Vol.12 (2), 2023, 100-115 DOI: 10.23960/jppk.v12.i2.2023.11
Jurnal Pendidikan dan Pembelajaran Kimia
e-ISSN: 2714-9595| p-ISSN 2302-1772
http://jurnal.fkip.unila.ac.id/index.php/JPK/index

Implementation of Project Based Learning to Improve Student Learning Outcomes and Activeness in Fundamental Laws Of Chemistry

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Received: Mey 15th, 2023 Accepted: July 8th, 2023 Online Published: August 1st, 2023

Abstract: Research has been carried out on the application of the Project Based Learning learning model to improve student learning outcomes and activities. This study aims to apply the Project Based Learning learning model to improve learning outcomes and the activity of students in class X even semesters on Basic Chemical Law material in class X 3 of SMA Negeri 2 Surabaya. This study was designed with a action research, namely the process of improving learning is carried out in two cycles with the assumption that if the first cycle is successful then the second cycle will serve as a consolidation. However, if cycle I is not successful, then cycle II is used as an improvement until the goal of improvement is achieved. The instrument in this study was the student activity observation sheet and the student learning outcomes test sheet. The data collection method used is the questionnaire method, the observation method, and the test method. The learning model used is declared effective if 80% of students get a minimum N-Gain score of 0.3 or in the medium category. Based on the results of the research and data analysis conducted, it can be concluded that the application of the Project Based Learning learning model can improve learning outcomes and the activeness of class X 3 students of SMA Negeri 2 Surabaya in the material on Basic Chemical Law for the 2022/2023 academic year. Student learning outcomes based on N-Gain increased from cycle I 0.28 or low criteria to 0.75 or high criteria in cycle II. This can also be seen from the activeness of students who have increased from 10% to 10.22% in learning activities.

Keywords: Project based learning, learning outcome, activeness.

Abstrak: ***Telah dilakukan penelitian penerapan model pembelajaran Project Based Learning untuk meningkatkan hasil belajar dan aktivitas peserta didik.*** *Penelitian ini bertujuan untuk menerapkan model pembelajaran Project Based Learning untuk meningkatkan hasil belajar dan keaktifan peserta didik kelas X semester genap pada materi Hukum Dasar Kimia di kelas X 3 SMA Negeri 2 Surabaya sebanyak 35 peserta didik. Penelitian ini didesain dengan penelitian Tindakan kelas yaitu proses perbaikan pembelajarandilaksanakan dalam dua siklus dengan asumsi apabila siklus I berhasil maka siklus II sebagai pemantapan. Akan tetapi apabila siklus I belum berhasil maka siklus II dijadikan perbaikan sampai dengan tujuan perbaikan tercapai. Instrumen pada penelitian ini adalah lembar observasi aktivitas siswa .dan lembar tes hasil belajar peserta didik. Metode pengumpulan data yang digunakan adalah metode angket, metode observasi, dan metode tes. Model pembelajaran Project Based Learning yang*

digunakan dinyatakan efektif apabila 80% peserta didik minimal mendapatkan nilai N-Gain sebesar 0,3 atau dalam kategori sedang. Berdasarkan hasil penelitian dan analisis data yang dilakukan dapat disimpulkan bahwa penerapan model pembelajaran Project Based Learning dapat meningkatkan hasil belajar dan keaktifan peserta didik kelas X 3 SMA Negeri 2 Surabaya pada materi Hukum Dasar Kimia tahun pelajaran 2022/2023. Hasil belajar peserta didik berdasarkan N-Gain mengalami peningkatan dari siklus I 0,28 atau kriteria rendah menjadi 0,75 atau kriteria tinggi pada siklus II. Hal tersebut juga terlihat dari keaktifan peserta didik mengalami peningkatan dari 10% menjadi 10,22% pada kegiatan pembelajaran.

Kata kunci: *Project Based Learning, hasil belajar, keaktivan*

- **INTRODUCTION**

Chemistry lessons are considered a very difficult and boring lesson. Students in class X 3 at SMA Negeri 2 Surabaya consider chemistry as one of the lessons that is considered difficult because of the abstract chemistry material and in the learning process not only memorizing but also calculating using formulas that they do not understand. According to (Rahma et al., 2019), chemistry learning must take into account the characteristics of chemistry as an attitude, process, and product. In general, students are able to follow the chemistry learning process well. However, there are still some students whose interest in learning is lacking, causing their enthusiasm for learning to be lacking, happy to talk to their other friends when the teacher is explaining, not wholeheartedly doing assignments, and not daring to ask the educator directly. According to (Wahyuningsih, 2023) learning is an activity carried out by students, this can be realized if students are directly involved in the learning process.

Based on observations and interviews with class X 3 chemistry teachers, the results show that the scores of students are still relatively low. Based on the results of the Coordinated Formative Test (TFT) of class X students on the material of the names of compounds and chemical reaction equations, there are still many students with scores below the KKM set by the school, namely njh. Data on student learning outcomes in class X 3 has the lowest score of 13, the highest score of 68 and a class average of 33.2. In essence, learning outcomes are changes in behavior that include cognitive, affective, and prokomotor domains (Rosyid & Suhayati, 2020). Learning outcomes are the most important benchmark for knowing the success of student learning (Maghfiroh & Hanafi, 2023). Educators have tried to improve students' activities and learning outcomes with varied learning media, but still cannot provide satisfactory results in terms of improving learning outcomes. Therefore, a model that invites students to be more active in the learning process is needed. learning

The reality in the field in the learning process emphasizes the lecture method. This causes students to be passive in the learning process. Chemistry lessons become boring for students because of memorizing concepts, facts and laws, this is not interesting for students so that learning outcomes become low. One of the important things in helping students understand learning material is by applying a cool and interesting learning model (Mistawati & Astuti, 2019). The model is one of the tools used in the implementation of education, which is used in delivering subject matter. Even easy subject matter is sometimes difficult to develop and be accepted by students because the method or learning model used is not appropriate. However, on the

contrary, a difficult lesson will be easily accepted and understood by students by the way of delivery and the learning model used is easy to understand, appropriate, and interesting (Husna & Yaswinda, 2023). The application of learning models is one of the factors that affect learning outcomes. When educators apply a learning model that suits their needs, the learning process and learning outcomes are as expected. Educators must be smart in choosing and sorting out the right learning model to be applied in the classroom according to the learning material. The model that can be applied to improve student learning outcomes is the Project Based Learning (PjBL) model.

The Project Based Learning (PjBL) model is a learning model that is centered on students and provides meaningful learning experiences. Learning experiences and concept acquisition are built on products produced in the project-based learning process (Amin, 2023). Laksono revealed that the learning process that applies the PjBL model requires students to work and design their own projects. In working on projects, students experience the learning process directly and build their own knowledge. This is in accordance with the principle of learning science, namely learning by doing, where science is established by discovering and searching for oneself through real experiences, so as to build one's abstract with objects created by oneself (Nurkhasanah, 2019). Learning outcomes in project-based learning are much better than cooperative learning in building the four pillars of learning. Improved learning outcomes are due to Project Based Learning several stages, namely determining fundamental questions, planning, compiling schedules, monitoring, testing results, evaluating experiences. These stages are organized, carried out, and evaluated by students themselves so that independence, responsibility and awareness of learning continue to grow in students.

Based on the description above, it is necessary to apply a project-based learning model to improve learning outcomes and student activity in basic chemical law material, namely "Application of Project Based Learning Model to Improve Learning Outcomes and Student Activity in Basic Chemical Law material."

▪ METHOD

This research is designed with a classroom action research model, namely the learning improvement process carried out in two cycles with the assumption that if cycle I am successful, cycle II is stabilized. However, if cycle I have not succeeded, cycle II is used as an improvement until the objectives are achieved. The cycle can be seen in the following figure:

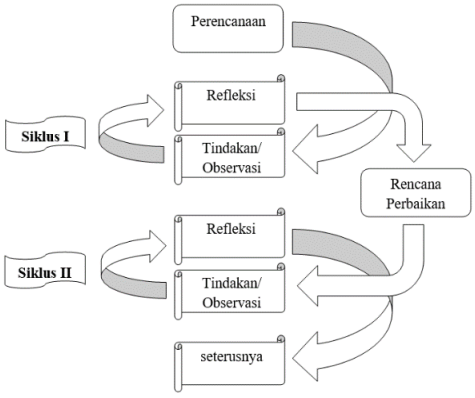

Fig. 1 Action research design

Learner activity observation data was obtained from observations by observers of all learner activities during learning using the Project Based Learning model. Analysis of observation data on learner activities was carried out by knowing the percentage of each activity and analyzed descriptively quantitatively. The percentage of time in each activity shows that students have carried out learning activities while using the Project Based Learning learning model.

The quantitative descriptive statement can be presented in the form of an equation as follows:

$$\boldsymbol{percentages} = \frac{\boldsymbol{time\ for\ a\ specific\ activity}}{\boldsymbol{total\ learning\ time}}\ \boldsymbol{x}\ \mathbf{100}\%$$

(Rando & Agustina, 2023)

The data that has been obtained from the results of data analysis in the form of observation sheets is then interpreted in table 1 as follows:

Table 1. Interpretasi Skor Observasi

Percentages	Category
81-100	Very Good
61-80	Good
41-60	Enough
21-40	Less
0-20	Very Less

(Rando & Agustina, 2023)

Students are said to be active in learning if they get a percentage of ≥ 61% or in the good or very good category.

Data on student learning outcomes in the form of pretests and posttests. The difference in scores between the pretest and posttest shows the improvement in the ability of students obtained after learning using the Project Based Learning model. Data from pretest and posttest results are used to determine the learning outcomes of students after applying the Project Based Learning learning model. Analysis of learning outcomes is done by analyzing the results of students' pretests and posttests. The improvement of students' learning outcomes after learning using the Project Based Learning learning model through the N-Gain index value.

The equation for determining the gain index value is as follows:

$$N - Gain = \frac{S_{post} - S_{Pre}}{S_{maks} - S_{pre}}$$

Description:
S *post* : *posttest score*
S *pre : pretestscore*
S *maks* : maximum score

(Mazidah & Sartika, 2023)

The results of the calculation of the gain value are then interpreted into table 2 as follows:

Tabel 2. N-Gain Grouping Criteria

Gain Score	Category
g ≥ 0,7	High
0,7 > g ≥ 0,3	Middle

Gain Score	Category
g < 0,3	Low

(Mazidah & Sartika, 2023)

The learning model used is declared effective if 80% of students at least get an N-Gain value of 0.3 or in the medium category.

▪ RESULT AND DISCUSSION

CYCLE I

Planning Cycle I

In the planning stage, the researcher compiled a research proposal complete with teaching modules that would be implemented with the application of the Project Based Learning learning model. Based on the initial results, the ability of class X 3 students is still below the minimum completeness value determined by the school, therefore researchers plan more intensive activities such as consulting with student teachers and peers about the preparation of learning implementation using Project Based Learning. Asking peers as peer partners in the implementation of the planned learning. The result is the readiness of peers and student teachers to participate in carrying out classroom visit supervision in observing existing deficiencies.

Peers are also useful in helping to observe students' learning activities, this is due to the limitations of researchers in observing a large number of students and compiling research instruments which include learning outcomes tests and observation sheets. Researchers planned to conduct research in even semesters, so they held planning in March 2023. The implementation of this cycle I class action research activity will be carried out in March 2023. The first meeting was held on March 29, 2023.

Implementation Cycle I

For the implementation of cycle I, 1 meeting is needed with details of cycle I carried out from introductory activities to preparing the schedule and ending with giving the end-of-cycle test. The implementation of the action was carried out by the teacher himself as well as the researcher by involving the cooperating teacher and 2 peers who were invited as team teaching and at the same time as observers. The teacher briefly conveys the Project Based Learning model used as an alternative learning model in the classroom. The steps taken at the implementation stage of the first cycle action are as follows:

a. Introduction Activity
   1) Greetings
   2) Checking the attendance and readiness of students
   3) Delivering apperception
   4) Conveying learning objectives
   5) Socializing the application of the Project Based Learning model

b. Core Activity
   1) Present the topic and ask questions on how to solve the problem
   2) Ensure that each learner is in a group that has been determined by the teacher and knows the procedure for making the project/product to be produced.
   3) Make an agreement on the schedule for making the project (stages and collection)
   4) Monitor learners' activity during discussion and guide if they have difficulties

c. Closing Activity
   1) Responding to the results of the day's discussion
   2) Making conclusions
   3) Giving feedback
   4) Closing greetings

Observation/Evaluation of Research Result Data Cycle I

Observations were carried out when learning took place to determine the learning activities of students, while the evaluation was carried out at the end of the cycle to determine the learning outcomes of students. X 3 learning outcomes were collected using a learning outcome test in the form of a written test with a total of 10 multiple choice questions. In cycle I, it was given to X 3 students according to the number of students in the class. The students' learning outcomes were then analyzed through the N-Gain index value.

Based on the results of the pretest and posttest scores that have been carried out, they are presented in the table as follows:

Table 3. Score result *pretest* and *posttest* Cycle I

No.	Name	*Pretest*	*Posttest*	Gain	Criteria
1	ARN	30	50	0.29	Low
2	ADY	40	50	0.17	Low
3	AS	30	60	0.43	Middle
4	AGYG	20	50	0.38	Middle
5	ASZC	30	60	0.43	Middle
6	ARPP	10	40	0.33	Middle
7	AMNS	40	60	0.33	Middle
8	BRPD	40	60	0.33	Middle
9	CAN	40	50	0.17	Low
10	DPA	30	50	0.29	Low
11	DMA	30	40	0.14	Low
12	EYB	30	70	0.57	Middle
13	E	40	60	0.33	Middle
14	FDEP	40	50	0.17	Low
15	FBAR	40	50	0.17	Low
16	FCZ	50	70	0.40	Middle
17	GCW	30	70	0.57	Middle
18	HKMP	30	50	0.29	Low
19	ICLM	20	50	0.38	Middle
20	KSA	20	30	0.13	Low
21	LPM	0	30	0.30	Middle
22	MFAP	10	20	0.11	Low
23	MSEPT	20	40	0.25	Low
24	MAM	20	30	0.13	Low
25	MAP	20	50	0.38	Middle
26	MR	30	40	0.14	Low
27	MFA	0	30	0.30	Middle
28	MFS	30	40	0.14	Low

No.	Name	*Pretest*	*Posttest*	Gain	Criteria
29	NSK	10	40	0.33	Middle
30	NNK	20	60	0.50	Middle
31	NIN	30	40	0.14	Low
32	REP	10	40	0.33	Middle
33	RAV	20	30	0.13	Low
34	SA	10	30	0.22	Low
35	SFA	30	50	0.29	Low
N-Gain		**25.71**	**46.86**	**0.28**	**Low**

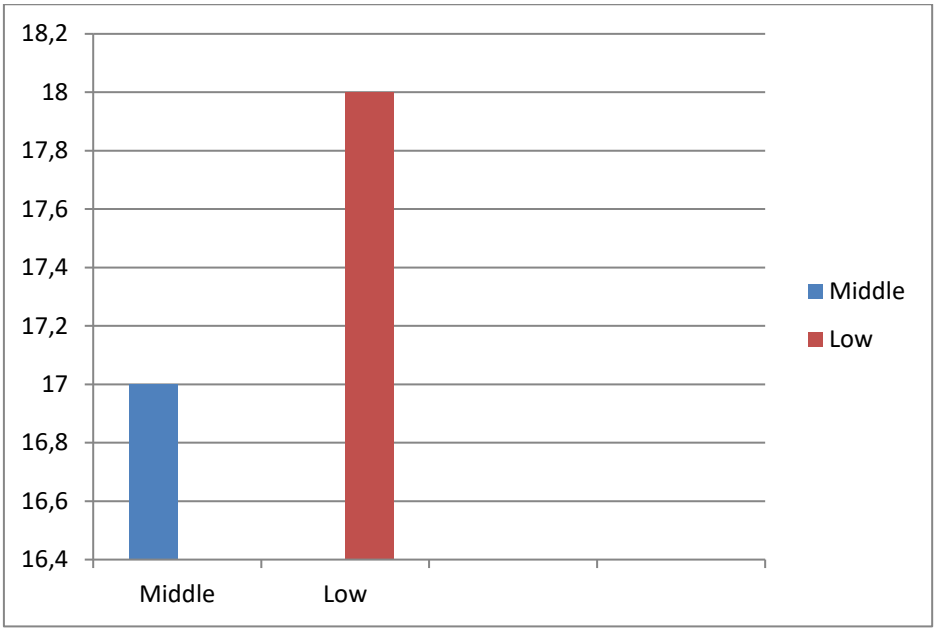

Fig. 2 Results of Pretest and Posttest Score Cycle I

Based on table 3 above, it can be seen that the average learning outcomes of students in the N-Gain analysis which shows an increase of 0.28 which means it is in the low category. All learners individually also experienced an increase in the low and medium categories. There are 18 students in the low category and 17 students in the medium category. Even though they are in the low and medium categories, learners have improved when viewed from the pretest and posttest scores. This shows that 100% of learners have improved with minimum criteria in the low category.

The results of learner response data are supported by learner activity observation data. Observations were made to 35 students of SMA Negeri 2 Surabaya conducted by 2 observers, each observer observed 5 groups during the learning process. During the learning process, students perform all activities and students are actively involved during the learning process by using the Project Based Learning learning model. The following data on the results of observations of student activities are presented in the table

Table 4. Results of observation of student activity

No.	Activity observed	Percentage of activity time

No.	Activity observed	Percentage of activity time
1	Listening and paying attention to the teacher's explanation during the lesson	4,48%
2	Observe the phenomenon presented in the ppt.	6,67%
3	Answer basic questions from the teacher.	8,40%
4	Prepare the literature materials used.	10%
5	Design the product plan	9,76%
6	Develop a schedule for making the product	5,33%
7	Working on and organizing the product to be produced	23,34%
8	Presenting product results	10%
9	Actively engage in learning activities.	10%
10	Work together in their groups to solve problems.	10%
11	Doing irrelevant activities (joking, playing on a cell phone, sleeping, etc.)	0%

Learners' activities during the lesson were observed by 2 observers. Every three minutes of the 60 minutes of face-to-face time in cycle I, the observer gave a check mark to the dominant activity. Based on the table above, the highest percentage of activity is shown by activity number 7, namely working on and compiling the product to be produced. This is in accordance with the syntax of the learning model, namely Project Based Learning, namely designing product planning. While in activity number 11, namely doing irrelevant activities (joking, playing cellphones, drowsiness, etc.) obtained a percentage of 0% because students were very actively involved when learning using the Project Based Learning learning model. Learners are very enthusiastic because this learning model frees students to choose the products that will be produced by their groups, so that students are very interested in the learning.

Reflection Cycle I

Based on the data above, it appears that the learning outcomes of new students have reached an N-Gain of 0.28 which has not reached 0.3 or as set out in the success criteria, so it is continued to cycle II. In this cycle I reflection on the weaknesses and advantages of the implementation of cycle I action is as follows:

The weaknesses that appear in the implementation of classroom action research in cycle I.

a. Learners do not understand the teacher's explanation regarding the implementation of learning through the Project Based Learning model is completely new to students. This can be known from the behavior of students who seem confused during the implementation of each stage in the model.
b. Learners still have difficulty determining the product they will produce
c. Students do not understand the material about the basic laws of chemistry, so the teacher still explains about the material
d. Giving awards or reinforcement to students who are active or enthusiastic is still minimal
e. Learners' memory is limited, only remembering the material when it is explained. When a few days pass, students forget the material because students only memorize but do not understand / explore through direct experience.

Meanwhile, the advantages seen in the implementation of the first cycle class action.

a. The division of groups is done evenly and fairly, i.e. in one group it consists of learners with different ability characteristics (smart/able, medium, and less able), so that less able learners can ask for explanations from able learners.
b. Providing feedback in the form of questions can hone students' abilities in each group during discussions.

Based on these weaknesses and advantages, what needs to be emphasized in learning in cycle II is as follows

a. Socialize the steps of learning activities with the project-based learning model clearly and the outline is written briefly on the board to anticipate students who forget.
b. Giving clear time for discussion activities, so that the hope is that when the specified time has expired, all groups are no longer discussing. All groups are focused on presenting the results which are carried out by each group in turn.
c. Giving reinforcement/awards to active/enthusiastic learners

CYCLE II

Planning Cycle II

Researchers collaborate with colleagues and student teachers to determine learning outcomes in accordance with the subject matter studied. Creating a learning plan for cycle II, consisting of; teaching modules and learner worksheets to assist students in the learning process. Prepare awards for students who show an increase in learning intention and learning outcomes. Prepare tools used for learning. Researchers discussed with colleagues as learning observers regarding the technical implementation of learning in cycle II. Based on the results of the discussion, it was agreed that the provision of LKPD the day before learning began to provide opportunities for students to prepare themselves. To complete cycle II, it takes 1 meeting with the scenario that has been prepared. The implementation of the action was carried out by the teacher himself as well as the researcher by involving 2 peers who were invited as team teaching who functioned as observers. The meeting in cycle II was held on April 5, 2023.

Implementation Cycle II

The implementation of the second cycle of action, the researcher conveyed the results of the reflection on the first cycle, then took several corrective actions as described in the discussion of the results of the reflection on the first cycle. The learning process continued the next syntax, namely monitoring the activeness and development of the project to evaluate the learning experience, then ended with a learning outcome test at the end of the cycle. The implementation of the action was carried out by the teacher himself as well as the researcher by involving 2 peers who were invited as team teaching and at the same time as observers. Researchers in this study acted as teachers who implemented the Project Based Learning model which was used as an alternative learning model in the classroom. In the implementation of cycle II, the teacher emphasized the weaknesses that occurred in cycle I to make improvements so that the learning outcomes of students in cycle II increased.

Learning through the Project Based Learning model starts from conducting exploration which aims to explore the initial concepts of students before learning. The importance of recognizing the initial concepts of students is as an initial step to start learning. The steps taken at the implementation stage of this cycle II action are as follows:

a. Introduction Activity

1) Greetings
2) Pray
3) Checking the attendance and readiness of students
4) Delivering apperception
5) Conveying learning objectives
6) Socialize the advanced syntax of the Project Based Learning model.

b. Core Activity

1) Ensure students are in their respective groups
2) Monitor the activity and progress of each group's project
3) Testing the project results, learners present the results of the product that has been designed
4) Evaluating the learning experience, the teacher gives feedback to students about the learning that has been done.

c. Closing Activity

1) The teacher informs the students about the material to be learned for the next meeting.
2) Teacher and students pray before ending the lesson
3) The teacher says greetings

1. Observation/Evaluation of Research Result Data Cycle II

Observations were carried out when learning took place to determine the learning activities of students, while the evaluation was carried out at the end of the cycle to determine the learning outcomes of students. X 3 learning outcomes were collected using a learning outcome test in the form of a written test with a total of 10 multiple-choice questions. In cycle II, it was given to X 3 class students according to the number of students in the class. The students' learning outcomes were then analyzed through the N-Gain index value.

Based on the results of the pretest and posttest scores that have been carried out, are presented in the table as follows:

Table 5. *Score result pretest* and *posttest* Cycle II

No.	Name	*Pretest*	*Posttest*	Gain	Criteria
1	ARN	30	70	0.57	Middle
2	ADY	40	80	0.67	Middle
3	AS	30	80	0.71	High
4	AGYG	20	90	0.88	High
5	ASZC	30	80	0.71	High
6	ARPP	10	70	0.67	Middle
7	AMNS	40	80	0.67	Middle
8	BRPD	40	90	0.83	High
9	CAN	40	80	0.67	Middle
10	DPA	30	90	0.86	High
11	DMA	30	80	0.71	High
12	EYB	30	90	0.86	High

No.	Name	*Pretest*	*Posttest*	Gain	Criteria
13	E	40	90	0.83	High
14	FDEP	40	90	0.83	High
15	FBAR	40	80	0.67	Middle
16	FCZ	50	80	0.60	Middle
17	GCW	30	80	0.71	High
18	HKMP	30	90	0.86	High
19	ICLM	20	90	0.88	High
20	KSA	20	80	0.75	High
21	LPM	50	80	0.60	Middle
22	MFAP	30	70	0.57	Middle
23	MSEPT	40	80	0.67	Middle
24	MAM	30	80	0.71	High
25	MAP	20	90	0.88	High
26	MR	30	90	0.86	High
27	MFA	30	80	0.71	High
28	MFS	30	80	0.71	High
29	NSK	20	90	0.88	High
30	NNK	20	70	0.63	Middle
31	NIN	30	70	0.57	Middle
32	REP	10	80	0.78	High
33	RAV	20	90	0.88	High
34	SA	10	90	0.89	High
35	SFA	30	80	0.71	High
N-Gain		**29.71**	**82.29**	**0.75**	**High**

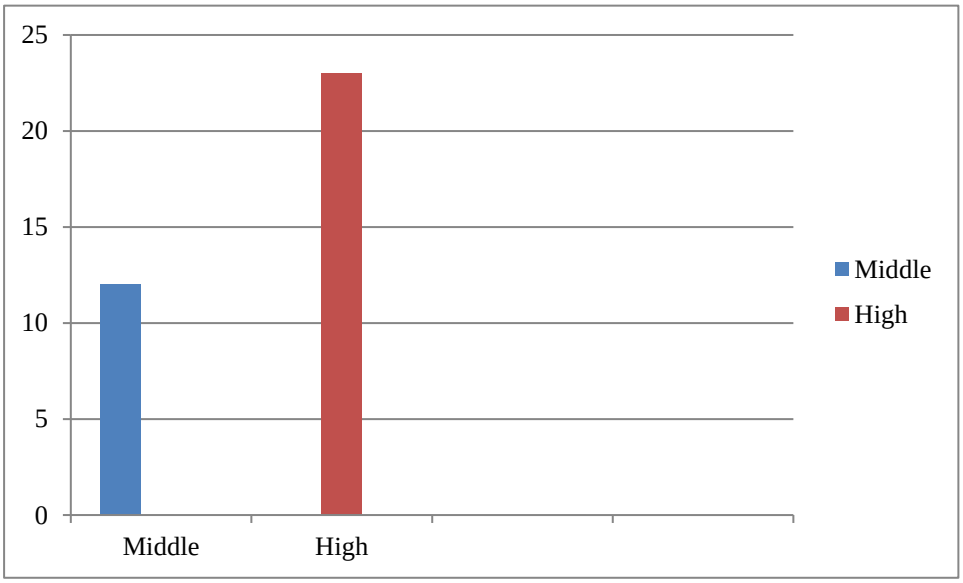

Fig. 3 Results of Pretest and Posttest Score Cycle II

Based on the table above, it can be seen that the average learning outcomes of students in the N-Gain analysis show an increase of 0.75 which means it is in the high category. All learners individually also experienced an increase in the medium and high

categories. There are 12 students in the medium category and 23 students in the high category. Even though they are in the low and medium categories, learners have improved when viewed from the pretest and posttest scores. This shows that 100% of learners have improved with minimum criteria in the low category.

The results of learner response data are supported by learner activity observation data. Observations were made to 35 students of SMA Negeri 2 Surabaya conducted by 2 observers, each observer observed 5 groups during the learning process. During the learning process, students perform all activities, and students are actively involved during the learning process by using the Project Based Learning learning model. The following data on the results of observations of student activities are presented in Table 6

Table 6. Results of observation of student activity

No.	Activity observed	Percentage of activity time
1	Listening and paying attention to the teacher's explanation during the lesson	7,77%
2	Observe the phenomenon presented in the ppt.	7,11%
3	Answer basic questions from the teacher.	8,46%
4	Prepare the literature materials used.	10%
5	Design the product plan	8,89%
6	Develop a schedule for making the product	5,11%
7	Working on and organizing the product to be produced	10,67%
8	Presenting product results	20%
9	Actively engage in learning activities.	10,22%
10	Work together in their groups to solve problems.	10,88%
11	Doing irrelevant activities (joking, playing on a cell phone, sleeping, etc.)	0%

Learners' activities during the lesson were observed by 2 observers. Every three minutes of the 60 minutes of face-to-face time in cycle I, the observer gave a checkmark to the dominant activity. Based on the table above, the highest percentage of activity is shown by activity number 8, namely presenting product results. This is by the syntax of the learning model, namely Project Based Learning, namely testing the results. While in activity number 11, namely doing irrelevant activities (joking, playing cellphones, drowsiness, etc.) obtained a percentage of 0% because students were very actively involved when learning using the Project Based Learning learning model. Learners are very enthusiastic because this learning model frees students to choose the products that will be produced by their groups so that students are very interested in the learning.

2. Reflection Cycle II

The increase in the percentage of students' scores in terms of students' learning outcomes shows that learning activities in cycle II have gone well. The approach and guidance given to students make students more courageous to ask questions and express their opinions. Learners can also appreciate every opinion that is submitted, this can eliminate fear and embarrassment when they want to give an opinion. The activity of learners when doing learning has begun to appear both in terms of group cooperation and class discussion activities. The frequency of students joking in cycle II has

decreased. Although there are still some students who joke, this can be overcome by researchers by going directly to students and providing sufficient guidance. The dominance of learners who are smart to work alone in groups has also begun to decrease. These learners are already willing to give opportunities to friends in their groups to do the learning and provide explanations if their friends experience mistakes. The results of this reflection show that with the improvements made, there is an increase in the quality of teaching and learning activities in the classroom.

3. Comparison of Research Results and Research Success Criteria

The development of research results between Cycle I and Cycle II can be seen again in the learning outcomes of students during Cycle I and Cycle II. The comparison of students' learning outcomes between Cycle I and Cycle II is as follows:

Tabel 7. Comparison of Research Results and Research Success Criteria

No.	Cycle I		Cycle II	
	N-Gain	Criteria	N-Gain	Criteria
1	0.29	Low	0.57	Middle
2	0.17	Low	0.67	Middle
3	0.43	Middle	0.71	High
4	0.38	Middle	0.88	High
5	0.43	Middle	0.71	High
6	0.33	Middle	0.67	Middle
7	0.33	Middle	0.67	Middle
8	0.33	Middle	0.83	High
9	0.17	Low	0.67	Middle
10	0.29	Low	0.86	High
11	0.14	Low	0.71	High
12	0.57	Middle	0.86	High
13	0.33	Middle	0.83	High
14	0.17	Low	0.83	High
15	0.17	Low	0.67	Middle
16	0.40	Middle	0.60	Middle
17	0.57	Middle	0.71	High
18	0.29	Low	0.86	High
19	0.38	Middle	0.88	High
20	0.13	Low	0.75	High
21	0.30	Middle	0.60	Middle
22	0.11	Low	0.57	Middle
23	0.25	Low	0.67	Middle
24	0.13	Low	0.71	High
25	0.38	Middle	0.88	High
26	0.14	Low	0.86	High
27	0.30	Middle	0.71	High
28	0.14	Low	0.71	High
29	0.33	Middle	0.88	High
30	0.50	Middle	0.63	Middle

No.	Cycle I		Cycle II	
	N-Gain	Criteria	N-Gain	Criteria
31	0.14	Low	0.57	Middle
32	0.33	Middle	0.78	High
33	0.13	Middle	0.88	High
34	0.22	Low	0.89	High
35	0.29	Low	0.71	High
	0.28	Low	**0.75**	High

Based on the table above, the criteria for success of research actions will be determined. A recap of the comparison of the analysis results is presented in the table below

Table 8. Recap comparison of analysis results

Aspects compared	Cycle I		Cycle II	
	Score	Criteria	Score	Criteria
N-Gain	0,28	Low	0,75	High

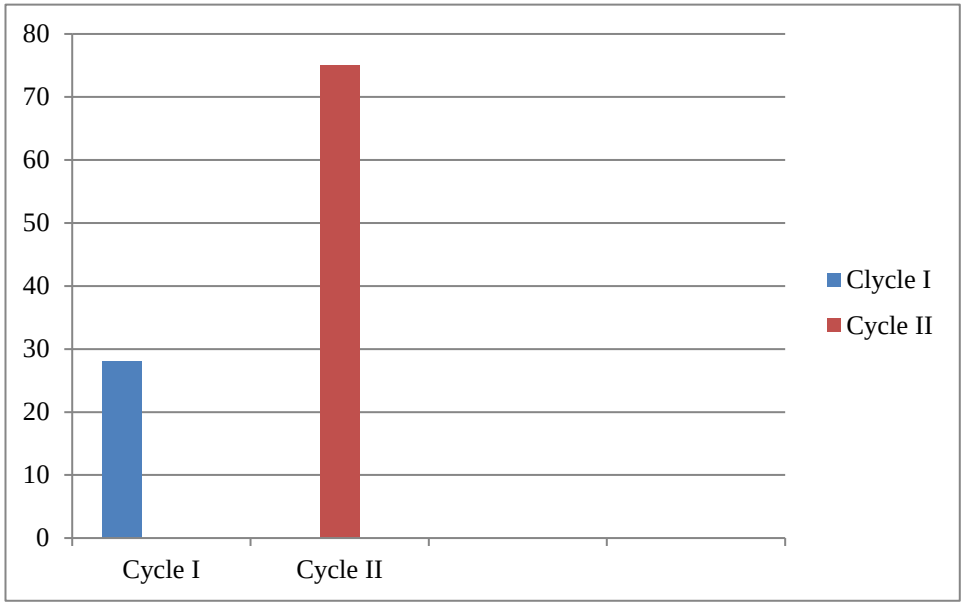

Fig. 4 Comparison of Cycle I and Cycle II

Based on the table above, it appears that there was an increase in the average learning outcomes from cycle I of 0.28 to cycle II to 0.75 from the low category to the high category. The results of this study indicate that there was an increase in learning outcomes of 0.47. Therefore, it can be concluded that the application of the Project Based Learning model can improve the learning outcomes of students in class X 3 SMA Negeri 2 Surabaya. The profile of the achievement of learning outcomes from each cycle is shown in the figure below.

Based on the results of research conducted in two cycles, it shows that there has been an increase in learning outcomes. Learning outcomes increased by 0.74 from cycle I to cycle II. The increase in the N-Gain average from cycle I to cycle II was due to the implementation of Project Based Learning in cycle II being more optimal. This result was proven by the improvement of the weaknesses that researchers found in the pre-cycle in cycle I. Seeing the results of this study, the researcher expressed gratitude,

because even though the obstacles felt before the research was carried out were worrying about the smooth implementation of the research, such as limited hours because the research was conducted during the month of Ramadan. However, thanks to the earnest willingness of researchers/teachers to improve student learning outcomes by applying project-based learning, and the encouragement of student teachers, this research can be carried out smoothly from the beginning to the end according to plan.

▪ CONCLUSION

Based on the results of research and data analysis conducted, it can be concluded that the learning outcomes and activeness of students in class X 3 SMA Negeri 2 Surabaya on the material of the Basic Law of Chemistry in the 2022/2023 academic year can be improved by applying the Project Based Learning learning model. The learning outcomes of students based on N-Gain have increased from the first cycle of 0.28 or low criteria to 0.75 or high criteria in cycle II. It can also be seen from the activeness of students has increased from 10% to 10.22% in learning activities.

Based on the results and discussion, the suggestions that researchers can give are in carrying out learning, teachers should use a variety of learning models to increase student activeness and learning outcomes, other than that using group learning can provide greater opportunities for students to express their opinions so that students can take an active role in the learning process.

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