

Systematic Review for Collaborative Problem Based Learning Models to Improve Creative Thinking Skills

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Abstract. Learning activities become teaching and learning activities that are quite complicated and challenging. As for a learning model that can be applied, namely the collaborative learning (CL) model with problem-based learning (PBL). This model is like providing space in developing students' social skills. Thus, with the initiative of the researcher to conduct a literature study to be able to examine how the influence in learning with the application of the CL and PBL methods. The research carried out applies a systematic meta-analysis approach with various reference articles that are still relevant according to the research topic in the last 10 years. In addition to this, the implementation in the form of collaborative groups is expected to create an exchange process between the ideas possessed by students. Referring to the results of the study through various references, the conclusion obtained is that the learning model with CL combined with PBL allows the teacher and students to share information efficiently and effectively. The implementation of Collaborative Problem Based Learning can optimize the ability to think critically and creatively for students.

Keywords: Learning, CL, PBL, and learning outcomes

1 Introduction

Students are required not only to explore the material but also to optimize skills that are still relevant to the learning topic. Activities are structured to realize three aspects cognitive, psychomotor and affective. The three aspects need to be implemented in each learning activity to achieve a balance related to the cognitive, psychomotor, and affective competencies of students. In addition to aiming at fulfilling these three aspects, the evaluation at the end of learning activities influences student learning outcomes. In order to realize the achievement of the target understanding of students with the actual situation after the learning process, at least there is a fundamental assessment of the cognitive aspects, for example in the concept of mastery and understanding of the material that needs to be improved. Efforts to achieve good performance through a well-implemented learning process. In general, learning activities start from an effort to provide problems, thus being able to optimize the independence of students so that solutions are found independently and carry out good understanding. Efforts to identify problems become a good opportunity to motivate students to solve students' problems by referring to high curiosity and creative thinking when making various brilliant ideas [1]. Learning activities have an orientation on students as an essential research study for educators. The need for active student participation can construct knowledge

fundamentally. However, in the current situation, in order to optimize the potential of students, it has not been fully facilitated. The majority of students depend on the provision of information and knowledge from teachers and have not been able to optimize the use of learning resources in instilling an attitude of learning independence and self-confidence in students.

Learning activities in various topics include the fields of science or social including a process that is quite complicated and challenging. This relates to the assumption related to science, in this case, science is a subject that is believed to be quite difficult. What's more, students have previously possessed this basic knowledge, making it easier for students to learn science, but there is the potential to create misconceptions if this understanding is not in line with the underlying theory. Even though there are challenges mentioned above, mastery of science is an important factor for national development in the future because it relates to various aspects. So, learning should be carried out by applying a model that is adapted to the demands of the *output* of the curriculum that still provides guarantees for understanding the material to students so that creative thinking power emerges.

One model that can help in mastering the material for students is *Collaborative learning* (CL). Collaborative learning means a series of learning strategies that implement collaboration among students in small groups (in this case two to five students) to

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improve learning. CL is able to support the improvement of learning outcomes from the academic side to the quality of the social interactions of students and can facilitate *regulated* students

Self-regulated learning is defined by the attitude of students obtained from their learning outcomes and responsibilities when solving problems [2]. *Self-regulated learning* is developed with skills in the science learning process because students carry out scientific investigations in finding solutions to problems from several learning sources as well as active roles in the learning process by applying models and creative thinking styles. In addition to this, by being given information through reduced teaching materials, students will search, process, and utilize various learning resources [3]. The learning models to facilitate *self-regulated learning* include the *Problem Based Learning (PBL) model*.

The abilities possessed by students in thinking can be optimized through the implementation of PBL models or learning by referring to problems that include learning models that utilize complex problems in life which are used as instruments in introducing learning concepts and principles to students. This model can support the development of the skills of students to think creatively, be able to solve problems and communicate. In the learning process, students will find some contextual problems by requiring the ability to think creatively and solve problems well. Thus, supporting the opportunity to work in a team, knowing and evaluating the material and the learning process. The problems presented can be taken from magazines, newspapers, books, journals, and television/films. Determining the topic of the problem can be adjusted to the science-related topic to be studied. This is carried out in order to maintain the relevance of the case to the basic theory which is to be studied in depth.

The application of the PBL model is aimed at preparing students to become researchers, creative and critical [4]. This is due to the demands of the current era in the ability to solve problems and think critically which is the purpose of holding education [5]. So, in an increasingly advanced and digital era, the ability to think creatively and critically needs to be optimized [6]. The PBL model from a theoretical perspective can facilitate students' ability to think critically and creatively [7]. With the implementation of this model, of course, it can be aligned with the demands of the abilities needed in the era of education because students are involved in thinking to analyze various symptoms in the real world so that the ability to think critically and creatively can be improved to overcome problems.

Referring to the findings of previous studies, it is stated that *Problem Based Learning (PBL)* is a learning model that presents concepts and principles from science that is suitable to be studied by giving students an appreciation score [8]. Furthermore, Nuswawati explained the *mixed method design* through experiments that applied *pre-test* and *post-test* in the *control group* aimed at knowing the effect of the implementation of the PBL model. The results explain that one part of the learning activity, for example, consultation with the teacher is carried out in order to carry out assignments,

rewriting in the form of reports with details of creative activity products, and presentations during learning. The application of the PBL model can optimize the ability to think creatively and act creatively from students [9].

The findings from Suyanta stated that the PBL model used a *quasi-experimental, non-equivalent post-test only group* research that was used as the research design, the results indicated a difference in the level of learning independence of students with the implementation of the PBL model which was obtained better results than the *control* who are not taught by the model [10].

The same research was carried out by Hanipah by applying a *quasi-experimental* using a *pre-test* and *post-test design* which was applied in two classes for the experimental group. As for the first experimental class, in this case, the students received treatment, namely by being taught using a learning model that focused on solving problems and in the second experimental class with a project-based model. Then the results obtained are (1) found differences in learning outcomes in the cognitive aspects of the group, based learning on project-based learning with a significance of $0.001 < 0.05$. Thus, the conclusion obtained is that the PBL model is proven to be able to optimize learning outcomes in cognitive aspects more than project-based models in chemistry learning [11]. Referring to various references and previous explanations, the researchers carried out a systematic review aimed at knowing the Effect of Collaborative *Problem Based Learning* to Improve Creative Thinking Skills.

2 Research Methods

This research applies a systematic approach analysis using various references, namely journals published in the last 10 years, and articles that are still relevant, both from peer reviewed articles and full text articles obtained from *Google Scholar* and *Science Direct*. The review includes several levels of education that use PBL for their learning model. The purpose of carrying out a systematic literature analysis is to be able to develop a structured review and provide opportunities for development. The research carried out applies an approach through studies of various previous studies, articles, and journals that are still relevant to the research. The references used include secondary data, namely data from *library research*. In this case, several journals and articles were collected on the topic of *collaborative learning* and *Problem Based Learning (PBL)* models.

The data is obtained through secondary data (*library research*) referring to the criteria from articles published in the last 10 years or related to implementation in learning activities. Furthermore, the data were analyzed by researchers by applying qualitative descriptive analysis, an analysis that explains and provides an overview related to the basic concepts of the implementation of *collaborative learning* by combining using *Problem Based Learning* and the existence of linkages to the application of learning activities in chemistry.

3 Results and Discussion

3.1 Number and Source of Articles included in the Inclusion Criteria

Based on the search results of articles using the keywords above, shows that there are 32 articles found in international journals. The next step is abstract review. After reviewing the abstracts of the selected 32 articles, 18 articles were excluded because they were not included in the experimental study, and 14 articles were entered for the next step which was a full-text review. Searching for the full text of the 14 selected articles, 11 articles were excluded because they were not included in the inclusion criteria. A total of 3 selected articles were included for analysis.

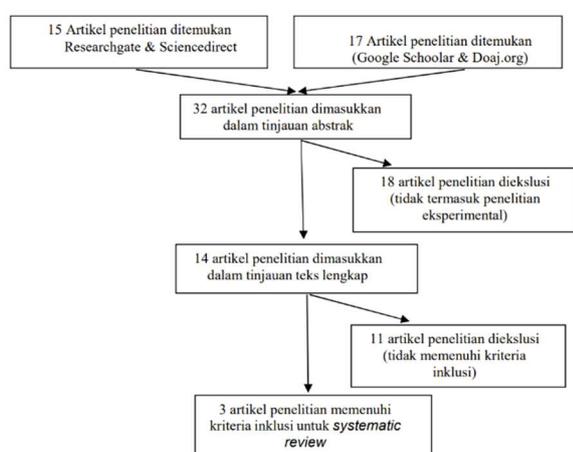


Fig 1. Journal Selection Flow

Quality assessment on articles using the theme Effect of Collaborative Problem Based Learning for systematic review articles from 3 selected articles. The 3 research articles above have shown their feasibility to be carried out by a systematic review because they have met the quality assessment criteria

3.2 Study of three journals

Based on its implementation *Problem Based Learning* (PBL) is a learning model that applies concepts and principles of science including environmental chemistry, which is also more suitable to be studied through score appreciation [8]. The results of research by Nuswowati with the title "*Implementation of problem-based learning with green chemistry vision to improve creative thinking skills and students' creative actions*" with a research model in the form of mixed-method design with embedded experimental models through pre-test and post-test in the control group. to determine the effect of the application of the Problem Based Learning Model (PBL). The results of the study indicate that one part of the learning activities such as consultation with lecturers is carried out for carrying out assignments, presentations, and rewriting in the form of reports in more detail from the results/products of

creative activities that have been carried out after the continuation of teaching and learning activities. The use of the PBL model is able to increase students' creative thinking skills and creative actions [9].

Another study by Suyanta entitled "*The Effect of Problem-Based Learning On Students' Self-Regulated Learning of Chemistry Learning*" used the PBL model with the type of research in the form of a quasi-experimental, non-equivalent post-test only group as the research design. The results showed that there were differences in the level of student learning independence through the application of problem-based learning for class X (electrolyte topic) and class XI (acid-base topic). The experimental class, both X and XI, showed better results than the control class without applying the PBL method to learning activities [10].

A similar study was also conducted by (Hanipah et al., 2018) entitled "*The Effectiveness of Problem Based Learning and Project-Based Learning Models to Improve Natural Science Study Outcomes*" which was carried out using a quasi-experimental model using pre-test and post-test designs. involving two classes as the experimental group. In the first experimental class, students received treatment with a learning model that focused on problem-solving, and in the second experimental class, students were given a project-based learning model of learning. It is known that: (1) there are different learning outcomes in the cognitive aspect between group-based learning and project-based learning whose significance value is $0.001 < 0.05$. So it can be concluded that the PBL learning model is more proven to be able to improve learning outcomes, especially in the cognitive aspects of students compared to the learning model *project-based* [11].

3.3 Learning Activities & Basic Competency Standards in Chemistry Learning

Each student has a way to understand and process various information in learning activities, both formal and informal. The existence of these differences is called learning styles which are the preferences of students in the learning process. The characteristics of learning styles explain how students process information that is applied and understood. So, if the teacher can understand the learning styles of the students in the class, it will make it easier to determine the appropriate learning model according to the students' understanding [12].

Students learn various subjects, but do not participate and are not interested in studying the subjects presented, especially if the teacher has not mastered the learning model. In complex subjects that are difficult to explain, it is necessary to visualize and explain the imagination of students and explain it well. Therefore, teachers need to play a role in facilitating the process of giving concepts so that students understand them more quickly.

One of the causes of the not yet optimal achievement of learning objectives for a subject for students is the use of learning models that are not in accordance with the concepts and theories of teaching materials and modern learning paradigms. In general,

the teacher acts as a material mediator in the learning process, which leads to the tendency of an authoritarian teacher, who creates a learning situation with one-way communication. Another way to achieve the objectives of a learning activity is to choose a learning method that is appropriate to the student's situation. Its purpose is to help students properly accept and understand the topics they are dealing with.

The application of learning models in learning activities is very important. The right learning model can be used to arouse student interest, change study

habits for the better, stimulate creativity and motivation to learn, and help teachers provide teaching materials and make it easier to understand the tasks they want to prepare. Gradually, this helps the achievement of learning objects and indicators evenly. Several types of strategies and approaches that can be implemented by teachers in learning activities are expected to improve the quality of learning activities [13]. In this case, choosing a learning strategy that is able to bring about change or constructively is an option that can be taken.

Table 1. The Identity Of The Selected Journal

Author	Title	Years	Methods	Results
Nuswowati, et. all.	Implementation of PBL with green chemistry vision to improve creative thinking skill and student's creative action	2017	Mixed Method	The consultation with the lecturer is carried out for the implementation of tasks, exhibit, communication, and rewriting in the form of reports in more detail results of the creative activity that has been done and also the sustainability of the action. The application of PBL model with green chemistry insight is able to increase creative thinking skills and creative action of the students
Suyanta, et. all	The Effect of PBL on Students' Self-Regulated Learning of Chemistry Learning	2019	Mixed Method	The result shows that there is a difference between students' self-regulated learning through the application of PBL for grade X (electrolyte topic) and grade XI (acid-base topic). The experimental classes both X and XI show higher values than the control class with high category on their abilities
Hanipah, et. all	The Effectiveness of PBL and PjBL Model to Improve Natural Sciences Study Outcomes	2018	Mixed Method	PBL is more effective to improve students' cognitive learning outcomes than PjBL. Both models do not show significant differences in improving students' environmental care attitudes. The benefits of this research can find a synthesis to add phenomenon in the field of science learning

Applying a constructive collaborative learning model is a recommended action for teachers. The model helps teachers optimize their limited class hours. The collaborative learning model can keep students motivated to learn and overcome boredom. In addition, the principles of the constructive learning model make it easier for teachers to compare the science concepts they learn with those they understand. Of course, this model is applied to minimize misunderstandings in teaching and learning activities. The model that can produce these results is the PBL model.

3.4 Learning Models and Their Effects on Learning Outcomes of Chemistry

3.4.1 Implementation of Collaborative Learning Learning Models Collaborative learning

is a learning process in which students work in small groups consisting of many people and help each other [14]. Collaborative learning refers to creating an environment in which students can learn, help each other, teach the material they are discussing, and collaborate to solve group assignments. Therefore, groups need to have a well-defined structure. If not, it is better to leave it to the students to determine and agree on the structure to be used.

The following five criteria include important aspects to foster basic concepts in reflecting on the

successful implementation of the collaborative learning model, including 1). Mutual dependence on positive things, 2). Promotive interaction, 3). Accountability of students, 4). Interpersonal skills as well as in small groups, and 5). Good group processing [15].

If the criteria for learning quality are achieved, then appears a tendency characterized by high motivation from students and the development of cognitive skills. skills include team skills example in organization project composition, and negotiating solutions after problems occur in groups. The collaborative learning model provides excellent opportunities for learning and developing the social skills needed today. The application of collaborative learning activities has been shown to lead to higher cognitive abilities self-confidence and satisfaction with students better responses to learning materials. However, the implementation of this model has several weaknesses, namely, the teacher has difficulty in organizing collaborative activities, student behavior they complete assignments, manage hours in groups, providing resources roles to students, and building collaborative behavior and teamwork. In a finding from Ruys conducting an analysis of teacher preparation for task collaboration, teachers focused on organizing collaboration, for example setting group norms or promoting activities [16]. The results show that teachers often group students or work together by not preparing them much productive collaboration.

The deficiency in the implementation collaborative learning model is due to the unbalanced focus of the teacher in setting objectives and learning results, this has an adverse effect on collaborative activities between students in learning activities. Learners can realize academic learning often still ignore the importance of social interaction. If both teachers and students pay less attention to the collaboration aspect, there will be many obstacles to using the model effectively. In addition, the benefits of this model include cognitive enhancement and socialization of students and an increase in learning motivation if applied properly. Improving academic performance with teamwork can facilitate collaboration skills, skills communication teamwork, as well as the ability of students to participate in group discussions [17].

Activities problems focus on how to use theoretical knowledge in solving both theoretical and practical ideally, the ability to use concepts and formulas in processes to solve “simple” problems, broader knowledge or “complex”, including a combination of various disciplines by requiring knowledge applying the model [18]. Finally, students are instinctively encouraged in realizing a position where they can develop and find scientific strategies and ideas that can be applied but still refer to research. Examples of collaborative learning models that are applied in realizing the goals and outcomes of the learning process are the PBL model [19].

3.4.2 Characteristics of Problem Based Learning (PBL) Learning Model

Effective learning activities ensure learning. Several previous findings describe education as effective including factors that influence learning activities [20]. In addition, methods and strategies teaching used problems help students focus more on understanding and processing solving problems, understanding theories, and applying new knowledge in order to get solutions received [21]. Effective teaching materials will improve the quality of learning activities, in addition, participation student. PBL is a model that can stimulate learning situations effectively referring to social constructive [22].

Problem-based learning (PBL) is a model that was initiated at McMaster University Canada in 1969. In subsequent developments, the model has spread widely used in several fields such as management, engineering, agriculture, and law. PBL has a focus on dealing with problems that are used as starting points for learning, based on perspectives such as learning-centered based learning, interdisciplinary learning, focus on practice, as well as collaboration combined with other approaches groups [23]. PBL aims to optimize and achieve learning outcomes centered optimal by introducing learning activities that are student, independent, contextual, collaborative, integrated, and more reflective. The application of PBL is subject to factors such as subjects, students, teachers, and their organizations influenced by the structural and educational in the application of PBL.

PBL includes various components including the structure of the program curriculum and the evaluation of learning fibers based on groups [24]. Group-based learning does not only facilitate knowledge, but also other components, such as skills to communicate, solve problems, work in groups, take responsibility independently in learning, exchange information, and respect other individuals. Thus, PBL is believed to be a learning model in small groups by combining knowledge on the development of basic skills and attitudes [25].

In order to facilitate understanding of the implementation of the PBL model, the basic concepts are divided into various parts, including:

1. The characteristics of the PBL model include efforts to organize curriculum and classes in an integrated manner in problem-solving, in addition to cognitive skills;
2. Conditions that support PBL, such as small groups, active learning and tutorial instructions; and
3. PBL prioritizes results, for example in developing skills and motivation to become a “*long-life learner*.”

The main objective of the PBL model is to produce productive discussions. In realizing these goals, the problems studied are presented in a simple and objective manner, including avoiding confusion by identifying the main objectives, motivating students, and case neutral providing information necessary. In this, case it is not necessary to include a resolution procedure in troubleshooting. Learners can make their own choices, focus on various themes of learning and prepare approximately 16 hours of independent learning activities, including various elements of knowledge possessed by previous students [26].

The PBL model has three keys, including problems of daily life, the existence of learning, and a control group for students. It is also known as the education and learning system, the model is built simultaneously with problem-solving strategies and knowledge that focuses on questions or problems that are used at the starting of the learning process. Therefore, the model is able to improve the ability of students to be skilled in critical thinking [27], leadership teamwork, as well as collaborative learning [28]. factors in implementing this model in learning activities are 1) students are given the responsibility for planning learning 2) problems are the main key of this model, and 3) the teacher as a facilitator, 4) students need to reflect, 5) students need to learn from several sources related to the topic solving [29].

There are various models used in the assessment during PBL implementation, including individual and group presentations, multiple assessments from group members, student reports on cases, developing portfolios (problems, gathering information and hypotheses, and writing reports), classmate assessments, self-assessment, open group assessments, assessments from their tutors/facilitators, *online* written every week or given an assessment at the end of the semester, written assessments and assessments of group members who have worked together in writing written reports containing observations and comments [30].

3.4.3 Advantages and Disadvantages of the PBL

The model provides opportunities for students to lead learning, collaborate with them, or propose independent learner, problem-solving [24]. The project-based learning model (PBL) correlates individual intelligence in groups and settings in solving related contextual problems. This problem is used in project-based learning which is used as the first when collecting and integrating new knowledge, referring to experiences in life. models who are innovative in learning are able to encourage students to be more active during their learning [31]. Haryono explained to teachers that quality can implement several innovations in activities learning have an influence on student learning outcomes [32]. The benefits of implementing the PBL model are that students are familiar with problem-solving activities, which makes them more independent [33]. Second, the implementation of the PBL model is proven to be able to make students think critically [34] and optimize their learning [23].

The PBL allows students to gain experience when collecting, organizing, and storing information in its future application. Students also face complex and practical problems. Active participation of students in small groups requires excellent interpersonal skills, for example negotiating, compromising, educating peers, giving and receiving criticism, and motivating other individuals [33].

The weakness of the implementation of the PBL model in research lies in the first stage, which is to give problems to students. Some students do not understand the problem in everyday life and therefore are not confident in solving it. In the three stages, namely providing assistance for investigations that are carried out independently or in groups, there are still students who are confused about doing practicum because they are not used to using tools and practicum materials and ignorance of understanding the working procedures which result in the class being not conducive and not under control. In the fifth stage, namely making presentations and evaluating the problem-solving process, there is often a lack of time for each group to make presentations regarding the findings from class discussions in the third phase, namely carrying out an investigation of the problem [35].

Another weakness of the PBL model is the implementation of teamwork as a supporting but also limiting factor. This refers to the complexity of the relationship between students and education, by including various social and behavioral aspects and is considered by the teacher who is responsible for implementing strategies in the classroom. The various factors include passivity, lack of commitment from group members, and difficulties in reaching consensus on solutions that can hinder the ability of a group to solve problems as well as the task of the teacher in curating the emergence of such things [36].

In addition to teamwork, the time factor becomes a challenge to implement the model in learning. In a curriculum that has a focus on material where the teacher has the role of being the main actor when delivering material, it becomes difficult to introduce

strategies that provide information to students so that they can show their active role. This is also reinforced by the situation where the culture of self-directed learning has not been applied to the behavior of most students in higher learning. So, as for a PBL contribution, namely supporting students to be familiar with learning on the basis of experience carried out with action, through an emphasis on developing themselves from students [37].

3.4.4 Results of Application of Problem Based Learning (PBL)

Model PBL model as a learning model by focusing on the theoretical framework, more precisely constructivism. In this model, the focus of learning is on the chosen problem so that students do not just explore various concepts related to the problem but need to understand the model scientifically in solving the problem. So, in this case, students are required not only to understand various relevant concepts as problems that are the center of attention but to receive learning related to skills in implementing scientific models in solving problems and developing patterns in critical and creative thinking [25]. Referring to the findings of Hanipah's analysis, it is explained that learning with the PBL model is more effective in making improvements to the quality of student learning outcomes. Thus, it can be observed through the difference in the mean value of learning outcomes after the implementation of the model [11].

The results show that the PBL model can increase student activity learning correlated are actively learning outcomes. The correlation of the active participation of students in terms of learning scientific The PBL model is designed to provide many problems, requiring students to acquire knowledge basic. Students can solve problems by applying the model and exploring skills work team The problem with the learning model lies in the situation that corresponds to actual everyday situations. When students get closer to real situations, they are more effective in improving their skills. This explains that the implementation of the problem-based learning model to able is to improve the results activities cognitive learning of students [11]. Activities learning using the PBL model, especially in learning able to involve students fully in problem- solving. Concept can effectively optimize learning outcomes. The results are effectively used for learning because the implementation of the problem-based model optimizes students' caring attitudes and learning outcomes are superior to using books on conventional models. Model project-based allows students to acquire soft skills as well as knowledge of the concepts presented. Through project-based learning, they can improve their critical and creativity. The implementation of the PBL model is able to on a significant impact on learning outcomes and improving the skills of students [38].

The results obtained explain that it can optimize interest in the material thereby becoming motivating to understand the material. At the beginning of learning activities, students will have difficulty carrying out

practicum on the subject of investigation. However, after being actively involved in learning, they become easy to apply the various components. Moreover, learning with the PBL model is proven to be able to make students able to do a test of understanding the results better than in other models. Students respond very positively to learning that applies the PBL model [35].

3.4.5 Combination of Collaborative Learning with Problem-Based Learning Models in the Learning Process

Approach with CL based on the PBL model is an effective effort in developing an ability in the 21st century to support the realization of critical thinking and problem solving, interpersonal communication, as well as media and information literacy, cooperation, innovation, leadership, and teamwork, as well as creativity. The results explain that the PBL approach indicates that the model is able to optimize the ability to solve problems and the academic performance of students which has a positive influence on perceptions of their learning profession.

The PBL concept explains the collaboration of two or more teachers in learning activities when they are in the process of planning, implementing, and evaluating by including an exchange of their training skills and reflective conversations with students. So it is proven that the PBL approach is able to provide various valuable learning experiences for teachers who do not have much experience and encourage professional development so that it can provide convenience when conveying knowledge to students. The PBL-based CL model allows students and teachers to share information. Specific topics can be discussed through a different perspective or through a pedagogical approach that includes teamwork. Students and teachers can benefit from the PBL model with professional and emotional support, professional learning, and personal development.

So, through the implementation of the model that is carried out maximally, it can provide opportunities for students to solve problems through a higher level of difficulty, then get used to solving problems, getting valid answers in line with the basic theory. The goal can be achieved if the implementation of the model can be carried out effectively and there is a positive response after the teacher has succeeded in giving direction to students well.

4 Conclusion

Referring to the explanation above, it can be concluded that the implementation of the PBL model in chemistry subject learning activities if a comparison is made to the conventional model, it indicates the PBL model is believed to be more effective in the learning achievement of students and instills the level of creativity of students. The CL model combined with PBL allows teachers and students to share information more effectively and efficiently. Topics specifically in

different perspectives as well as through a pedagogical approach that includes teamwork. Educators and students can benefit through the implementation of the PBL model with professional and emotional support, and efforts to improve professional learning and develop a personality. The implementation of PBL which is used as an active learning strategy explains the potential for application in learning activities with integrated cognitive, social and behavioral dimensions. Students support integration into the context of activities in a professional manner. So through the PBL model, it is able to optimize academic achievement and the understanding of students related to learning. Meanwhile, the teacher's role in this model is to help students acquire skills to use in life, such as analysis, collaboration, communication research, problem-solving, and synthesis. So the teacher should give consideration to the approach to the PBL-based CL model. However, in general, students who are accustomed to carrying out lectures using conventional methods have a tendency to be uncomfortable when applying the PBL model for the first time so it takes time to make adjustments.

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