Implementation of the Project-Based Learning (PjBL) Model in Bioactivity Courses to Improve Students' Activities and Learning Outcomes

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ABSTRACT
Bioactivity is an elective course at the Jambi University Chemistry Study Program which focuses on finding compounds that can act as drug candidates. This study aimed to determine the results of the implementation of the PjBL model in terms of the quality of the student activity process and the quality of the results, student achievement. This research is a descriptive study with the subject of semester V students for the 2021/2022 academic year who contracted the Bioactivity course. Data collection techniques were carried out by test and non-test techniques. The research data was measured and analyzed using the average percentage method on the results of the assessment of student activities (visual activities, oral activities, listening activities, writing activities, motor activities, mental activities, emotional activities) and student learning achievements (cognitive, affective, psychomotor) explained qualitatively and using data reduction, data display, and verification steps. The results showed that the implementation of the PjBL model improved the quality of the process, namely high student activity reaching 80% (2) the quality of the results in terms of: (a) cognitive learning achievement with an average of 75 known to be 46% - 88% of students completed. (b) affective learning achievement is known that 15% of students have very good affective learning achievement, 79% of students are good, 6% of students are poor, and 0% of students are very poor; (c) the quality of the results, namely psychomotor learning achievement on the project with an average of 87.5% very good; 10% is good, and 5% is not good

Keyword(s): Bioactivity Courses, PjBL model, Students' Activities, Learning Outcomes

INTRODUCTION

Education is one of the important elements to improve the quality of human resources due to, by taking education the human can gain knowledge, experience, and skills through a learning process (Muhibbin, 2008). The purpose of national education based on 1945 Indonesian Constitution states that aims to increase faith and devotion to God Almighty and noble character in the context of the intellectual life of the nation (Adi, Handayani and Supanto, 2018). The achievement of educational goals can be done by improving the quality of education, where the quality of education can be seen from the success of formal education in the form of student learning outcomes and changes in behavior towards students (Manasikana and Anggraeni, 2018; Nabillah and Abadi, 2019). The Indonesian government has made many efforts to improve the quality of education (Panjaitan, Simangunsong and Sihombing, 2020). Efforts have been made by the government to improve the quality of education, one of which is curriculum renewal in educational institutions, including the curriculum in universities (Solikhah, 2015). Currently, the curriculum being developed at several Indonesian universities is the Indonesian National Qualifications Framework (KKNI). KKNI is a level of competency qualifications that can juxtapose, equalize, and integrate the fields of education and the field of job training following the structure of work in various sectors. Jambi University is one of the universities in the process of implementing the KKNI-based curriculum to the fullest. Based on Presidential Decree No. 8 of 2012 it is

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stated that the implementation of the KKNI considers educational objectives in the form of characterizing knowledge and skills, work skills, attitudes to work, and ways of living in society as the minimum requirements that must be achieved by students in completing a study program. Conceptually, the qualification level in the IQF is composed of four parameters, namely: (1) work skills, (2) scientific scope (knowledge), (3) methods and level of ability to apply knowledge, and (4) managerial abilities. Internalization and accumulation of the four parameters must be achieved through a structured educational process or work experience as learning outcomes. Determination of learning outcomes in universities contains 4 elements of the IQF description, namely elements of attitudes and values, elements of workability, elements of scientific mastery, and elements of authority and responsibility (Junaidi and dkk, 2020).

Bioactivity course is one of the elective courses in the KKNI curriculum structure which has been developed in the Chemistry Study Program, Department of Mathematics and Natural Sciences, Faculty of Science and Technology. The course has two credits containing knowledge about the activity of chemical compounds in several biological aspects, such as anti-inflammatory, antidiabetic, antibacterial, and others. This course is one of the potential courses to be developed based on Jambi's local content. Jambi is one of the provinces with a high diversity of plants and plants that have the potential as medicine and have bioactivity. The characteristics of learning in higher education are providing a deep understanding with dense material content. Thus, the learning process is expected to be carried out quickly and easily understood. Efforts to realize this learning can be carried out by prioritizing the application of material rather than just providing theory in class. The success of the teaching and learning process can be seen based on the learning outcomes obtained by students, learning experiences, and skills acquired. Learning outcomes are changes in individual behavior as a result of the learning process that includes the cognitive, affective, and psychomotor fields. To improve it, it is necessary to strengthen learning by facilitating student learning tools, one of which is providing teaching materials (textbooks) (Munawaroh, 2017).

Based on previous observations in the Bioactivity course at the Jambi University FST Chemistry Study Program that, information was obtained regarding the 2020/2021 bioactivity concept learning process. The learning process is carried out with presentations and discussions (direct instruction). In addition, in general, using the learning media in the form of PowerPoint from lecturers and student teaching materials still relies on books and outlines. The teaching materials used as learning references are limited and tend to focus on rote products, but the mastery of student skills has not been seen.

Nowadays, there have been several teaching materials that are classified as well based on scientific criteria which are used as student handbooks. However, there are limited books/teaching materials that lead to skills and the minimal load of worksheets (projects) in them (Atmarizon, 2016). Efforts can be made to prepare effective teaching materials in bioactivity courses with innovative teaching materials. Teaching materials are materials or subject matter systematically arranged that are used by educators and students in the learning process. Honestly, some of the teaching materials that are frequently used are worksheets, handouts, books, and modules. In this study, the teaching materials developed were in the modules that were integrated with local wisdom (local content) in Jambi Province. This research is a preliminary study, which there are still poor teaching materials or learning resources used by educators to students who emphasize efforts to explore local wisdom. However, we thought that if a book or teaching material is embedded in a project that is developed based on local content, students will not only expand their knowledge of the material but will indirectly gain more skill and skill values.

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Based on previous research conducted, the results of research on the implementation of teaching materials can be integrated with spiritual values with a collaborative-oriented problem based learning (PBL) learning model to improve student learning outcomes, namely there are significant differences in student learning outcomes who are taught using value-integrated bioactivity teaching materials. spirituality with the learning outcomes of students who are taught using chemistry textbooks with Sig. (2-tailed) < (0.000 < 0.05) (Okmarisa, Darmana and Suyanti, 2016). In line with that, the development of teaching materials based on spiritual values resulted in the feasibility of spiritual values of 3.50, BSNP eligibility of 3.61, students' views on teaching materials of 3.47 (very good/valid criteria).

In addition, because ideally, the lecture process carried out refers to the KKN curriculum, students are expected to be more active, able to solve analytical questions, instill elements of better attitudes and values and be able to produce work rather than just mastering concepts. Moreover, the teaching materials for the bioactivity course that will be used are based on a project-based learning (PjBL) model. Project-Based Learning (project-based learning) is a learning model that uses projects as the core of learning (Junaidi and dkk, 2020). Students explore, assess, interpret, synthesize and exchange information to produce various forms of activities. In general, project-based learning takes three stages, namely project planning, project implementation, and project evaluation. This is in line with research conducted by (Sungkono, 2015), shows that project-based learning can improve student learning outcomes in audio media development courses, also increase learning activities, be more motivated to learn, and higher collaboration among students. The results show that case studies of educators who develop / use in their learning, from the results of the study it was found that Project Based Learning is a teaching method that supports, facilitates and improves the quality and learning process, and can also enrich the creativity of students (Tamim and Grant, 2013)

RESEARCH METHODS

This research is a descriptive study that aims to describe and reveal (to describe and explore), describe and explain (Sukmadinata, 2009). The limitation in this study is to apply the PjBL model to the Bioactivity course. The research data were measured and analyzed using the average percentage method, then qualitatively explained. The subjects in this study were fifth semester students who contracted the Bioactivity course. Sampling was carried out using a purposive sampling technique which was based on the considerations of students who contracted courses, which were elective courses.

The object of this research is the quality of the process, namely the activity and the quality of learning outcomes in the form of student achievement in the cognitive, affective, and psychomotor domains. Sources of data come from information data originating from lecturers and students in the form of observations, interviews, document or archive studies. Data was collected using test techniques (cognitive domain) and non-test (observation, interviews, affective questionnaires, and feedback from students. The learning instruments were RPS and LKM.

The research instruments used included student activity instruments, cognitive, affective, and psychomotor domains, and feedback. The analysis technique of the cognitive domain evaluation instrument uses: 1) Validity Test using the Gregory formula (Gregory, 2015), reliability test, used Kuder Richardson formula (KR-20) (Sudijono, 2005), While the affective domain questionnaire analysis technique uses 1) validity test, the determination of validity uses the Gregory formula (Gregory, 2015), 2) reliability test, used alpha formula (Sudijono, 2005). The data analysis technique is in the form of a qualitative descriptive

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analysis from Miles and Huberman and Spradley using steps of data reduction, data display, and verification (Sugiyono, 2013). Students are categorized as having a good understanding of learning if they have a value based on the value interval on:

Table 1. Category of student understanding

Score	Category
90-100	Very good
80-89	Good
60-79	Enough
41-59	Less
0-40	Very Less

(Widyaningsih and Yusuf, 2020)

In addition, to determine the cognitive achievement of Didwa was analyzed through pretest and posttest. The pretest and pottest score data were obtained from the questions given to the students and calculated the N-Gain. N-Gain is a comparison of the gain scores obtained by students with the highest possible gain scores obtained by students (Ramdhani, Khoirunnisa and Siregar, 2020). The calculation of N-Gain was obtained from the pretest and posttest scores of each experimental class. The formula for g factor (N-Gain) is:

$$G = \frac{\text{Posttest Score} - \text{Pretest Score}}{\text{Ideal score} - \text{Pretest score}},$$

The N-Gain score assessment criteria can be seen in Table 2. Data on student activity during learning activities can be obtained by calculating the average score for each observer in each meeting then calculated using the percentage (%) activity formula, then the percentage obtained obtained from the calculation results above will be analyzed using a Likert scale (Khoiruddin and Suwito, 2021):

Tabel 2. Scoring Category

Limitation	Category
$G > 0,7$	High
$0,3 \leq g \leq 0,7$	Moderate
$G \leq 0,3$	Low

RESULT

The bioactivity course is one of the courses used as a Pilot Project for the application of the Project Based Learning model in the Chemistry Study Program, Faculty of Science and Technology, Jambi University. During the action, the students' activity, affective, and psychomotor observations were observed. At the end of the action, cognitive and affective tests were carried out, as well as feedback from students. Based on the results of test and non-test observations, the results can be seen in Table 1.

Table 3. The student action result in Bioactivity Course Action Result Data in Student Bioactivity Course

Competency section	Accessibility (%)
Activity	85.00
Cognitive	80.00
Affective	91.00
Psychomotor	94.00

The results of the student activity assessment are shown in Figure 1.

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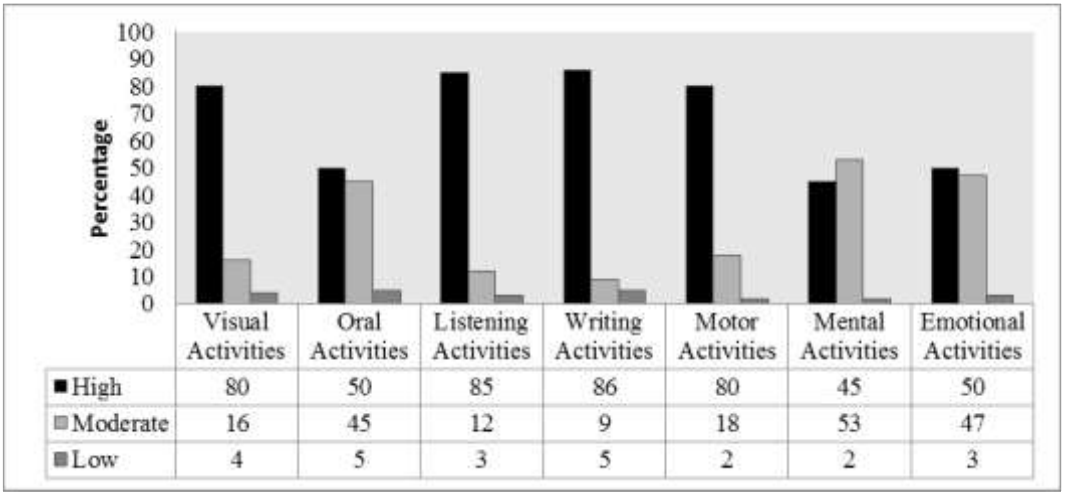
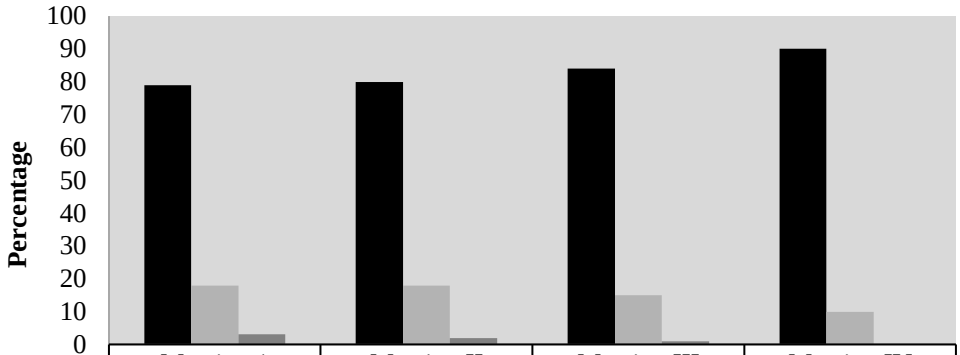


	Visual Activities	Oral Activities	Listening Activities	Writing Activities	Motor Activities	Mental Activities	Emotional Activities
High	80	50	85	86	80	45	50
Moderate	16	45	12	9	18	53	47
Low	4	5	3	5	2	2	3

Figure 1. Histogram of Student Activities During Learning



	Meeting 1	Meeting II	Meeting III	Meeting IV
High	79	80	84	90
Moderate	18	18	15	10
Low	3	2	1	0

Figure 2. The Histogram of Student Activity Assessment Final Results in each Meeting

In the cognitive domain of students, it is known that the comparison of mastery of each meeting between the post-test and the cognitive test is shown in Figure 3. It is known that the mastery of students in the post-test of each meeting increases and the N-Gain is getting smaller (Table 2).

Table 4. The Results of Pre-test and Post-Test Learning

Name	P1	P2	N-gain	Category	P1	P2	N-gain	Kategori	P1	P2	N-gain	Category
RM	30	60	0.6	**	40	70	0.5	**	60	80	0.50	**
AS	40	75	0.87	***	60	100	1	***	71	88	0.58	**
TK	40	75	0.87	***	60	100	1	***	80	80	0.00	*
NA	45	80	1	***	60	100	1	***	50	65	0.30	*
EA	30	70	0.8	***	60	100	1	***	80	88	0.40	**
NM	30	75	0.9	***	60	70	0.25	**	50	88	0.76	***
BR	20	65	0.75	***	60	80	0.5	**	60	65	0.12	*

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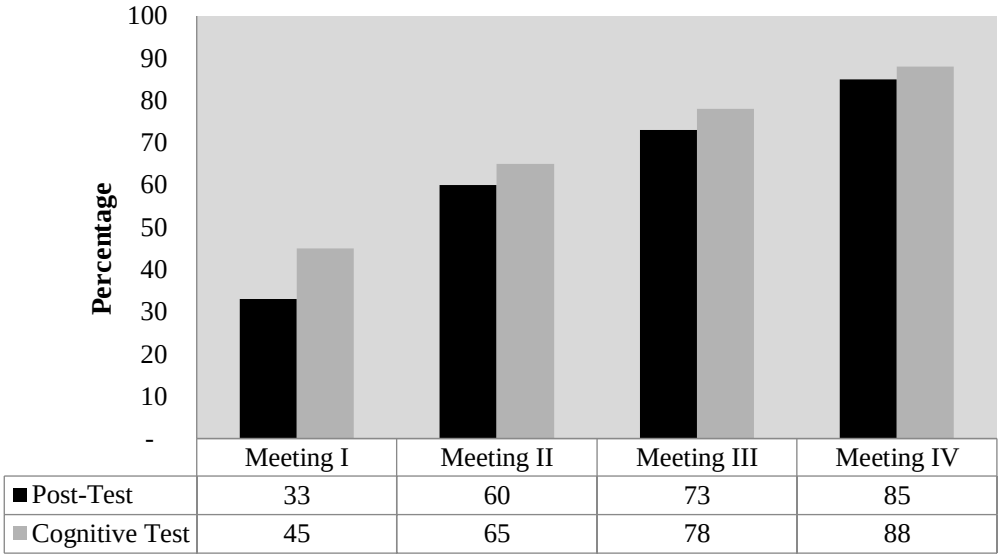
RM	30	65	0.7	***	60	100	1	***	71	75	0.138	*
MWP	40	78	0.95	***	40	60	0.33	**	71	100	1.00	***
MA	20	50	0.5	**	40	60	0.33	**	57	75	0.42	**
A N A	20	65	0.75	***	40	90	0.83	***	82	88	0.33	**
DT	20	55	0.58	**	40	60	0.33	**	55	65	0.22	*
SD	25	65	0.73	***	40	90	0.83	***	50	88	0.76	***
AR	25	65	0.73	***	40	80	0.67	**	71	88	0.58	**
MA	20	50	0.5	**	40	60	0.33	**	40	60	0.33	**

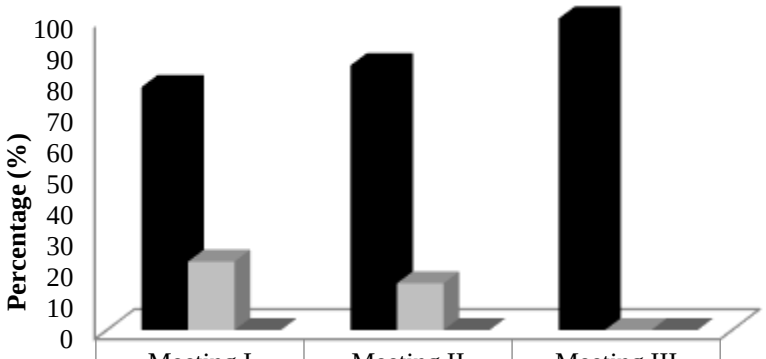
(* low; ** moderate; *** high)



	Meeting I	Meeting II	Meeting III	Meeting IV
Post-Test	33	60	73	85
Cognitive Test	45	65	78	88

Figure 3. The Histogram Comparison of Completeness Between Post Test and Cognitive Test

Assessment of the affective domain comes from two assessments, namely the assessment of questionnaires and observations with the results shown in Table 3 and Figure 4.



	Meeting I	Meeting II	Meeting III
High	78	85	100
Moderate	22	15	0
Low	0	0	0

Figure 4. The Histogram of Project Activity Results During Learning Process

Table 5. Student Portfolio Score

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	Percentage			
	Very Good	Good	Low	Very Low
Portfolio Value	81	12	7	

Tabel 6. Affective Questionnaire and Student Affective Observation

Method	Percentage			
	Very Good	Good	Low	Very Low
Questionnaire	35	40	25	0
Observation	51	42	7	0

Table 7. Student Affective Learning Achievement

	Percentage			
	Very Good	Good	Low	Very Low
Student Achievement	15	79	6	0

Psychomotor learning achievement is obtained from the observation value of practical activities, portfolios, and projects which are presented in Figure 6. It is known that most students have high criteria at meetings I and II for each activity.

The feedback questionnaire given to students is aimed at knowing student responses, besides being supported by the results of interviews with the PjBL model learning, the results of student feedback questionnaires are shown in Figure 5.

Table 8. Student Project Results During Learning

Student Project	Percentage			
	Very Good	Good	Low	Very Low
Project I	90	10	0	0
Project II	85	10	5	0

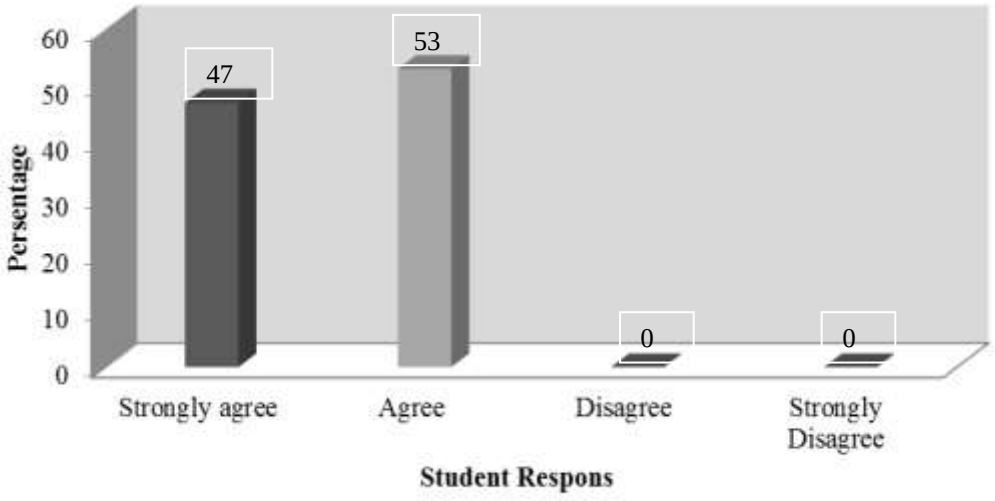

Figure 5. Student Feedback Questionnaire Graph

DISCUSSION

This course has a weight of 2 credits and is an elective course (specialization). When implementing the PjBL model of learning with students in groups, Lecturers play more of a role as facilitator and motivator of students in generating motivation and interest in student learning to be more active. In general, the steps of the PjBL model applied in this study are:

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(1). Start by asking the essential questions; (2). Planning of project work rules, (3). Monitoring the progress of Student Projects. (4). Discuss the results of student work; (5). Assessment of student work, (6). Evaluation of Student Learning experience. From the implementation of the PjBL learning model steps, students play more roles than lecturers. Students play a central role while lecturers act more as facilitators and motivators so that learning is dominated by student activities in building or discovering knowledge through scientific processes such as observing, solving problems, processing data, reporting results, and formulating conclusions with a more pleasant process. Based on Table 1, it was found that learning with the PjBL model in the bioactivity course was reviewed from, (1) the quality of the process, namely student activities, it was known that 85% of students with high activity; (2) the quality of the results in terms of, (a) cognitive learning achievement with an average of 75.0 known that 80% of students completed; (b) affective learning achievement of students is known to 92% of students have very good and good affective learning achievement; (c) psychomotor learning achievement is known to 91% of students complete.

The quality of the learning process can be seen from student activities during learning and every meeting. It is known that 80% of students have high learning activities. This result is in accordance with cognitive theory, learning shows the existence of a very active soul, the soul processes the information we receive, not just storing it without transforming it. According to this theory, children are active, constructive, and able to plan things. Children are able to search, find, and use the knowledge they have acquired. In the teaching and learning process, children are able to identify, formulate problems, seek and find facts, analyze, interpret, and draw conclusions (Dimyati and Mudjiono, 2010).

The results of the measurement of student learning activities found that more than 50% of students had high learning activities according to learning, indicating a very active soul, the soul of processing the information we receive, not just storing it without transforming it. In addition, when compared to the average post-test with cognitive tests, it was found that the scores were not significantly different. This can be caused that students are accustomed to reading material before lectures so that the N-Gain is getting smaller, and it indirectly affects students' cognitive scores.

The percentage of students' completeness increased at the I, II, III, and IV meetings. This is because students are more prepared in learning, and the increased motivation of students based on the results of cognitive test work. Most students access the material that has been prepared in E-learning earlier and read it before the lecture starts which can improve student understanding in learning because it first induces itself with the initial knowledge.

The value of cognitive learning achievement of students with the PjBL model has a higher average than students in other classes with the lecture model. This result proves several learning theories such as Bruner's learning theory (discovery learning), Ausubel's learning theory (meaningful learning), and Piaget's theory. Learning with the PjBL model provide students to find their concept or purpose of the material being taught due to the teacher does not convey the material directly. Students' efforts to find their understanding of the material make learning more meaningful and the material can be stored longer. This also proves that students can maximize their cognitive abilities. Based on the results of questionnaires and affective observations, it is known that most or more than 50% of students have very good and good affective learning achievements.

The results of the assessment of student affective learning achievement in PjBL model learning are following Vygotsky's learning theory (Social constructivism) which states that the learning process of students with different skills and backgrounds is accommodated to collaborate in completing assignments and discussions to achieve a common understanding of Theory. From the results of interviews and observations, it is known that students have

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never carried out a project in learning, from the results of observations and interviews it is known that they feel happy and interested in learning activities, while at the third meeting all students feel happy, and the value of practical activities increases with each meeting.

The results of project activities during the learning process (Table 4) show that most of the students have very good portfolio scores. At the time of the Student worksheet assessment, it was known that some students had cognitive scores below the MCC scores but could get portfolio scores like students who had cognitive scores above the MCC scores. This seems due to the collaboration between members in one group, such as students who already understand the course can help students who do not understand yet so that the portfolios of students in one group have many similarities in terms of answers and student scores. Things like that become a weakness in portfolio assessment that is done in groups. Most of the students did the project very well. These results are in line with the results of observations of student activities which is most of the students have high activity. Students with high activities will be more enthusiastic in working on projects and have high motivation to complete the learning projects. From these results, it can also be seen that students feel happy and interested in working on projects during learning.

Based on the assessment of practical activities, portfolios, and projects, the percentage of students' completeness in psychomotor learning achievement is 94%. Moreover, the student psychomotor learning achievement assessment was indicated that the learning process using the PjBL model makes students active. Furthermore, from the results of the interviews, it is known that students are interested in learning the PjBL model because in this learning students find it easier to relate theoretical material concepts to practice through project activities. In accordance with Bruner and Ausubel's learning theory, this project activity is one step in finding material concepts so as to make learning more meaningful, because finally, students know the compatibility between theory and practice that can provide learning experiences for students.

In addition, the results of feedback questionnaires and interviews with students showed that students agreed that the PjBL model was applied to several appropriate subject topics. Even so basically, there are still some obstacles in the application of the PjBL model, as reported by previous studies (Friani, Sulaiman and Mislinawati, 2017), that PjBL has a long-term effect and can be applied to several topics of discussion that focus on practical learning, not theory (Tyas, 2017). The results of this study are in accordance with several previous studies (Baş and Beyhan, 2010), that students who were educated with the PjBL model were more successful and had higher attitudes towards lessons compared to students who were educated with instruction based on student manuals. In addition, the implementation of PjBL shows that after the level of student learning activities and academic skills in learning chemistry in the classroom, there is an increase. (Dwi Ariani, Addiin and Redjeki, 2014). The effect of PjBL models shows that not only on cognitive learning achievement but also increases students' creativity and innovation in studying any given learning material. Project-based learning facilitates students to learn concepts in depth (Latifah, Kimia and Semarang, 2021).

CONCLUSION

Our finding in this research is that the implementation of the PjBL model can improve the quality of the learning process such as high student activity reaching 80% which seen from (a) cognitive learning achievement with an average of 75, it is known that 46% - 88% of students complete. (b) affective learning achievement is known that 15% of students have very good affective learning achievement, 79% of students are good, 6% of students are poor, and 0% of students are very poor; (c) the quality of the results, psychomotor learning achievement on the project with an average of 87.5% very good; 10% is good, and

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5% is not good. Furthermore, the student achievement reached 79% and working on projects with a percentage of 85-90% in very good categories.

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