

PROJECT BASED LEARNING MODEL (PjBL) TO IMPROVE COLLABORATION SKILLS AND STUDENT COGNITIVE LEARNING RESULTS

Dewi Nur Aifah¹, Dyah Astriani^{2*}

^{1,2}Science Education Study Program, Faculty of Mathematics and Natural Sciences, Universitas Negeri Surabaya

*E-mail: dyahastriani@unesa.ac.id

Abstract

This research aims to describe the improvement in collaboration skills and cognitive learning outcomes of students using the PjBL learning model on mixed separation material. This type of research is quantitative research with a one-group pretest-posttest design. Data collection techniques use observation of collaboration skills, cognitive learning outcomes tests, and distribution of questionnaires. The results obtained from this research show that students' collaboration skills have increased at each meeting, from the collaborative category to very collaborative. Student learning outcomes have increased as evidenced by the average N-Gain score in the medium category. The results of the paired t-test show that there is a significant difference between cognitive learning outcomes before and after the implementation of the PjBL learning model. Based on the results obtained, it can be concluded that the implementation of the PjBL learning model has succeeded in improving collaboration skills and cognitive learning outcomes for junior high school students.

Keywords: Project Based Learning, collaborative skill, cognitive learning outcomes

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INTRODUCTION

The independent curriculum is a new paradigm in education and is designed to address the challenges of the 21st century by emphasizing skills such as collaboration, creativity, critical thinking, digital literacy, problem-solving, and communication (Rosmana et al., 2024). Education in the 21st century emphasizes the formation of moral traits and principles that are the basis for building responsible individuals who can contribute to society (Kemendikbud, 2016). Therefore, the abilities emphasized in the 21st century must be applied and taught in the education process so that students have the skills to overcome obstacles in the future (Fitriyah & Ramadani, 2021). One of the 21st-century skills that play an important role in supporting student success even after completing their studies is collaboration skills (Kholifah & Hariastuti, 2022).

Collaboration skills are important to have so that humans have sensitivity to the surrounding environment, can socialize, and control egos and feelings (Hayati et al., 2023). Collaboration skills according to Sunbanu & Mawardi (2019) are a series of learning processes carried out together where people listen, provide suggestions, take part in discussions, and support each other to

balance opinions and knowledge. In Natural Science (IPA) lessons, collaboration skills are very important because this field not only studies principles and facts but also problem-solving, creation processes, and phenomena (Sufajar & Qosyim, 2022). Therefore, in learning science, collaboration skills are needed because collaboration allows students to work together in groups, and each student will actively participate in solving a problem (Sholikah et al., 2023).

Learning observations at one of the public junior high schools in Surabaya found weaknesses in teaching and learning in group discussions. These weaknesses include, when learning is done in groups, students use group work time to talk to their friends and not cooperate. Most students do not understand the tasks that must be done, so the group work is usually only done by 1 or 2 students. In addition, some groups do not listen to the opinions of their friends. In Every discussion, students had to be motivated by the teacher because some students were not active and did not participate in the presentation. This illustrates that students' collaboration skills in the class are still not optimal.

The results of an interview with a Science Teacher at one of the 63 Surabaya State Junior High Schools,

explained that students' abilities were still at the C1 and C2 cognitive levels. In addition, science learning is often dominated by teachers rather than students, so communication between teachers and students only takes place in one direction. Limited student activities make students less active, so they have not been able to train students to collaborate and discuss. Research by Sari & Rochmiyati (2023) explains that learning that is not interactive and teachers who still dominate makes students less creative and collaborative because student activities only listen to the teacher explaining the material and writing explanations of material that is considered important.

Departing from this problem, a model that is student-oriented and that makes students work together with friends to increase understanding related to the concept of the material being studied is needed (Triastuti, 2020). This model allows students to conduct collaborative experiments and explore the material in various ways that interest them (Astriani et al., 2023). Through projects, it teaches students higher-order thinking by encouraging them to observe, analyze, argue, and conclude (Muis & Dewi, 2021). PjBL is a model whose student-oriented learning focuses on projects that are completed within a certain period and allows students to collaborate and actively participate in learning activities and gain explicit work experience. Collaboration skills play an important role in science learning because science studies relate phenomena and problem-solving. To support this, students can work together with group members, then each student will be moved to actively participate and be constructive in solving a problem. In this case, students will more easily digest the material, because students can apply their knowledge to the project directly so that students' cognitive learning outcomes will also increase.

Relevant research related to the PjBL model for collaboration skills and student learning outcomes, namely research by Khumaerah et al. (2023) showed that the application of the PjBL model was able to improve collaboration skills and student learning outcomes. Another study conducted by Asyhari & Arsana (2023) concluded that the PjBL model was effective in developing collaboration skills and student learning outcomes. In line with that, research by Khanifah et al. (2019) also concluded that there was a significant effect on students who received treatment in the form of PBL learning models on student learning outcomes.

The thing that distinguishes this research from previous research is the indicators of collaboration skills that are the focus of research. In previous studies, the indicators of collaboration skills that became the focus of research were positive interdependence, face-to-face interaction, individual personal accountability and responsibility, communication skills, and group work skills. Meanwhile, in this study, the collaboration indicators that became the focus of the research were the indicators proposed by Greenstein (2012) which were adjusted to the conditions in the classroom. These indicators include actively contributing, taking responsibility, compromising, and mutual respect between group members. Indicators of actively

contributing can be by communicating ideas, suggestions, or solutions discussed (Nopiani et al., 2023). Responsible indicators are important for students to be able to complete project tasks and examine projects wholeheartedly (Dewi et al., 2019). Indicators of compromise can be accepting mutually agreed provisions, accepting constructive suggestions and criticism, negotiating differences of opinion between members to obtain mutual agreement, and always compromising with the group in solving problems (Marita et al., 2023). Indicators of mutual respect can be shown by being polite and kind to fellow friends, respecting the opinions/ideas given by friends, and discussing ideas together (Irawati, 2015).

Based on the description above, research was conducted on "PjBL Learning Model to Improve Collaboration Skills and Student Learning Outcomes" to describe the improvement of student collaboration skills and student learning outcomes.

METHOD

This research uses pre-experimental designs with a One Group Pretest Posttest Design research design. This study did not use a control class, only used 1 experimental class. This research was conducted in an even semester in class VIII-B with 25 students. The method of selecting research subjects is by using a purposive sampling technique.

The data collection techniques used were observation and testing. Observation was used as a data collection method to observe students' collaboration skills in groups during the learning process in class. Observation of collaboration skills was carried out by 4 students, where 1 observer observed the collaboration skills of 1 study group during the discussion process. The observation sheet contains indicators of collaboration skills proposed by Greenstein (2012) and then elaborated into 10 statements. Filling in the collaboration skills observation sheet was done by ticking the "Yes" and "No" columns on each statement. The indicators of collaboration skills are outlined in Table 1.

Table 1 Indicators of Collaboration Skills

Indicators of Collaboration Skills	Number of statements
Actively Contribute	1,2,3
Take responsibility	4,5,6
Compromise	7,8
Mutual respect between group members	9,10

Data from the observation of collaboration skills were analyzed by calculating collaboration skills on each indicator. The results were then categorized based on the benchmark reference assessment in Table 2.

Table 2 Benchmark Assessment

Rate	Category
>80	Highly Collaborative
>60-80	Collaborative

Rate	Category
>40-60	Collaborative Enough
>20-40	Less Collaborative
≤ 20	Not Collaborative

(Widyoko, 2009)

The data were compared at each meeting to observe and describe the improvement of students' collaboration skills.

Students cognitive learning outcomes tests (pretest and posttest) were analyzed using the n-gain test, normality test, and paired t-test. The n-gain test was used to determine the improvement of students' cognitive learning outcomes between before and after treatment. The n-gain test results for each student were categorized according to the categories proposed by Hake (1999) as in Table 3.

Table 3 Category Of N-Gain

Skor gain	Category
$g > 0,7$	High
$0,3 \leq g \leq 0,7$	Medium
$g < 0,3$	Low

(Hake, 1999)

Furthermore, the results of the pretest and posttest were analyzed using the normality test to show whether the results obtained from the pretest and posttest were normally distributed or not. This study used the Shapiro-Wilk test as a normality test. Data is called normally distributed if (Sig.) > 0.05 and not normally distributed if (Sig.) < 0.05. Normally distributed data was further analyzed with paired t-tests.

The paired t-test aims to determine whether or not there is a difference between pretest and posttest scores using SPSS. The paired t-test is conducted using the Sig (2-tailed) significance level. The hypothesis made to conclude from this can be described as follows.

H_0 : $\alpha > 0,05$ showed that there was no difference between the results of the pretest and posttest results, so the research hypothesis was rejected.

H_1 : $\alpha < 0,05$ showed that there was a significant difference between the pretest and posttest results, so the research hypothesis is accepted.

RESULTS AND DISCUSSION

The learning process was carried out for three meetings in class VIII-B in one of the public junior high schools in Surabaya. The material used was mixture separation by applying the PjBL model. The steps of the PjBL model used were proposed by the George Lucas Education Foundation and adapted from Purnomo & Ilyas (2019) research: (1) Determine the fundamental question; (2) Plan the project; (3) Develop a schedule; (4) Monitor the course of the project (5) Product Assessment; (6) Evaluate the experience. The steps of the PjBL model are divided into three meetings due to time constraints. The first meeting of the PjBL steps that were implemented were determining the fundamental question, developing project planning, and developing a schedule. In the second

meeting, the steps implemented were monitoring the implementation of the project, then in the third meeting the PjBL steps implemented were testing the process and product results and evaluating the experience.

Collaboration Skills

The collaboration skills observed in this study refer to 4 types of indicators proposed by Greenstein (2012), namely: 1) Actively contributing, 2) Taking responsibility, 3) Compromise, and 4) Mutual respect between group members. The data analysis method used is using the percentage of each statement, then continued with the calculation of the average of each indicator of collaboration skills in units of percent. The data from the analysis of collaboration skills are outlined in Table 4.

Table 4 Percentage of Student Collaboration Skills (%)

Indicators of Collaboration Skills	Meeting			Average
	1	2	3	
Actively Contribute	53	58.7	76	63
Take responsibility	73	91	96	87
Compromise	74	80	90	81
Mutual respect between group members	62	88	92	81
Average	66	79.3	88.5	78

Table 4 shows that at the first meeting, the percentage of students' collaboration skills obtained an average of 66% in the collaborative category. In the second meeting, students' collaboration skills increased with an average of 79.3% categorized as collaborative. Furthermore, in the third meeting, students' collaboration skills also increased with an average of 88.5% categorized as very collaborative. All indicators of collaboration skills observed also increased at each meeting.

The indicator of actively contributing obtained results with an average of 63% in the collaborative category. at the first meeting obtained a percentage of 53% with a fairly collaborative category, this was because there were group members who still did not contribute actively when completing the LKS and projects. The second meeting saw an increase in this indicator with a percentage of 59%. This shows that students have begun to be trained to contribute actively in working on LKS and projects. In the third meeting, there was an increase in the percentage obtained, namely 76% in the collaborative category. This indicates that students have been trained to actively contribute to the completion of worksheets and projects. This is because in the PjBL learning model, students are actively involved in the learning process interact socially, and share understanding to achieve mutually agreed goals (Dewi, 2023). During the learning process, each student is required to be active in working on the project which is the final result.

The indicator takes responsibility obtained results with an average of 87% in the highly collaborative category, which means that students have been trained to be responsible by completing projects on time, following orders that have become their duties, and not playing

mobile phones during learning. This is because the PjBL model has the characteristics of students having the responsibility to find and manage the information obtained (Purnomo & Ilyas, 2019). Students are also responsible for completing all activities that support the success of learning such as obligation to the tasks that have been given, discipline at the time of implementing learning activities, and obeying the rules (Marlina et al., 2022). Each student carries the same obligation in his/her group.

The indicator of a compromise obtained results with an average of 81%, categorized as very collaborative. This shows that students can cooperate with group mates even though they have different opinions, and then negotiate these differences to achieve common goals and agreements. This is to Purnomo & Ilyas's (2019) statement that the PjBL learning model has the characteristics of students playing a role in making decisions and creating a framework. Marita et al. (2020) also stated that the achievement of indicators of the ability to compromise can be by accepting criticism and suggestions, making joint decisions, and negotiating different opinions to achieve common goals.

The indicator of mutual respect between group members obtained results with an average of 81% in the highly collaborative category. This indicates that students can respect their friends' opinions and speak politely when discussing. Overall, it can be concluded that students' collaboration skills are in the highly collaborative category after the implementation of the PjBL model. The results showed that when doing activities, students' collaboration skills were well-trained. Students were able to contribute actively, take responsibility, compromise, and respect each other among group members. The results show that the PjBL model can be a learning option implemented in schools so that students collaborate well. The PjBL model is in line with the basic learning "learning by doing" formulated by John Dewey which provides space for students to work productively and actively acquire knowledge. John Dewey also stated that a democratic classroom means that students are divided into groups to work on interesting projects according to students' own choices (Nugraha et al., 2023). In line with that, Vygotsky's theory also asserts that student-focused learning can make students interact, collaborate, and support each other to achieve mutually agreed goals (Wardani et al., 2023).

Student Cognitive Learning Outcomes

Measurement of students' cognitive learning outcomes was carried out by pretest and posttest. Both data were then analyzed using the n-gain test to determine the improvement of students' cognitive learning outcomes before and after the application of the PjBL model on mixture separation material (Astriani et al., 2023). The results of the n-gain analysis are presented in Table 5.

Table 5 N-Gain Test Results

Rage	Student Cognitive Learning Outcomes		
	Frequency	Percentage (%)	Category
$g < 0,3$	0	0	Low
$0,3 \leq g \leq 0,7$	18	72	Medium
$g > 0,7$	7	28	High
Average of <i>n-gain</i>	0,6		Medium

Based on Table 5. obtained n-gain scores for each student. From these calculations, it is obtained that student cognitive learning outcomes have increased with details of 18 students who are in moderate criteria, and 7 students are in high criteria. overall shows an increase from pretest scores to posttest scores. the increase can be seen from the average gain score obtained which is 0.6 and is included in the moderate criteria.

The data from the pretest and posttest results will then be tested for normality using the Shapiro-Wilk normality test. The Shapiro-Wilk test is used for research samples <50 (Bee Wah & Mohd Razali, 2011). The results of the normality test are presented in Table 6.

Table 6 Normality Test Results

	Shapiro Wilk		
	Statistic	df	Sig.
Pretest	.934	25	.107
Posttest	.940	25	.150

Based on Table 6. pretest and posttest data are normally distributed because the significance of pretest and posttest > 0.05. After the data is normally distributed, then a paired t-test is conducted to determine the difference in pretest and post-test scores. The results of the paired t-test are presented in Table 7.

Table 7 Paired T-Test Results

Mean	Std. Mean Error	t	df	Sig. (2-tailed)
-32.800	1.78139	-18.41	24	<.001

Based on the paired t-test output, the probability value of Sig. (2-tailed) probability value is <0.001. This value is <0.05 so that the decision can be made that H0 is rejected and H1 is accepted. It can be said that there is a difference between students' science learning outcomes for pretest and posttest, which means that there is an influence of the PjBL model on students' science learning outcomes.

Based on the results of data analysis, the PjBL model can improve students' cognitive learning outcomes. These results can be seen through the n-gain score obtained in the medium category, then the paired t-test results show a significant difference between the pretest results and the posttest results before and after the application of the PjBL model. The results of this study are in line with Asyhari & Arsana (2023) who concluded that student learning outcomes increased after the application of the

PjBL model from a percentage of completeness of 67% to 97%. This is because, through the PjBL model, students actively participate in learning activities and achieve their goals through social interaction and sharing understanding. This is in line with Vygotsky's theory which explains that developing students' knowledge can be done through social and peer interactions (Wardani et. al., 2023). This learning process provides space for students to share knowledge and understanding so that learning does not only focus on the teacher. In line with that, Piaget's theory also states that the teacher is only a facilitator and students must be active in constructing knowledge (Khoiruzzadi & Prasetya, 2021). Only by being active, students can master learning well.

CONCLUSION

Based on the description of the results of data analysis and discussion, it was found that the application of the PjBL model succeeded in improving the collaboration skills and cognitive learning outcomes of students in class VIII-B in one of the public junior high schools in Surabaya. Students' collaboration skills increased from a percentage of 66% categorized as collaborative at the first meeting to 88.5% categorized as very collaborative at the third meeting. Students' cognitive learning outcomes also increased as evidenced by the average N-Gain score in the moderate category and the paired t-test results showed that there was a significant difference between cognitive learning outcomes before and after the application of the PjBL learning model.

Suggestions that can be given for the research that has been done, namely: (1) Researchers can consider time management when learning takes place. Doing PjBL learning takes a longer time, so it is necessary to consider more time management so that the resulting project is maximised, (2) Teachers can use the PjBL model by adjusting the applicable material so that learning can be carried out optimally and collaboration skills and student cognitive learning outcomes increase.

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