrams (DFD) in the past academic years. Although learning activities strongly emphasized students, they could not understand the DFD clearly. Students were not able to analyze and design the system as accurately as it should be because some issues still existed including a lack of a work plan, systematic thinking, cooperation, and teamwork to attain the goal set. Therefore, the researcher draws into the PjBL activities combined with collaborative learning to help and develop the critical thinking skill and teamwork skills of students. Due to the PjBL activities are the distinctive learning point and the explicit step, learners have performed their roles and responsibilities based on their attention and aptitude through sharing of knowledge, experiences, and interactive opportunities for their duties (Fayda-Kinik, 2022). Teachers functionally organize instructional activities to support students who can work together, choose the interesting project of the group, be ready to face problems together, promote learning enthusiasm, investigate answers, implement plans with friends, prepare presentation of reports and project results, discuss and share learning between learners and teachers, and summarize overview of the project results. After that, all students jointly select the most complete project to receive a reward from the teacher as a way to reinforce their work. The results of such learning management can be used as a guideline for applying to other subjects in the future.

2. Objectives

This study aims: 1) to determine the quality of the learning achievement test, the subject of system analysis and design, the topic of data flow diagrams; 2) to compare between the pre-test and post-test learning achievement of undergraduate students through activities of project-based learning combined with collaborative learning; and 3) to study student's satisfaction toward learning activities through project-based learning activities combined with collaborative learning

3. Methods

This study consists of 4 steps as follows:

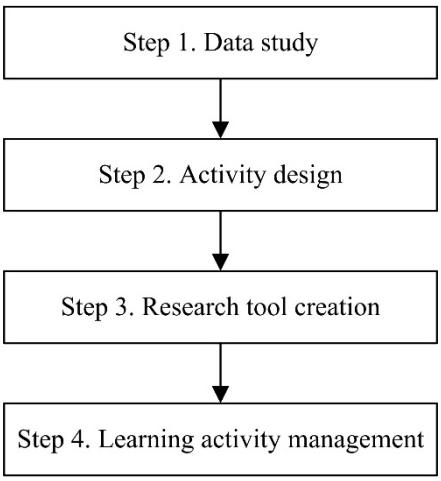

Figure 1. Research method

Step 1. Data study

This step is a study about the curriculum structure, problem situations, instructional administration, and population determination detailed as follows:

The study of curriculum structure, this is a detailed study of the bachelor's degree program, bachelor of education in digital technology for education revised curriculum (4-year program) in 2019 according to the Thai Qualifications Framework for Higher Education (TQF for HEd).

Investigation of problem situations, there were found that some documents were incomplete to guide or explain an overview of the complete project. From the previous assessment result of students, it was found that their learning achievement was less than 70 percent. Most of the students could not understand the use of symbols to analyze and design the system. They thought that this subject was too difficult, could not be imaged in the overall system, and were anxious and unconfident in doing activities with poor results. In addition, they lacked of a teamwork, roles, responsibilities, planning, and knowledge sharing between each other.

The study of instructional administration guidelines in order to lay out teaching styles for students to achieve the specified goals and study the behavior of students to organize activities in accordance with the nature of learning, providing diverse and sufficient learning resources, the high-speed internet, and synthesis of learning activity steps that suit students and the nature of the course is project-based learning combined with cooperative learning for students to enhance learning achievement and be happy with the instructional activities created.

The defined population is 40 undergraduate students in digital technology for education, the second year, Faculty of Education, Ubon Ratchathani Rajabhat University, Thailand, who enrolled in the system analysis and design course in semester 2 of the academic year 2022, a total of 2 classes.

Step 2. Activity design

This research is experimental researches using the one group pre-test and post-test design as follows (Tiantong, 2012).

$$E \quad Q1 \quad X \quad Q2 \tag{1}$$

From (1), E: Experimental group, Q1: Pre-test, X: Learning activity using PjBL combined with collaborative learning, and Q2: Post-test

Learning activity design consists of three elements shown in Figure 2.

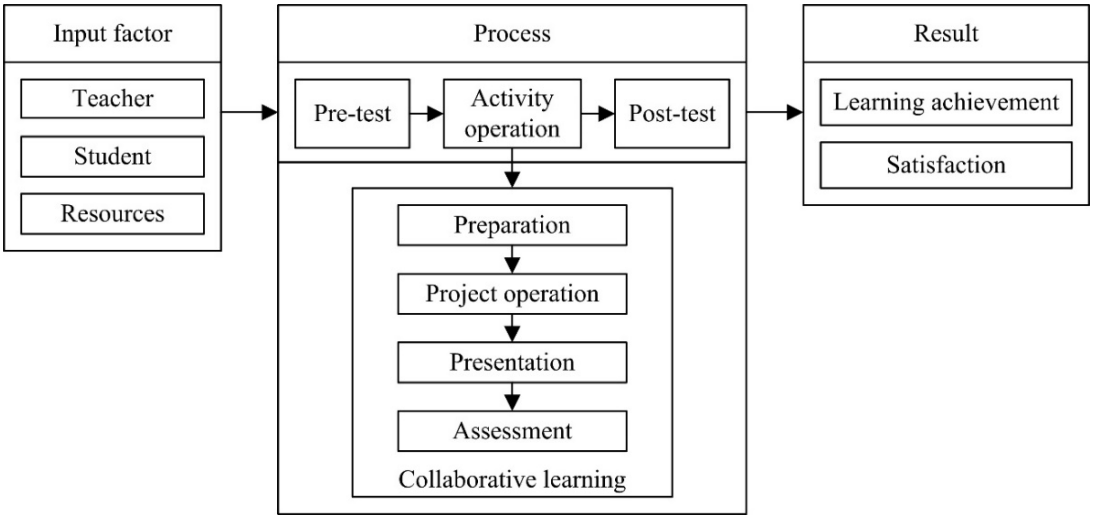

Figure 2. Learning activity design

From Figure 2, details of the learning activity design are as follows:

1) Input factor is the initial and important element in learning activities (Kazi, 2021) consisting of a teacher acting as a consultant or coach, teamwork stimulation, monitoring, and verification of operations. Students are responsible for conducting learning activities according to their interests, feasibility study, brainstorming, creation and presentation of the project plan, and summary of the project performance. Moreover, resources include learning environment arrangement for study, the internet network performance, use of search engines on various websites, and complete teaching handouts.

2) Process is the learning activity operation using PjBL combined with collaborative learning, there are 3 parts: (1) pre-test is the first part that all students must take the test; (2) activity operation part comprises 4 steps which are synthesized by using PjBL combined with collaborative learning to achieve specified goals. The first step, preparation is a step that teachers explain to the students to understand the PjBL by dividing 4 or 5 students per group according to voluntary in communication or convenient interaction. Then, they select the project topic and set their roles, and responsibilities for all members of the group to learn collaboratively. Furthermore, they also study information from reliable sources by interviewing, inquiring, surveying from media on the internet, searching data from various learning resources, analyzing the collected data, and summarizing them as information in order to design their own projects. The second step, project operation is an action followed with the project plan in the specified time. The teacher monitors the operations by organizing meetings to periodically share knowledge, discussion, and progress monitoring using a collaborative approach of work, data recording, solving problems together, and decision-making among members of the group. The third step, presentation is an activity to write reports and propose the project performance to others in order to understand what is being done, and everyone inspires alongside each other for improving the further work development. The last step, assessment is a work evaluation according to actual conditions to reflect and criticize the project. Moreover, assessment is to use information for developing in the future in which teachers and students rate together the best project and award to them; (3) post-test, after students have completed the learning activities, they must take the test again and make the satisfaction questionnaire for the learning activity management.

3) Result is the element of using the t-test value analysis and the satisfaction assessment with the mean ($\bar{X}$) and the standard deviation (SD).

Step 3. Research tool creation

This step comprises three procedures: 1) preparation of syllabus, contents of data flow diagrams (DFD) are separated into 7 lessons. After analyzing behavioral objectives based on these lessons, the researcher designs learning activities using PjBL combined with collaborative learning; 2) when the contents and behavioral objectives on DFD have been already discussed, the learning achievement test has been created with a total of 65 items. In addition, 5 experts are selected by using the purposive sampling. They are from the senior lecturers who have experienced and taught for more than 10 years from 4 higher education institutes in order to verify the content

validity using the Index of Item Objective Congruence (IOC). Then, this test that is already qualified by the experts is tried out with 22 undergraduate students in digital technology for education, Faculty of Education, Ubon Ratchathani Rajabhat University, Thailand, who have ever enrolled in this subject. Moreover, the quality of this test is also analyzed; and 3) the satisfaction questionnaire contains 5 aspects including aspect of teacher, aspect of content, aspect of PjBL activity, aspect of collaborative learning, and aspect of learning assessment (a total of 38 items) that the same experts evaluate the appropriateness of the questions using a questionnaire on the 5-level rating scale. After that, data is analyzed with the mean and the standard deviation. From a comparison of the mean with the scoring criteria, it is found that all items are between 4.66 and 5.00. Therefore, there is a suitable and usable questionnaire.

Step 4. Learning activity management

In semester 2 of the academic year 2022, a total of 40 students have taken the pre-test, 65 items. PjBL activities combined with collaborative learning are managed under Step 2. Activity design in the process element including preparation, project operation, presentation, and assessment. When the instructional activities have been completed, students have to take the post-test to mention learning achievement and answer the satisfaction questionnaires based on their PjBL activities with collaborative learning.

4. Results

1) From the quality of the learning achievement test, this test is the 5-choice, 65 items, there is found that all items of the test which have been qualified by experts, are the content validity value between 0.80 and 1.00 so the test is reliable. Moreover, undergraduate students who have ever enrolled in this subject take the learning achievement test with these results: (1) The p-value is between 0.23 and 0.77 so the test is an appropriate difficulty; (2) The r-value is between 0.27 and 0.55 so the test is an appropriate discrimination; and (3) The reliability value of the whole test is 0.912 that approaches 1.00 so the test has high reliability.

2) Comparison results of the learning achievement through PjBL activities combined with collaborative learning for undergraduate students

Table 1. Comparison of the pre-test and post-test learning achievement

The test		N	$\bar{X}$	SD	t	df	Sig
Learning achievement	Pre-test	40	20.20	6.060	-21.913	39	.000*
	Post-test	40	33.93	6.044			

*Statistical significance level of .05.

From Table 1, a comparison of results of the learning achievement through PjBL activities combined with collaborative learning, the subject of system analysis and design, the topic of data flow diagrams, for undergraduate students in digital technology for education using t-test, there is shown that from the perfect score of 65, students have taken the pre-test average score of 20.20 and the post-test average score of 33.93. Therefore, it is indicated that the learning achievement of students after learning is higher than before learning at a statistical significance level of .05.

3) Satisfaction results of students toward PjBL activities combined with collaborative learning

Table 2. Student's satisfaction results

Satisfaction of students	Satisfaction level		
	$\bar{X}$	SD	Level
1. Aspect of content	4.64	0.40	Highest
2. Aspect of teacher	4.80	0.29	Highest
3. Aspect of project-based learning (PjBL) activity	4.72	0.39	Highest
4. Aspect of collaborative learning	4.74	0.40	Highest
5. Aspect of learning assessment	4.72	0.42	Highest
Overall summary	4.72	0.33	Highest

From Table 2, the satisfaction results of undergraduate students in digital technology for education toward learning activities using PjBL combined with collaborative learning, the subject of system analysis and design, the topic of data flow diagrams, an overall satisfaction is the highest level ($\bar{X}$=4.72, SD = 0.33). For consideration of each aspect, there is found that all aspects are at the highest level, in the ordered following with the mean: aspect of teacher is the highest level ($\bar{X}$=4.80, SD = 0.29); aspect of collaborative learning is at the highest level ($\bar{X}$=4.74, SD = 0.40); aspect of PjBL activity is at the highest level ($\bar{X}$=4.72, SD = 0.39); aspect of learning assessment is at the highest level ($\bar{X}$=4.72, SD = 0.42); and aspect of content is at the highest level ($\bar{X}$=4.64, SD = 0.40).

5. Discussion

Learning with PjBL and collaborative learning, the subject of system analysis and design for undergraduate students in digital technology for education, discussion of results is detailed as follows:

IOC evaluation result of the test qualified by 5 experts, the subject of system analysis and design, the topic of data flow diagrams containing 7 lessons, the test is the 5-choice, 65 items, there is found that the qualified test of 65 items has taken the value of the content validity between 0.80 and 1.00 so the test is the content validity. This test is complete due to the test has been conducted through a systematic process, a relationship analysis between the major contents and the minor contents, reviews of creating the test, and consideration of the test improvement. According to this test, there is aligned with the study of Chusawatdikul (2015), the learning achievement test of 40 items has been built corresponded with contents and objectives that were qualified by 3 experts, and it was found that the IOC of the test was between 0.67 and 1.00 shown that all items were more than 0.5. In addition, quality assessment results of the learning achievement test for 22 undergraduate students in digital technology for education who have ever enrolled in this subject, there is found that the difficulty value is between 0.23 and 0.77, the discrimination value is between 0.27 and 0.55, and the reliability value is 0.912 approached to 1.00 because the test is built by a systematic process and students have ever study this subject affecting their understanding and perception to be able to take this test. In the same way, the study of Ladnok (2019), the test was 36 items taken by 30 undergraduate students, it was found that the difficulty value was between 0.27 and 1.00, the discrimination value was between 0.24 and 0.47, and the reliability was 0.92. Besides, the study of Suvarnaphaet (2014), the learning achievement test, the subject of Fundamentals of Physics, was the 4-choice, 40 items taken by 30 undergraduate students, it was found that the difficulty value was between 0.20 and 0.80, the discrimination value was 0.20 or more, the reliability of the pre-test was 0.86, and the reliability of the post-test was 0.89.

Comparison of the learning achievement of the pre-test and the post-test through PjBL combined with collaborative learning, the subject of system analysis and design for undergraduate students in digital technology for education, there is found that the post-test average score is higher than the pre-test average score at a statistical significance level of .05, and two key points affecting enhanced learning achievement are: 1) Content analysis is organized in order from easy to difficult, and the design of learning activities is appropriate and in line with the contents of each lesson that is related continuously to each other, thus students are interested in activities all the time, and 2) Because the learning activities that allow all students to participate in group activities that are clear to create activities, each student is assigned responsibilities and duties according to his/her aptitude (Vallaeys et al., 2022). There gives all members of the group a chance to share knowledge and experiences, and have the freedom to study and research within the specified time frame. Moreover, the teacher keeps track of their work, and gives advice and help throughout the activities. As a result, the students are happy, fun, and relaxed, without anxiety or lacking of self-confidence in doing activities. In the same way as the study of P. Lorwongtrakool, and C. Lorwongtrakool (2021), the comparative results of learning achievement of the pre-test and the post-test of students who studied with the active learning management that promote creative thinking processes with project-based learning, it was found that the learning achievement of the post-test was higher than the pre-test with a statistical significance, there pointed that this instructional administration helped students to learn and understand the contents better due to the increased study has taken action applying to the subject of interest. Furthermore, the study of Keawmanee (2019), students in the middle school who studied with PjBL have gotten the learning achievement of 70% which was higher than the defined criteria with a statistical significance level of .05. There corresponded to the study of Jeenawong (2013), the learning achievement for two groups of students who studied with learning activities using: 1) the developed instructional pattern (experimental group), and 2) a normal instructional pattern (controlled group), it was found that the post-test average scores of these two groups were different with statistical significance level of .05, and the study of Wongsuriya (2017), learning activities management using the PjBL center for 9 students, the topic of C++ Programming Application, it was found that the post-test average score of the programming skills ($\bar{X}$=25.44, SD = 2.40) was higher than the pre-test average score ($\bar{X}$=10.11, SD = 2.57). When testing the difference of these scores using t-test, it was indicated that the pre-test score and the post-test score were different with a statistical significance level of .05.

Satisfaction of students towards learning activities of PjBL combined with collaborative learning, the subject of system analysis and design for undergraduate students in digital technology for education, it is found that all items of satisfaction are the highest level due to learning activities are in order from easy to difficult making students feel relaxed and not pressured. The teacher usually supervises, advises, explains, helps, answers questions, provides a variety of learning resources to learn at any time, and monitors their activities with them. Because each lesson of contents is supported with activities of the group to share learning and cooperation in activities to achieve the specified goals by using the PjBL that processes apparent steps for doing activities, therefore, the students are satisfied at the highest level. In the same way as the study of Poomas (2017), the satisfaction assessment of students toward the instructional administration process using PjBL to promote awareness of information has taken the average of 4.51, it meant that students were extremely satisfied toward the instructional administration process using PjBL to promote awareness of information. In addition, this study has been aligned with the study of Kamjun (2018), it was found that the satisfaction of students was the highest level ($\bar{X}$=4.54, SD = 0.2). For discussion of each aspect, it shown that aspect of quality of teacher was satisfied at the highest level ($\bar{X}$=.56, SD = 1.89), and aspect of instructional administration was satisfied at the highest level ($\bar{X}$=4.52, SD = 2.22). In the same way that Pankun (2016) has studied satisfaction of students toward learning management process using PjBL, the subject of website development using HTML, to enhance website development skills, it was found that satisfaction in aspect of contents presentation was the highest level with the average of 4.67, aspect of using tools and learning media was the highest level with the average of 4.5, aspect of learning utilization was the highest level with the average of 4.4, and an overall satisfaction was the highest level with the average of 4.52. Likewise, the study of Chawengchutirat (2016), it was found that students in a middle school who studied the subject of health care and promotion learning with PjBL, were satisfied with an overall in the highest level ($\bar{X}$=4.54, SD = 0.45). In a similar way, the study of Wongarmart (2018), it was found that the satisfaction of students toward learning management using PjBL, the subject of arts, the topic of sculpture from natural materials, was as follows: aspect of the instructional atmosphere was 77.75%, aspect of instructional activity was 84.21%, and aspect of learning utilization was 91.45%. Furthermore, an overall satisfaction of 19 students was the highest level with an average of 4.79 or 84.47% affecting the quality of life of students to lead sustainably to society development, knowledge and interest of students, the ability of work, responsibility, and more creative thinking. Therefore, development of this instructional administration will be useful to organize a suitably instructional pattern in the future.

6. Suggestions

6.1 Utilization

When using the learning activities of PjBL combined with collaborative learning, the teacher should supervise the implementation of all 4 learning steps, help to promote students' perceiving experiences and knowledge, interest-based learning and individual difference, and answer various issues while doing activities of the group in order to reach the specified goals and complete learning.

The teacher has to supervise the activity according to the learning process by participating in activities with all groups and allow all students to reflect on the results of group activities and mutual knowledge sharing. These affect greatly a positive effect to students because of more self-confidence, confidence in presentation, and self-esteem for being a part of the group's success.

6.2 The Next Research

While using PjBL combined with collaborative learning, teachers should review an integrated instructional technique including Student Team Achievement Division (STAD) or Team-Games-Tournament (TGT) to encourage students to be more enthusiastic about learning and to enhance the learning achievement.

Teachers should be careful about activities of the group and reflection on the results of sharing knowledge and experiences. If the teacher cannot closely supervise all activities, some students do not pay attention to their activities, do not reflect learning outcomes, and no sharing knowledge among the members affecting students in understanding, perception, expertise skill of contents, and loss of self-confidence.

References

Agasisti, T., Falzetti, P., & Soncin, M. (2020). School principals' managerial behaviours and students' achievement An empirical analysis of Italian middle schools. *International Journal of Educational Management, 34*(5), 937-951. https://doi.org/10.1108/IJEM-11-2018-0350

Amzil, A. (2023). Academic Resilience and its Relation to Academic Achievement for Moroccan University Students During the Covid19 Pandemic. *International Education Studies, 16*(1), 1-7. https://doi.org/10.5539/ies.v16n1p1

Asuquo, M. E., & Onyinye, C. (2022). Internal School Quality Assurance Pratices and Undergraduate Students' Attitude towards Academic Activities: A Case of Public Universities in Cross River State, Nigeria. *International Education Studies, 15*(4), 108-116. https://doi.org/10.5539/ies.v15n4p108

Boonumpai, T., & Peerapattanapong, N. (2016). Evaluation of the Ph.D. Curriculum in Educational Technology, Faculty of Education, Burapha University, Revised 2011. *Journal of Education, 27*(2), 162-171.

Brouwer, J., Fernandes, C. A. D. M., Steglich, C. E. G., Jansen, E. P. W. A., Hofman, W. H. A., & Flache, A. (2022). The development of peer networks and academic performance in learning communities in higher education. *Learning and Instruction, 80*, 1-11. https://doi.org/10.1016/j.learninstruc.2022.101603

Chawengchutirat, P. (2016). *Learning Activity in Health Education Subject for Improving and Caring Personal Health of Mathayomsuksa III Students by Using Project Base Learning* (Master's thesis, Burapha University, Chonburi, Thailand).

Chitchayavanich, K. (2019). *Learning Management*. Bangkok: Chulalongkorn University Press.

Chusawatdikul, C. (2015). *The Effect of E-Learning with Project-Based Learning via Cloud Computing Learning Management System on Achievement of Computer Programming Applications Subject* (Master's thesis, King Mongkut's Institute of Technology Ladkrabang, Bangkok, Thailand).

Clark, J. T., & Chrispeels, J. H. (2022). Using multiple leadership frames to understand how two school principals are influencing teachers' practices and achievement of Hispanic English learners. *Journal of Educational Administration, 60*(3), 303-322. https://doi.org/10.1108/JEA-03-2021-0054

Daosri, T., Thipthonglad, P., & Khempong, P. (2021). The study of the learning management approach of school in the 21st Century. *Journal of Humanities and Social Sciences, 11*(1), 59-74.

Dechakupta, P., & Yindeesuk, P. (2015). *Learning Management in the 21st Century* (2nd ed.). Bangkok: Chulalongkorn University Printing House.

Dietrich, J., Schmiedek, F., & Moeller, J. (2022). Academic motivation and emotions are experienced in learning situations, so let's study them. Introduction to the special issue. *Learning and Instruction, 81*, 1-4. https://doi.org/10.1016/j.learninstruc.2022.101623

Fakkao, S. (2018). *Learning Management to Enhance 21st Century Skills*. Bangkok: Faculty of Education, Chandrakasem Rajabhat University.

Fayda-Kinik, F. S. (2022). The role of organisational commitment in knowledge sharing amongst academics: an insight into the critical perspectives for higher education. *International Journal of Educational Management, 36*(2), 179-193. https://doi.org/10.1108/IJEM-03-2021-0097

Fernandez, B. B., Mula-Falcon, J., & Domingo, J. (2023). Educational constellation: A systematic review of macro-networks in education. *International Journal of Educational Management, 37*(1), 259-277. https://doi.org/10.1108/IJEM-09-2022-0339

Gordon, M. F., & Hart, H. (2022). How strong principals succeed: improving student achievement in high-poverty urban schools. *Journal of Educational Administration, 60*(3), 288-302. https://doi.org/10.1108/JEA-03-2021-0063.

Guo, J., Lv, S., Wang, S., Wei, S., Guo, Y., & Yang, L. (2023). Reciprocal modeling of university students' perceptions of the learning environment, engagement, and learning outcome: A longitudinal study. *Learning and Instruction, 81*, 1-10. https://doi.org/10.1016/j.learninstruc.2022.101692

Haataja, E. S. H., Chan, M. C. E., Salonen, V., & Clarke, D. J. (2022). Can noncomplementarity of agency lead to successful problem solving? A case study on students' interpersonal behaviors in mathematical problem-solving collaboration. *Learning and Instruction, 81*, 1-10. https://doi.org/10.1016/j.learninstruc.2022.101657

Huang, Y. F., & Do, M. H. (2021). Review of empirical research on university social responsibility. *International Journal of Educational Management, 35*(3), 549-563. https://doi.org/10.1108/IJEM-10-2020-0449

Jeenawong, R. (2013). *The Development of Project-Based Instruction on Microwave Antenna for Undergraduate Education in Telecommunication Engineering* (Doctoral dissertation, King Mongkut's University of Technology North Bangkok, Bangkok, Thailand).

Kamjun, T. (2018). *The Result of Learning Management in Visual Art Subject of Art and Fashion Design by Flipped Classroom Concept and Project-Based Learning for Grade 10 Students* (Master's thesis, Khon

Kaen University, Khon Kaen, Thailand).

Kazi, M. (2021). Instructional leadership: teaching evaluation as a key element for 6th grade student's achievement in mathematics. *International Journal of Educational Management, 35*(6), 1191-1204. https://doi.org/10.1108/IJEM-03-2021-0091

Keawmanee, N. (2019). *Study of Learning Achievements in the Learning Area of Occupations and Technology and Creative Thinking Ability of Grade 9 Students Using Project-Based Learning Approach* (Master's thesis, Valaya Alongkorn Rajabhat University under the Royal Patronage, Pathum Thani, Thailand).

Kensang, N. (2017). *Project Based Learning Model in Computer and Information for Work Crouse for the First Year Students of Vocational Certificate in Visual Communication Design Major* (Master's thesis, King Mongkut's University of Technology Thonburi, Bangkok, Thailand).

Khaemmanee, T. (2018). *Teaching Science: Knowledge to Manage the Efficient Learning Process* (21st ed.). Bangkok: Chulalongkorn University Printing House.

Ladnok, C. (2019). *Development of Online Lessons with Project-Based Learning Approach Entitled Products Design using Computer Program in Information Technology Subject for Mathyomsuksa 2* (Master's thesis, Nakhon Ratchasima Rajabhat University, Nakhon Ratchasima, Thailand).

Lorwongtrakool, P., & Lorwongtrakool, C. (2021). *Research Report: The Study of the Learning by Doing to Promote Creative Thinking through Project Based Learning for Management Information System of Higher Education*. Rajamangala University of Technology Isan, Khon Kaen, Thailand.

Maharma, H. A., & Abusa'aleek, R. (2022). Teachers' Feedback and Students' Academic Achievement. *International Education Studies, 15*(6), 65-70. https://doi.org/10.5539/ies.v15n6p65

Nilsook, P. (2022). *Vocational Academia Teacher in the 21st Century*. Retrieved November 1, 2022, from https://www.academia.edu/10810551

Panich, V. (2012). *Ways to Create Learning for Students in the 21st Century*. Bangkok: Sodsri-Saritwong Foundation.

Pankun, S. (2016). *The Developing of Project Based Learning with Web-Based Programming to Encourage Web Development Skill* (Master's thesis, Khon Kaen University, Khon Kaen, Thailand).

Pimpimool, A., & Pimpimool, I. (2021). *Collaborative Instructional Model on Web-Based Instruction for Graduate Diploma in Teaching Certification Students of Ubon Ratchathani Rajabhat University.* Ubon Ratchathani Rajabhat University, Ubon Ratchathani, Thailand.

Poomas, P. (2017). *Development of the Project-Based Instructional System for Enhancing Information Literacy of Undergraduate Students of Burapha University* (Doctoral dissertation, Burapha University, Chonburi, Thailand).

Shava, G., & Heystek, J. (2021). Managing teaching and learning: integrating instructional and transformational leadership in South African schools context. *International Journal of Educational Management, 35*(5), 1048-1062. https://doi.org/10.1108/IJEM-11-2020-0533

Sintapanon, S. (2018). *Instructional Innovation for Developing Skills of Learners in the 21st Century*. Bangkok: 9119 Technique Printing Press.

Srijumnong, J., & Serthsri, S. (2017). *The Model of Development for Mathematics Teachers in Loei and Khon Kean Province by Project Based Learning Based on Empowerment Approach*. Loei: Faculty of Education, Loei Rajabhat University.

Suvarnaphaet, P. (2014). *The Development of Blended Learning Model using Problem-Based Learning and Inquiry-Based Learning to Enhance Physics Expectation of Undergraduate Students* (Doctoral dissertation, Silpakorn University, Bangkok, Thailand).

Tiantong, M. (2012). *Research Methodology in Computer Education* (2nd ed.). Bangkok: Danex Intercorporation.

Tiantong, M. (2013). *Innovation: Computer-Based Learning and Teaching*. Bangkok: Danex Intercorporation.

Tumnanchit, B. (2022). The Instruction with Online Lessons Combined with Cooperative Learning by Using Learning through Digital Storytelling. *Journal of Technical Education Development, 34*(123), 3-12. https://doi.org/10.14416/j.ted.2022.06.014

Vallaeys, F., Oliveira, M. L. S., Crissien, T., Solano, D., & Suarez, A. (2022). State of the art of university social

responsibility: a standardized model and compared self-diagnosis in Latin America. *International Journal of Educational Management, 36*(3), 325-340. https://doi.org/10.1108/IJEM-05-2020-0235

Vemde, L. V., Donker, M. H., & Mainhard, T. (2022). Teachers, loosen up! How teachers can trigger interpersonally cooperative behavior in students at risk of academic failure. *Learning and Instruction, 81*, 1-14. https://doi.org/10.1016/j.learninstruc.2022.101687

Wongarmart, S. (2018). *The Result of Art Learning Management of Sculpture from Natural Materials with Project-Based Learning for Grade 9 Students* (Master's thesis, Khon Kaen University, Khon Kaen, Thailand).

Wongsuriya, W. (2017). *A Development of Science and Technology based Learning Activities using Project-Based Learning under Learning Center Management in the Topic of C++ Programming Application* (Master's thesis, King Mongkut's University of Technology North Bangkok, Bangkok, Thailand).

Acknowledgments

I would like to especially thank and appreciate Asst. Prof. Dr. Sarayut Phorncharoen who assisted in critiquing this study and manuscript preparation.

Informed consent

Obtained.

Ethics approval

The Publication Ethics Committee of the Canadian Center of Science and Education.

The journal's policies adhere to the Core Practices established by the Committee on Publication Ethics (COPE).

Provenance and peer review

Not commissioned; externally double-blind peer reviewed.

Data availability statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Data sharing statement

No additional data are available.