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Problem Based Learning (PBL) Learning Model for Increasing Learning Motivation in Chemistry Subject: Literature Review with Bibliometric Analysis

Indria Arifiani, Latiffatunnissa Nurul.H, Setia Rahmawan *

Pendidikan Kimia, UIN Sunan Kalijaga, Yogyakarta, Indonesia
*Correspondence: E-mail: setia.rahmawan@uin-suka.ac.id

ABSTRACT

This research aims to determine the Effect of the Problem-Based Learning (PBL) Learning Model in Increasing Learning Motivation in Chemistry Subjects. The method used in this study uses qualitative research with data collection techniques, namely literature studies. In this study, data collection is obtained from scientific articles and journals that are following this study, and then the data that has been obtained is analyzed and studied in depth, critically, and systematically which is then described narratively. This literature study research reviewed as many as 10 journal articles related to how the results of using the PBL learning model in grade XI science students on learning motivation. From the results of the study, it can be concluded that the learning model has proven effective in increasing student motivation in chemistry subjects. 10 research article results have shown that the application of the PBL model can improve student motivation and learning outcomes.

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1. INTRODUCTION

Science learning is learning that not only emphasizes mastery of products but also mastering process skills and scientific attitudes (Fuadi *et al*., 2020). The science process skills approach (PPP) is an educational method that helps learners find facts, create concepts, and make theories, and during learning, learners are asked to participate in scientific activities (Amnie, 2017). Teaching learners process science skills is essential because they will have the ability to learn further, such as conducting research and solving problems. Science process skills also help learners learn critical thinking skills and gain useful learning experiences (Rini & Aldila, 2023; Princess *et al*., 2022). The application of the science skills approach can be developed through the scientific attitude of learners which includes finding facts, ideas, and principles of science (Saputri & Wilujeng *et al*., 2017). So far, science learning tends to focus on *remembering and* understanding, with little training in students' ability to talk about the subject (Fitriana *et al*., 2019). This problem is exacerbated when learning is focused on lectures, which limits learners' learning activities (Purwandari *et al*., 2022). During the learning process in class, teachers usually ask students to memorize material that makes students force their brains to remember what they have learned (Fuadi *et al*., 2020). As a result, teachers need to create varied learning models for teaching, preventing learners from getting bored and continuing to encourage their acid-base material thinking and views to develop.

Learning models that involve students directly in the learning process and interact with their environment make learning meaningful and involve students actively (Anisa *et al*., 2014). One type of learning model that can make students actively involved in learning is *Problem-Based Learning* (PBL) based learning (Rahmadani, 2019). PBL is a learning model in which students are faced with a real problem they have experienced (Ardianti *et al*., 2022). According to Samsudin & Raharjo (2023), the problem-based learning model is a learning approach that involves contextual problems to encourage students to learn. Problems are given before class begins, motivating learners to investigate, understand, and find solutions to problems. Problem-based learning is used to improve critical thinking skills in problem-oriented contexts, which also includes improving study skills. In problem-based learning, teachers must create problems, ask questions, and encourage inquiry and discussion (Maryati, 2018). More and more learners' experience with problems increases their ability to think critically and build effective thinking strategies to solve problems. If learners have become accustomed to these conditions, there is a possibility that their attitudes and activities will develop and be qualified (Alfiantara *et al*., 2016). Therefore, the PBL model can also be applied to subjects that have characteristics involved in daily life (Sari et al., 2018).

One of the high school/MA subjects that match these characteristics is chemistry. The most important subject to teach learners is chemistry because it can improve their thinking skills and encourage them to think creatively (Rachman *et al*., 2017). It is just that many students face difficulties when learning chemistry, this is because it is an abstract and complex concept that requires a deep understanding (Sariati *et al*., 2020). Most students consider chemistry as a difficult and boring subject, chemistry being one of the fields of science that students do not like (Muderawan *et al*., 2019). Learners often face difficulties in learning chemistry because they do not know how to learn it, difficulty connecting concepts, and the need to use logic, mathematics, and language (Zakiyah *et al*., 2018). The concept of biassed chemistry has many applications in everyday life (Wilcken et al., 2012). PBL is suitable to help chemicals because its application is close to everyday life. Thus, learners are familiar with the given problems (Varadarajan & Ladages, 2022). That way learners are more motivated to learn with

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PBL because they have control over their learning process, which can trigger intrinsic motivation (Fukuzawa *et al*., 2017).

Learning motivation is learning motivated by internal and external drives in learners who learn to make behavior changes (Hidayah & Hermansyah, 2018). The role of motivation in an educational and learning activity is very important for both intrinsic and extrinsic motivation Types of learning motivation are intrinsic (motivation that comes from within the learner himself that can encourage him to learn) and extrinsic (motivation that comes from outside the student that drives him to learn) (Emda, 2017). There is a relationship between motivation and psychological, emotional, and emotional problems that can affect human behavior (Cahyono *et al*., 2022). Learners are motivated to achieve the best learning outcomes. These learning outcomes will be used as a basis for determining expected competencies (Ramli, 2014). Motivation allows learners to develop activities and initiatives to help them follow lessons and remain patient (Cahyono *et al*., 2022). Therefore, learning activities need to be motivated to help learners prepare and meet their needs. That way students can follow learning activities from the beginning if they are motivated.

Based on the description above, there is a need for a solution to overcome the problem, namely the use of a learning model that aims to increase student learning activity in learning chemistry subjects. Therefore, we are interested in conducting literature study research on this matter.

2. METHODS

This research uses descriptive qualitative research methods with data collection techniques, namely literature studies. The study of literature is referred to as library research or literature research. The limitations of this activity only lead to journal analysis without the need for field research. This literature study research reviewed as many as 10 journal articles related to how the results of using the *Problem-Based Learning* (PBL) learning model in grade XI science students on learning motivation. In this study, data collection was obtained from scientific articles and journals following this study, to determine the effect of Using the PBL Learning Model in Increasing Learning Motivation in Chemistry Subjects, then the data that was obtained was analyzed and studied in depth, critically, and systematically which is then described narratively.

3. RESULTS AND DISCUSSION

A literature review is a scientific study that focuses on a particular topic and provides an overview of its development (Cahyono *et al*., 2019). This literature review is conducted to determine the effect of using a PBL-based learning model in chemistry subjects that aims to increase student learning motivation. The collected literature is analysed in several tables that show the analysis of Study Literature. Then includes several core journals/articles and the results of journal/article studies as well as conclusions from the collected literature.

3.1. Analysis Study Literature

10 papers discuss the PBL learning model on acid-base material. All of these journals are national journals that have been selected relevantly based on references accessed on the *Google Scholar* portal. By searching for "Chemistry Problem Based Learning Model", "Increasing Student Motivation", and "PBL Learning Outcomes". Then analyzed the core of the journal and the results of journal studies to get conclusions that answer the use of *the*

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Problem-Based Learning (PBL) learning model in increasing student motivation regarding acid-base material. **Table 1** shows a literature study analysis from 10 articles.

Table 1. Literature analysis study.

No	Title	Research Results	Reference
1.	Penerapan *Problem Based Learning (*PBL*)* Pasca Pandemic untuk Meningkatkan Hasil Belajar Pembelajaran Kimia Materi Asam Basa pada Peserta Didik Kelas XI IPA 3 MAN Kapuas Tahun Ajaran 2022/2023 (Susanty, 2023).	In the research cycle, from research data, research design, research instruments, data collection methods, and data analysis techniques, it was produced that the first cycle was able to complete learning 69%. Cycle II showed an increase in learning with 92% completeness with an average score of 74.8, and 2 people (8%) experienced remedial studies. The research method used is Action Research. The study was stopped when it reached 85% completion of classical learning. This study experienced an increase in learning completeness based on an increase in the percentage of cycles I and II.	Susanty (2023)
2.	Upaya Meningkatkan Hasil Belajar Kimia dengan Model *Problem Based Learning* pada Materi Titrasi Asam Basa SMAN 3 Kota Bengkulu	Pre-Cycle which includes pre-test results with an average score of 49 and a percentage of 6.25%. Thus, only 2 students whose scores meet the minimum completeness criteria (known as kriteria ketuntasan minimal (KKM)). In Cycle I, actions, and observations were carried out simultaneously, then the wet acid titration sub-material and carried out face-to-face for 2 hours of lessons, then post-tested 10 questions and the results were an average score of 60 with 52% completeness and the number of students was incomplete around 17 students. Silklus II presents conceptual material based on acid-base titration curves and reviews miss-conceptions in stoichiometry, the results get 86% completeness. The learning outcomes of the cognitive realm cycle I as many as 19 out of 36 were completed. Cycle II has as many as 31 out of 36 students. Targeted success indicators have been achieved in the second cycle. Implementing PBL with this Classroom Action method can improve student learning outcomes.	Putri *et al.* (2021)
3.	Inovasi Pembelajaran Kimia pada Materi Asam Basa Melalui Model Pembelajaran *Problem Based Learning*	The description of the Initial Conditions was as many as 17 out of 27 students (62.96%) who completed the KKM. Thus, the Cycle 1 Description continued, showing the results of the recap in 3 meetings. From these observations, active learning conditions are improved. In cycle II, the observation sheet in the form of a questionnaire proved 92.59%. Increasing student learning outcomes and activeness with the innovation of learning models that are used gradually according to procedures.	Nirwesthi (2022)

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Table 1 (Continue). Literature analysis study.

No	Title	Research Results	Reference
4.	Penerapan Model Pembelajaran *Project Based Learning* untuk meningkatkan Prestasi Belajar Peserta Didik pada Materi Asam Basa di Kelas XI MIPA 1 SMA NEGERI 1 ANGSANA	Cycle I is carried out, based on the results of observation when learning takes place online. The success of the action of making concept maps in the first cycle was evaluated. In cycle II, the application of face-to-face PBL with practicum activities. This cycle has reached classical completeness. This is influenced by the active role factor of the student. Therefore, student activeness is seen in cycle II, the role of teachers, and project assessments that support student learning outcomes. Based on the results of research and discussion, PBL can improve student achievement on acid-base material through project activities that include psychomotor values in grade XI MIPA I SMA Negeri Angsana.	Rokhani (2022)
5.	Integrasi Metode Pembelajaran Kooperatif dan Model Pembelajaran *Problem Based Learning* Untuk Meningkatkan Motivasi Belajar Kimia Peserta Didik	Use cooperative learning and PBL integration. PBL is carried out cooperatively, which is used as *Number Head Together* in Cycle I, and *jigsaw* in Cycle II. Data collection was conducted through student motivation questionnaires. The results obtained during 2 meetings on the Likert scale, the score obtained in cycle I was 2,347 (78.89%) while cycle II was 2,388 (82.89%). Thus, there is an increase in student learning outcomes. The use of both learning methods applied through integrity between the cooperative model and PBL can increase student motivation which can be seen from the increase in student learning outcomes scores on the chemical material.	Putri (2023)
6.	Meningkatkan Motivasi Belajar Siswa melalui Pendekatan *Problem Based Learning* Berbantuan Padlet pada Pembelajaran Kimia	Cycle I and cycle II are performed. The PTK implementation stage is carried out with motivation instruments and student motivation assessment rubrics. Pre-cycle observations were obtained through questionnaires for PBL assisted by Padlet Animation videos. In cycle I with the results of student motivation analysis of 61% classified as medium category so that further action is needed in cycle II, based on the results of learning motivation analysis in cycle II, 83.3% of high levels of student motivation were obtained. From the results of the study, the application of PBL in Padlet-assisted chemistry subjects greatly helped increase student learning motivation. after the application from cycle, I to cycle II from 61 to 83.3%.	Nurmi and Auliah (2023)
7.	Penerapan Model *Problem Based Learning* (PBL) untuk meningkatkan Motivasi dan Hasil	Using 4 stages of research, namely plan, action, observation, and reflection. Cycle I received the results of an analysis of student learning motivation in the high category at an average score of 72.18% with the PBL learning model carried out.	Soejana (2023)

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Table 1 (Continue). Literature analysis study.

No	Title	Research Results	Reference
	Belajar Peserta Didik	The distribution of student completeness in the first cycle was 57.14%. Cycle II was carried out according to the unfinished reflection of cycle I by 42.86% by doing it according to the RPP of the PBL model in cycle II. The results of observation after the action produced very high cycle II analysis data with an average score of 85.11%. Senke shows an increase in learning outcomes and student learning motivation. The distribution of learning completeness is categorized as complete. This study was conducted by class action, through 2 cycles. Cycles I and II showed an increase in scores from 72.18 to 85.11% with the complete category of student learning outcomes. This proves that the application of the PBL model can improve student motivation and learning outcomes.	
8.	Penerapan Model Pembelajaran *Problem Based Learning* Terintegrasi *Culturally Responsive Teaching (CRT)* untuk Meningkatkan Motivasi dan Hasil Belajar Siswa Kelas X IPA 2 SMA Negeri 7 Mataram Pada Mata Pelajaran Kimia Tahun Ajaran 2022/2023.	The research method is the Classroom Action Method with 4 stages, namely planning, action, observation, and reflection. Cycle I analyzed learning activities with an overall learning activity score of 58% then increased in the second meeting to 72%. Analysis of the learning outcomes of the first cycle students based on the pretest showed an average score of 58.57 so the percentage of completeness was 22.86%. To improve student understanding, the Culturally Relevant Teaching (CRT)-integrated problem-based learning model learning process was carried out, and the results showed an increase in learning outcomes by 77% completeness. Cycle II carried out scientific method material to produce student activity data, the results showed active students and increased the score from 79.05 to 84%. Then the data analysis of learning outcomes in cycle II is the acquisition of pretests at an average value of 67.14% and completeness of 46%, then the application of PBL and CRT learning results in an average post-test score of 80.14 and completeness of 86%. Based on the results of the study, the application of the CRT-integrated PBL model was carried out in 4 stages to analyze learning activities, learning outcomes, and student motivation levels. Based on cycles I and II, there is a very good improvement in terms of student learning outcomes. So that the integrity of the PBL model with CRT can improve student motivation and learning outcomes in chemistry subjects.	Sari *et al*. (2023)
9.	Peningkatan Motivasi dan Hasil Belajar Peserta Didik dalam Pembelajaran Kimia melalui	Using the type of classroom action research, data collection techniques using observation techniques, and document techniques to determine children's development during the learning process in the form of lesson plans with	Sumiati and Haryanto (2017)

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Table 1 (Continue). Literature analysis study.

No	Title	Research Results	Reference
	Penerapan Model Pembelajaran *Problem Based Learning (*PBL*)* di SMA Negeri 1 Bantul tahun Pelajaran 2016/2017 (Sumiati, 2017).	Chemical Equilibrium material using PBL. The methods used are test methods and questionnaires. Then the last technique is the interview technique. The results showed a percentage of the level of motivation to learn cycle I of 38% and a recap of learning outcomes average value of 77.7 (61.8% complete) but the completion requirement of classical indicators must reach 85% so that cycle II is carried out which results in the percentage of learning motivation increased to 91% with a total of 94.1% of complete learning outcomes. The application of the PBL model can improve student learning outcomes and motivation so that the effectiveness is used in chemistry. Based on the value of the improvement score from Cycle I and II.	
10.	Penerapan Model *Problem Based Learning* berbasis *Live worksheet* untuk meningkatkan motivasi belajar Kimia Peserta Didik Kelas X SMAN 1 Sinjai (Annasiyah Mukhtar, 2023).	It is a type of PTK with 4 stages, namely planning, action, observation, and reflection. The method of analysis uses quantitative descriptives. Success indicators on the criteria of high student learning motivation with a classical completeness of 90%. In cycle, I, the application of the PBL model found that the level of student motivation reached 76% so it was not complete in achieving success indicators, therefore continued in cycle II. In cycle II, there was an increase in student motivation reaching 96%. This study shows the success of applying PBL based on *Liveworksheet* in chemistry learning by increasing the percentage of student understanding and motivation through learning outcome data which was originally 76 to 96% and was declared complete.	Mukhtar (2023)

3.2. Synthesis Analysis of Journal Findings

This analysis is a process where a collection of various studies or journal articles have been analyzed to provide a comprehensive picture following this study entitled "Literature Study: Application of *Problem-Based Learning (*PBL*)* Models in Increasing Student Learning Motivation in Chemistry Subjects". The answer to the problem formulation by containing a preliminary structure is called a finding (Afifah & Liswati, 2022). That way the findings contained from 10 national journals that have been grouped based on methods, models, data collection techniques, results and discussions, and conclusions can be regrouped based on similarities and differences in journal research. According to (Ridwan *et al*. 2021) Synthesising findings can be done by concluding collectively with the results after the similarities and differences of the dissertation that have been discovered. Therefore, the synthesis analysis of journal findings from 10 journal articles is listed in the synthesis matrix in **Table 2**.

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Table 2. Journal synthesis matrix.

No	Findings	Target	Similarities	Difference
1.	Post-pandemic PBL implementation	Students XI Science 3 MAN Kapuas academic year 2022/2023	This type of PTK research uses 4 stages of planning, action, observation, and reflection in Cycle I and II.	Learning Outcomes increased from 69 to 92% with the requirement of 85% classical completeness and Instruments used
2.	Efforts to improve learning outcomes	Students XI MIPA 2 SMAN 3 Kota Bengkulu	Type of PTK Research, Using 4 stages of planning, action, observation, and reflection in Cycle I and II.	There is a Pre-Cycle before performing Cycle I &; cycle II actions. Pre-cycle is used as a benchmark for the initial ability of students. Learning outcomes 52 to 86% completeness. Instruments used
3.	Learning Innovations used	Students XI MIPA 5 SMAN 2 Tegal	Types of PTK Research, learning models, and, Methods used, Chemistry	Measured learning outcomes and teaching activities. Instruments used
4.	Student Achievement Level	Students of Class XI MIPA 1 SMA NEGERI 1 ANGSANA	Types of PTK research, Methods used, learning models, Chemistry	Measured improvement in student achievement and instruments used
5.	Integration between cooperative methods and PBL models	Students of Class XI MIPA I SMA Negeri 2 Bulukumbuh	Types of PTK research, methods used, learning models, which measured student motivation	The use of cooperative methods carried out in conjunction with the PBL model is used in both cycles. Instruments used
6.	Development of Learning Media based on the PBL Learning Model	Student XI.10 Public High School 1 Sinjai	Type of research, Field of Subject, Method, Learning Model, Measured Motivation	Media used Padlet, Learning Outcomes are different, Pre-cycle presence, Instruments used
7.	Application of Learning Models	Students of grade XI MIPA 2 UPT SMA Negeri 3 Wajo	Types of PTK Research, Applied Learning Models, Research Methods, measured Motivation	Not done pre-cycle and the student Learning Outcomes listed are not the same, the subject of the material used. Instruments used
8.	The Effect of Integration of Two Learning Models, namely CRT and PBL	Students of Class X Science 2 SMA Negeri 7 Mataram	Type of PTK research, PBL learning model, measured Student learning motivation, subject field Chemistry	Measured student learning outcomes, as well as motivation, CRT, and PBL methods, are carried out simultaneously, the subject of the sub-material used is different. Instruments used

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Table 2 (Continue). Journal synthesis matrix.

No	Findings	Target	Similarities	Difference
9.	Increased Learning Motivation and Learning Outcomes through PBL	Student XI Science 8 SMA Negeri 1 Bantul	Type of PTK Research, Learning Model used, as measured in Student Learning Motivation	Research methods used, data collection techniques, results and discussion, instruments used
10.	Application of PBL Model	Class X Students of SMAN 1 Sinjai	Type of Research, Methods used, learning model used, Student learning motivation measured	Results and discussion, sub-materials applied, learning media used, data collection techniques, instruments taken.

From **Table 2**, the Journal Synthesis Matrix shows that the 10 journals taken are related to this study. Journal articles have similarities in measuring student learning motivation of learners. The application of the learning model used; namely *problem-based learning* affects the measured student learning motivation. Thus, in the results and discussion as a whole, the journal shows a percentage of improvement in student learning outcomes. Although the study has differences in techniques, instruments, research series, and even the sub-material used. But, the *problem-based learning model* can be said to be effectively used to increase student motivation and learning. According to Magdalena (2024), The learning model is a pattern made to form a long-term learning plan in the continuity of the teaching and learning process. Therefore, the learning model is very important in determining the success of learning outcomes against the stimulation of students.

The *problem-based learning* (PBL) learning model is one type of learning model that is used as a learning design and approach where the focus is on the experience of solving problems (Rokhimawan *et al*., 2022). In several studies in the journal synthesis matrix, it is stated that the problem-based *learning* (PBL) learning model is the model chosen and used in classroom action research. Classroom action research was conducted using 4 stages of learning planning applied in the classroom. The stage consists of planning, action, observation, and reflection (Fahmi, 2021). These stages are a series of components of the Kemmis and Taggart models. Where the four components are integrated and united in one cycle. In the journal synthesis described earlier, the series of class actions used through four components produces one cycle of research data. With the application of the model used, of course, it can provide accurate results in research based on what is measured. Dickens and Watkins (1999), explained that most researchers who use PTK agree that the stages of research can be carried out with further action. Thus, class research on the journal matrix has a maximum of two cycles. According to McDonald (2012), the class action research cycle includes objectives to revise such as examples of competencies, processes, situations or circumstances, ways of working, and systems. The researcher will emphasize a research subject in his cycle of action. In this emphasis, researchers usually focus more on paying attention to feedback, planning or learning, and building material than varying the duration of each cycle. This shows that researchers can achieve optimal and procedural classroom action research.

The relevance of journal articles selected based on this study must also consider the context of PTK in journal findings. The context that is considered, for example, the pattern of high student interaction in the method is related to increasing the understanding of student concepts. The acquisition of data to be analyzed in research can be intended as a report of

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significant improvement data and support learning outcomes through the platform used by researchers. It can be said that the integration of findings into the context of the theoretical framework can give deeper meaning to existing findings. The similarity shows that in the synthesis of journal findings, there is a strong tendency *(best practice)* in this research, such as in the type of research, methodology, learning model used, and subject areas taken. However, if you look at the differences in each journal finding, it can indicate variations in context or the necessity of paying attention to methodology.

3.3. Evaluation of Limitations

Classroom action research conducted with a literature review provides a realistic context for the results that have been analyzed. The evaluation of limitations in this study includes consideration of the validity of the results, the methods used, and relevance to the wider context. The following are steps to evaluate the feasibility of the research.

(i) Methodological limitations include diverse research designs. Thus, classroom action research studies such as before and after group design, control group design, and action cycle design are different. This can make it difficult to compare results directly to each study based on the researchers' findings. In evaluating these limitations, the step is to pay attention to variations in research design to explain the influence on conclusions that can be drawn from the literature. Many classroom action research studies use relatively small samples because they are conducted in a specific classroom context. This suggests that some class action studies with small samples may not be generalizable to the wider population.

(ii) Variations in implementation and context. There are differences in school contexts, classroom action research studies are carried out by researchers in school contexts with different characteristics of students, teachers, and environments. Thus, as to evaluate its limitations through how differences in certain contexts can affect the results of the study. Variations in the implementation of a classroom action study intervention on findings from journal synthesis can also affect research findings and reduce the consistency of research results that have been reviewed.

(iii) Bias and validity Because classroom action research (PTK) is often carried out by teachers who are also researchers, there is a risk of research bias in collecting and analyzing data from journal articles or literature reviewed. Related to the validity of measurement instruments used by researchers in the studies analyzed is also important in measuring results (such as tests, questionnaires, and observations) including proven to have been validated or tested for reliability.

(iv) Generalizability, contextual results of classroom action research with the application of *problem-based learning models* in the field of chemistry may be generalized. By taking into account the limitations of generalizing research results to the specific context of the findings, both where the findings may apply and where they do not apply.

(v) Research Duration, research conducted if you often use a relatively high duration or period can affect the success of learning outcomes that apply to the object studied. Thus, the limitations of short-duration studies in evaluating the long-term impact of the interventions carried out. This causes the lack of maximum research process that takes place on the literature that has been analyzed.

This analysis is a process where a collection of various studies or journal articles have been analyzed to provide a comprehensive picture following this study entitled "Literature Study: Application of *Problem-Based Learning (*PBL*)* Models in Increasing Student Learning Motivation in Chemistry Subjects". The answer to the problem formulation by containing a

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preliminary structure is called a finding (Afifah & Liswati, 2022). That way the findings contained from 10 national journals that have been grouped based on methods, models, data collection techniques, results and discussions, and conclusions can be regrouped based on similarities and differences in journal research. According to (Ridwan *et al*. 2021) Synthesising findings can be done by concluding collectively with the results after the similarities and differences of the dissertation that have been discovered. Therefore, the synthesis analysis of journal findings from 10 journal articles is listed in the synthesis matrix in **Table 2**.

4. CONCLUSION

Based on literature studies that have been conducted, it can be concluded that there is a need for PBL learning model to have a positive impact on improving student learning outcomes in each cycle. The results of the analysis of 10 journal articles show that the application of the PBL model, both in various chemical learning contexts, has succeeded in increasing student motivation and learning outcomes. In several studies, the application of PBL integrated with classroom action methods, such as planning, action, observation, and reflection, has resulted in significant improvements in student learning outcomes. In addition, the PBL model has also proven effective in increasing student learning motivation, both through increasing the percentage of understanding, high levels of student motivation, and increasing the completeness of classical learning. This shows that the application of PBL model in each cycle can provide significant improvements in learner-learning outcomes.

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6. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. Authors confirmed that the paper was free of plagiarism.

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