

ผลของการจัดการเรียนรู้แบบโครงงานเป็นฐานเพื่อเสริมสร้างทักษะแห่งศตวรรษที่ 21 ของนิสิตพยาบาลระดับปริญญาตรี

The Effect of Project-Based Learning to Enhance the 21st Century Skills of Baccalaureate Nursing Students

นิพนธ์ต้นฉบับ

Original Article

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บทคัดย่อ

วัตถุประสงค์: เพื่อ (1) เปรียบเทียบผลสัมฤทธิ์ทางการเรียน ความสามารถในการทำโครงงาน และทักษะแห่งศตวรรษที่ 21 ภายหลังการเรียนรู้แบบโครงงานเป็นฐานกับเกณฑ์ที่กำหนด (อย่างน้อยร้อยละ 75) (2) เปรียบเทียบความสามารถในการทำโครงงาน และทักษะแห่งศตวรรษที่ 21 ภายหลังการเรียนรู้แบบโครงงานเป็นฐานของนิสิตพยาบาลที่มีความสามารถทางการเรียนต่างกัน และ (3) เปรียบเทียบแต่ละด้านของทักษะแห่งศตวรรษที่ 21 ก่อนและหลังการเรียนรู้แบบโครงงานเป็นฐาน **วิธีการศึกษา:** การวิจัยกึ่งทดลองแบบกลุ่มเดียววัดก่อน-หลังนี้มีกลุ่มตัวอย่างคือนิสิตพยาบาลชั้นปีที่ 3 คณะพยาบาลศาสตร์ มหาวิทยาลัยบูรพา ที่ลงทะเบียนเรียนวิชาการวิจัยและสารสนเทศทางการพยาบาลในปีการศึกษา 2559 จำนวน 60 คน เครื่องมือวิจัยคือ แผนการจัดการเรียนรู้แบบโครงงานเป็นฐาน และแบบสอบถามที่ใช้วัดทักษะแห่งศตวรรษที่ 21 และความสามารถในการทำโครงงาน สถิติที่ใช้ในการวิเคราะห์ข้อมูลคือ สถิติพรรณนา การทดสอบที การทดสอบทีรายคู่ และการทดสอบความแปรปรวนทางเดียว **ผลการศึกษา:** (1) พบว่าคะแนนผลสัมฤทธิ์ทางการเรียนหลังการเรียนรู้ต่ำกว่าเกณฑ์ที่กำหนด ส่วนคะแนนความสามารถในการทำโครงงาน และคะแนนเฉลี่ยทักษะแห่งศตวรรษที่ 21 สูงกว่าเกณฑ์ที่กำหนดอย่างมีนัยสำคัญทางสถิติ (P -value < 0.01, < 0.05 และ < 0.001 ตามลำดับ) (2) นิสิตที่มีความสามารถทางการเรียนต่างกันมีคะแนนความสามารถในการทำโครงงาน และคะแนนทักษะแห่งศตวรรษที่ 21 ไม่ต่างกัน (3) คะแนนรวมทักษะแห่งศตวรรษที่ 21 และคะแนนรายด้าน คือ ด้าน 3R (อ่านออก เขียนได้ และคณิตศาสตร์) ด้านการคิดอย่างมีวิจารณญาณและการแก้ปัญหา ด้านการคิดสร้างสรรค์และนวัตกรรม ด้านความร่วมมือ การทำงานเป็นทีมและภาวะผู้นำ ด้านการสื่อสาร การรู้เท่าทันสารสนเทศและสื่อ ด้านคอมพิวเตอร์ เทคโนโลยีสารสนเทศและการสื่อสาร และด้านทักษะอาชีพและการเรียนรู้หลังการเรียนรู้สูงกว่าก่อนเรียนอย่างมีนัยสำคัญทางสถิติ (P -value < 0.01) **สรุป:** การจัดการเรียนรู้แบบโครงงานเป็นฐานเป็นวิธีที่เหมาะสมในการส่งเสริมและทักษะแห่งศตวรรษที่ 21 ให้กับนิสิตพยาบาลได้

คำสำคัญ: นิสิตพยาบาล, การจัดการเรียนรู้แบบโครงงานเป็นฐาน, ทักษะแห่งศตวรรษที่ 21

Abstract

Objective: To compare (1) learning achievement, project running ability, and the 21st century skills with their respective 75% cut-off criteria after the project-based learning among nursing students, (2) the project running ability and the 21st century skills after the project-based learning between students with different learning ability, and (3) compare each of the 21st century skills before and after the project-based learning. **Methods:** This one-group pretest-posttest quasi-experimental study recruited 60 3rd year nursing students of Burapha University who enrolled in the regular Research and Nursing Informatics course. Research instruments were project-based learning plans and two questionnaires to measure project running ability and students' 21st century skills. Descriptive, one sample t-test, paired t-test, and one way-ANOVA were used for statistical analysis. **Results:** (1) Mean score of learning achievement was lower and mean scores of project running ability and 21st century skills were higher than their respective cut-off criteria with statistical significance (P -value < 0.01, < 0.05 and < 0.001, respectively). (2) There were no differences in project running ability and the 21st century skills regarding different learning ability. (3) The overall mean scores of the 21st century skills and their individual skills including 3Rs (i.e., (R)eadng, (w)Riting, and (a)Rithmetic skill, critical thinking and problem-solving skill, creativity and innovation skill, collaboration, teamwork and leadership skill, communication, information and media literacy skill, computing and information communication technology literacy skill, and career and learning skill after the project-based learning were significantly higher than those before the learning (P -value < 0.01). **Conclusion:** Project-based learning is an appropriate method to enhance the 21st century skills of nursing students.

Keywords: nursing students, project-based learning, 21st century skills

Editorial note

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Introduction

Educators in all disciplines have paid attention on how to prepare students to live their lives in society while technology has been changed dramatically. One example of the changes in technology involving in our everyday life is the number of people who use YouTube, Web blogs, mobile

mapping and bar-codes on smart phone is increasing day by day.¹ It is noticed that students also pay attention on their mobile phones while they are studying. Therefore, educators have the changing ways in teaching to persuade students' attention which is related to their generations. Generations

are defined as groups of people born within the same span of years who share a unique identity due to life experiences² due to being born in a specific time period and it was first introduced by Karl Mannheim in the early 1920s.³ Therefore, Rodphothong and colleagues (2016) indicated problems in working between nurses who had different generations.⁴

Similar to other education, nursing education has to adapt the teaching strategies to use multiple and innovative ways of teaching and learning methods. These new methods are needed to design learning activities which encourage critical thinking, problem solving skills, creativity and high communication skills which are linked to real life practice.⁵ There are four issues which are essential for all nurse educators in Thailand to be concerned. Firstly, there are some changes of nursing student characteristics because of their generation while nursing educators are at different generation which is called 'generation gap'.⁶ For example, Gen Z students have been called technology savants, constantly adapting to new technology and expecting their teachers to do the same. This could potentially be a problem because many nursing faculty members are older and more likely to be Baby Boomers⁷ who are not as technologically sophisticated as a person born into Generation X or Generation Y.⁸ Therefore, nurse educators have to understand these differences and focus on student needs without compromising standard.⁸ Secondly, it is also the responsibility of nurse educators to teach the skills for nursing students to stay in the workplace in the 21st century society. Trilling and Fadel (2009) reviewed the surveys and suggested the 21st century skills including 1) 3Rs-reading, (w)Riting, (a)Rithmetic, 2) critical thinking and problem solving, 3) creativity and innovation, 4) cross-cultural understanding, 5) collaboration, teamwork and leadership, 6) communications, information, and media literacy, 7) computing and information communication technology (ICT) literacy, and 8) career and learning skills.⁹ Moreover, Sarakshetrin and co-workers (2019) suggested that nurse educators should prepare teaching and learning activities with concerns of atmosphere of learning, cultural difference understanding, transformative learning, information and technology availability, verbal communication and student empowerment. They also suggested project based teaching as the strategy which can improve student critical thinking and verbal communication.¹⁰ Thirdly, the regulations of Thailand Nursing Council about nurse competency are still

the aims of the learning and teaching.¹¹ Lastly, the Health Professional Education Foundation (2016) suggested nursing education should promote transforming teaching and learning methods, as well as, various strategies that promote critical thinking and practice in real situations need to be considered regarding to education reform of health professionals for the 21st century.¹²

Project-Based Learning (PBL) is a teaching strategy which support John Dewey's concept of learning by doing, so it is a student-driven, teacher-facilitated approach to learning.¹³ Learners pursue knowledge by asking questions from their natural curiosity. Students develop a research question under the teacher's supervision. Most projects contain reading, writing, and mathematics. Many questions are science-based or current social problems. The outcome of PBL is greater understanding of a topic, deeper learning, higher-level reading, and increased motivation to learn.¹⁴ There are two essential components of projects. Firstly, they require a driving question or problem that serves to organize the project activities. Secondly, these activities should result in inventions that finish a final product. Project-based learning has a lot of potential to enhance 21st century skills and engage students in real-world tasks. It is not only beneficial for students, but also for educators.¹⁵

Research competency is one of the eight nursing competencies which was announced by the Thailand Nursing and Midwifery Council in 2009.¹¹ The knowledge of nursing research is not only important for individual nurse to contribute a variety of skills and experiences to the science of nursing care, but also for the advancement and reputation of nursing profession.¹⁶ The nursing research course for bachelor degree program in Burapha University, Thailand aimed to encourage students to know concepts and nursing research methodology, utilize nursing research in nursing practice, search and make a decision of information for developing self-study skills and continuous nursing profession development. This course also encourages nursing students' competencies in critical thinking and problem solving, basic research competency and innovation, mathematics, information management ability to work in team, communication to others effectively both in Thai and English, basic computer program, and informatics technology which are most crucial 21st century skill. Research methodology is the most challenging course for nursing students because they have work in group to write research

design, selection of sample, conduct data analysis, and present the findings.¹⁶ In conducting a research project, students work in group, request consultation from nurse educators when they have questions, and report contribution from each of the group members.

Project-based learning in undergraduate students has been reported in only a few research investigations. Braguglia & Jackson (2012) reported the 95 percentage of student who received project-based teaching in research course had knowledge at least 80 percentage and got higher score in doing research project.¹⁷ Khawloueng reported that students who received project-based instruction had significant different critical thinking score higher than students who received usual teaching.¹⁸ To solve problems about the nursing students' attention and also lack of contribution, the application of project based learning was applied in teaching and learning for this subject. It was noticed that researchers investigated effects of project-based learning on the different skills¹⁸ and learning achievement between pretest and posttest.¹⁷ However, some researchers compared skills and learning achievement at posttest with a cut-off criterion indicating proficient level of student performance.¹⁷ It is one type of criterion-referenced evaluation which is used to evaluate teaching method. No research in nursing field has applied project-based learning with nursing research and informatics. In addition, differences in learning achievement among various learning methods (i.e., project running ability, 21st century skills, and the cut-off criterion score evaluation) in nursing students have not been studied. Finally, there has been a lack of research investigating the differences of project running ability and the 21st century skills among nursing students who have different learning abilities. It is expected that the findings of this present study could be useful for the educators applying project-based learning.

This research aimed to 1) determine the effects of project-based learning on learning achievement, project running ability, and the 21st century skills after the project-based learning with the cut-off criterion of 75 percentage, 2) compare the project running ability and the 21st century skills after the project-based learning between different groups of students who had different learning ability, and 3) compare the students' 21st century skills before and after the project-based learning. The independent variable was learning ability, whereas the dependent variables were learning

achievement, project running ability, and the 21st century skills.

In accordance with the study questions, study hypotheses were 1) the mean scores of learning achievement, project running ability, and the overall 21st century skills after the project-based learning were not less than 75 percentage cut-off criterion, 2) nursing students who had different learning abilities had different scores of project running ability and overall 21st century skills after the project-based learning, 3) overall and individual scores of the 21st century skills after the project-based learning were higher than those before the learning. Individual 21st century skills included 3Rs (Reading, (w)Riting, and (a)Rithmetic) skill, critical thinking and problem-solving skill, 3) creativity and innovation skill, cross-cultural understanding skill, collaboration, teamwork and leadership skill, communications, information, and media literacy skill, computing and information communication technology literacy skill, and career and learning skill.

Methods

This research used the one group-pre posttest design. The study population was 181 3rd year bachelor's degree nursing students at the Faculty of Nursing, Burapha University who enrolled in the course of 104301 Research and Nursing Informatics in the second semester of the academic year 2016. The sample was 60 3rd year bachelor degree nursing students in group three of the 104301 course selected by the cluster sampling. According to Yaduvanshi and Singh's report, many researchers investigated the role of cooperative learning affecting diverse academic abilities commonly categorized as low, average and high achievers.¹⁹ Educators who apply project-based learning must facilitate students to collaborate with peers, so cooperative learning is one of the features of project-based learning.²⁰ Sampled students were divided into three subgroups depending on their learning ability to learn which was categorized as high, medium and low level. Based on the actual range of participants' cumulative grade point average (GPA) of 2.23 to 3.97, cut-off values of 25th percentile (GPA 2.83) and 75th percentile (GPA 3.32) were applied to categorize them into three groups.²¹ As a result, low, medium and high learning ability was represented by GPA of 2.23 – 2.83, 2.84 – 3.31, and 3.32 – 3.97, respectively.

Ethical consideration

This research project received a certified approval by the research ethical committee of Burapha University (No. 3/2017). All participants signed the consent form after they was introduced about the aims of the study and their right to withdraw from the study anytime they requested.

Study procedures

Process of the project-based learning was incorporated into the regular course of 104301 Research and Nursing Informatics. There were three stages in the research process. At the first stage, the researcher made teaching plans and work sheets for each activity. The process of teaching was different from the usual one. The researcher applied project-based teaching including studying all content before practicing research process by completing assignments in class. The steps of conducting project consisted of 1) problem identification, 2) data collection design, 3) data collection, 4) data analysis, and 5) conclusion and presentation. At the second stage, the participants were asked to fill up their personal data, GPA, and the 21st century skills questionnaire at pretest. The participants received project-based instruction for 15 weeks. These lessons were divided into 7 modules including introduction to nursing research, quantitative nursing research, qualitative nursing research, nursing informatics, research process, research presentation, and research utilization. These classes lasted 1 to 5 hours. In addition to these classes, another 10 classroom practices included searching the data base, conducting a research project and conducting research presentation in classroom. These practices lasted 2 to 6 hours. At the final stages, the participants were asked to answer 21st century skills questionnaire and ability to do project questionnaire after the project-based learning. Their course examination scores were also recorded. Data collection was conducted from January 1st, 2017 to May 31st, 2017.

Study instruments

The study instruments included those for experiment and data collection as follows. A set of 7 teaching plans were designed by the researcher as guided by the five steps of project-based learning including 1) problem identification, 2) data collection design, 3) data collection, 4) data analysis, and 5) conclusion and presentation. The instrument also

included 10 work sheets. This learning instrument was approved by three experts with acceptable content validity (IOC of 0.67 to 1.00).

Data collection tool consisted of two questionnaires, namely project running ability and 21st century skills. The project running ability was defined as successfully managed tasks in doing research project of nursing students. The project running ability questionnaire was developed by Kaoleaung in 2007.¹⁸ It contains 25 items representing five parts including 1) problem identification (4 items), 2) data collection design (8 items), 3) data collection procedure (4 items), 4) data analysis (4 items), and 5) conclusion and presentation (5 items). The response is a 5-point rating scale ranging from 1 (improvement needed), to 2 (poor), 3 (fair), 4 (good), and 5 (very good). In this study, internal consistency reliability was high with a Cronbach's alpha coefficient of 0.97. According to Srisatidnarakul²², project running ability based on the total mean scores could be classified as improvement needed, poor, fair, good and very good (1.00 - 1.46, 1.50 - 2.49, 2.50 - 3.49, 3.50 - 4.49, and 4.50 - 5.00 points, respectively).¹⁸ With a total score of 125 points, 93.75 points corresponded to the 75% cut-off criterion.

The 21st century skills were defined as the 3R and 7C of nursing students.⁹ It was developed by Tunner et al in 2015.²³ The total of 63 items included 1) 3Rs (Reading, (w)Riting, and (a)Rithmetic) skill (11 items), 2) critical thinking and problem-solving skill (8 items), 3) creativity and innovation skill (6 items), 4) cross-cultural understanding skill (4 items), 5) collaboration, teamwork and leadership skill (9 items), 6) communications, information, and media literacy skill (8 items), 7) computing and information communication technology literacy skill (7 items), and 8) career and learning skill (10 items). The response format is a 5-point rating scale ranging from 1 (no skill), to 2 (urgent improvement needed), 3 (poor), 4 (good), and 5 (very good). In this study, the internal consistency reliability was high with a Cronbach's alpha coefficient of 0.97. Levels of the 21st century skills could be classified as very low, low, medium, good, and very good according to the total scores (1 - 1.50, 1.51 - 2.50, 2.51 - 3.50, 3.51 - 4.50, and 4.51 - 5.00 points, respectively).²¹ With a total score of 315 points, 236.25 points corresponded to the 75% cut-off criterion.

Each participant was asked for demographic information including sex, academic level, and grade point average. Moreover, the learning achievement was defined as the

course score which nursing students obtained from the examination and assignments at the end of the research and nursing informatics course. Out of 100 points for the regular course, the 75th percentile cut-off criterion was 75.00.

Data analysis

Demographic information and scores of all study variables were presented with descriptive statistics including frequency with percentage and mean with standard deviation. Mean scores of learning achievement, project running ability, and the 21st century skills after the project-based learning were tested against their respectively 75th cut-off criterion using one-sample t test. Mean scores of project running ability and the 21st century skills after the project-based learning by levels of learning ability (low, medium and high) were tested using one-way ANOVA. Mean scores of each of the 21st century skills before and after the project-based learning were compared using paired t test or Wilcoxon signed rank test, as appropriate. Statistical significance was set at a type I error of 5% or *P*-value < 0.05. All analyses were conducted using the IBM SPSS Statistic Premium Authorized User V 26.

Results

Majority of the participants in this study were women (86.67%), 22 years old (56.67%), and had a medium learning ability (50.00%) (Table 1).

Table 1 Characteristics of nursing students (N = 60).

Characteristics	N	%
Gender		
Female	52	86.67
Male	8	13.33
Age		
21	19	31.67
22	34	56.67
23	5	8.33
24	1	1.67
25	1	1.67
Learning ability*		
Low (GPA: 2.23 – 2.83)	15	25.00
Medium (GPA: 2.84 – 3.31)	30	50.00
High (GPA: 3.32 – 3.97)	15	25.00

* Learning ability: GPAs at ≤ 25, 26 – 74 and ≥ 75 percentiles for low, medium and high learning ability, respectively.²¹

After the project-based learning, learning achievement mean score was significantly lower than the cut-off criterion of 75% (*P*-value = 0.002). The mean scores of project running ability and the 21st century skills were significantly higher than the cut-off criterion of 75% (*P*-value = 0.030 and < 0.001, respectively) (Table 2).

Table 2 Mean scores of learning achievement, project running ability, and the 21st century skills study variables after the project-based learning compared with the cut-off criterion of 75% (N = 60).

Variable	Mean	S.D.	<i>t</i>	<i>P</i> -value
Learning achievement	72.49	5.91	-3.265	0.002
Project running ability	97.60	13.18	2.226	0.030
The 21 st century skills	253.17	26.96	4.568	< 0.001

* One-sample t test comparing mean score with its 75th percentile cut-off criterion, i.e., 75.00, 93.75 and 236.25 points for learning achievement, project running ability and 21st century skills, respectively.

After the project-based learning, participants with different learning ability did not present any differences in project running ability or the 21st century skills (Table 3).

Table 3 Mean scores of project running ability and the 21st century skills by levels of learning ability after the project-based learning (N = 60).

Study variables	Level of learning ability (mean, SD)						<i>P</i> -value*
	Low		Medium		High		
Project running ability	105.75	12.20	97.21	13.88	93.10	6.93	0.54
The 21 st century skills	268.33	22.28	248.97	27.37	258.80	16.03	0.67

* ANOVA test.

The overall mean score of the 21st century skills before the project-based learning was significantly higher than that after the learning (*P*-value < 0.001) (Table 4). All scores of domains of the 21st century skills, except the cross-cultural understanding, after the learning were significantly higher than those before the learning. The significantly improved domains included skills of (1) 3rs-Reading, (w)Riting, (a)Rithmetic, (2) critical thinking and problem solving, (3) creativity and innovation, (4) collaboration, teamwork and leadership, (5) communications, information, and media literacy, (6) computing and information communication technology, and (7) career and learning.

Table 4 Mean scores of each of 21st century skills before and after the project-based learning (N = 60).

Skills	21 st century skill scores				P. value
	(mean, SD) with level				
	Before learning		After learning		
3Rs-Reading, (w)Riting, (a)Rithmetic	3.20	0.47	3.68	0.52	< 0.001*
	<i>Medium</i>		<i>Good</i>		
Critical thinking and problem solving	3.25	0.37	3.94	0.52	< 0.001*
	<i>Medium</i>		<i>Good</i>		
Creativity and innovation	3.30	0.53	3.94	0.52	< 0.001*
	<i>Medium</i>		<i>Good</i>		
Cross-cultural understanding	4.04	0.56	4.26	0.57	0.004†
	<i>Good</i>		<i>Good</i>		
Collaboration, teamwork and leadership	3.69	0.49	4.17	0.50	< 0.001†
	<i>Good</i>		<i>Good</i>		
Communications, information, and media literacy	3.49	0.45	4.07	0.53	< 0.001†
	<i>Medium</i>		<i>Good</i>		
Computing and information communication technology	4.0	0.64	4.41	0.46	< 0.001†
	<i>Good</i>		<i>Good</i>		
Career and learning	3.88	0.48	4.32	0.43	< 0.001†
	<i>Good</i>		<i>Good</i>		
Overall 21 st century skills	3.57	0.36	4.04	0.41	< 0.001*
	<i>Good</i>		<i>Good</i>		

* Paired t test.

† Wilcoxon signed ranks test.

Discussions and Conclusion

After the experiment, the mean score of learning achievement was significantly lower than the cut-off criterion of 75% (the score of 75 points of the regular course) while those of project running ability and the 21st century skills were significantly higher than the criterion. It could be explained that the focus of the experiment tool was on the research activities more than the knowledge. Moreover, that the measurement of learning achievement in this course was organized at ten weeks after the regular course lecture. The long period between lecture and examination may affect student's memories in some parts which they used less. In addition, students studied clinical teaching at the same time which could put more burden on the student. The results from the Tongsaawang's study indicated that nursing students who had high level of stress would correlate with the learning achievement.²⁴ Although learning achievement was significantly lower than the cut-off criterion, as high as 52.54% of students obtained B+ or A from the regular course. This result is different from the Braguglia and Jackson's study which indicated that 95% of the students earned a score of 80% on the assessment of the course.¹⁷ Project-based learning provided opportunity for student to work in group under supervision of educators when they did assignments.

Such learning could enhance student's ability to conduct the project. Therefore, the ability to run a project at posttest was significantly higher than the cut-off criterion of 75%. In this study, students worked with peers to identify problem, design how to collect data, collect data, analyze data, make a conclusion and present their project findings. This could result in the level of the 21st century skills at posttest significantly higher than the cut-off criterion of 75%.

Participating students with different learning ability did not have differences in project running ability and the 21st century skills. Students could have had various learning ability because they identified their own topic of interest and worked in group. They taught and helped each other. Their performance according to project running and the 21st skills could have been the results of their shared learning experience. This could result in comparable scores of the project running and the 21st skills among students with different learning ability. Our finding was different from the work of Khawloueng which indicated that participants with higher learning ability had project running ability higher than those with lower learning ability.¹⁸ However, such discrepancy could result from different categorization of learning ability between studies.

The overall mean score of the 21st century skills at post-test was significantly higher than that at the pre-test. This finding supported the ideas proposed by Trilling and Fadel (2009) that questions and problems were the most powerful learning tools while scientific approach could contribute to the 21st century education.⁹ The mean scores of sub-skills of 3rs-Reading, (w)Riting, (a)Rithmetic, critical thinking and problem solving, creativity and innovation, collaboration, teamwork and leadership, communications, information, and media literacy, computing and information communication technology literacy, and career and learning at post-test were significantly higher than those at pre-test. As opposed to most sub-skills of the 21st century skills, the mean score of cross-cultural understanding at post-test was not different from the pre-test. These participants were mostly 21 - 22 years old, so they were in generation Z. Their technology habits led them to demonstrate a limited attention span, and they were bored easily when they perceived monotony and repetition. The teaching approach should encourage them to focus on their group work including editing and refining the project.²⁵ The implementation of project-based learning in this study somehow fit the student's preference since they

were worked in small groups. The study of Wongdaeng and Hajihama (2018) reported students thought their reading, critical thinking and communication skills could be improved in their attempts to accomplish the project. They also reported students felt that with their active learning, they could make choices and lead others.²⁶

Our findings supported the work of Braguglia and Jackson (2012) which explained that when the project-based learning was applied in teaching research course, it provided an opportunity to practice decision making, report writing, and presentation of their work for critical review and publication.¹⁷ Therefore, the mean scores in reading, (w)riting skill and critical thinking and problem-solving skills were improved after the project-based learning. Most of these findings were similar to the study of Lawang and Junprasert (2017).²⁷ However, these findings were different from the study of Şenyuva and colleagues (2014) who found there was no statistically significant difference between the social skill average scores of students between pre-test and post-test.²⁸

This study had limitations because it was a one-group pretest-posttest quasi-experimental study which did not control some extraneous variables. Therefore, the future research should employ two or more groups to ensure a strong level of internal validity.

In conclusion, project-based learning could enhance project running ability, and the 21st century skills for nursing students. Therefore, it is challenging for nurse educators to learn how to apply it effectively. The highlights of this study were the application of the cut-off criterion score of 75% to measure the effects of project-based learning and also investigation on any effects of different learning abilities on project running ability, and the 21st century skills.

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