# LITERATURE REVIEW: IMPLEMENTATION OF PROJECT BASED LEARNING TO IMPROVE CREATIVE THINKING SKILLS IN CHEMISTRY LEARNING

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## Abstract

*Project-Based Learning (PjBL)* is an effective learning approach to improve students' creative thinking skills in 21st century chemistry learning. This study aims to systematically review scientific articles that discuss the implementation of PjBL and its relationship to the implementation of PjBL. development of creative thinking skills based on Guilford's theory ( *fluency , originality, flexibility, elaboration* ) and Mihaly Csikszentmihalyi ( *curiosity, openness, perseverance, ambiguity tolerance, task commitment* ). The research method used was a systematic literature review of 10 scientific journal articles published between 2020 and 2024. The results showed that *PjBL* can significantly improve students' ability to generate original ideas, think flexibly, and have a commitment to tasks and high curiosity. These findings confirm that *PjBL* is a model that is able to integrate cognitive, affective, and social aspects of students in the context of chemistry learning. This study recommends the implementation of *PjBL* consistently and contextually by teachers to build a learning environment that encourages creativity.

**Keywords:** Project Based Learning, creative thinking skills, chemistry learning

## INTRODUCTION

The development of science and technology in the 21st century demands a transformation in the world of education and learning systems that are not... only learn material but also on the development of high-level thinking skills such as creative thinking skills. In the context of chemistry learning, creative thinking skills are very important because students are faced with abstract concepts that require imagination and the ability to relate chemical phenomena to real life. Unfortunately, various studies show that chemistry learning is still dominated by conventional teacher-centered approaches, so it has not been able to optimally encourage students' creative thinking skills (Setyorini *et al* ., 2023) .

Project-Based Learning (PjBL) is an innovative approach that can answer these challenges. This model emphasizes learning experiences through real projects that require students to think critically, creatively, and collaboratively. PjBL has been proven to improve students' creative thinking skills through the stages of problem exploration, solution design, project implementation, and reflection on work results. According to Thomas ( 2000) , Project-Based Learning (PjBL) is an effective approach in encouraging students to produce original solutions that are relevant to the real-world context. This model emphasizes the active involvement of students in the learning process through the completion of meaningful projects related to problems in everyday life. Thus, PjBL not only helps students understand concepts more deeply, but also hones critical thinking, problem-solving, and collaboration skills. This statement is supported by the results of recent research which shows that the application of PjBL in chemistry learning can improve various indicators of creative thinking skills, such as fluency (fluency in generating ideas), flexibility (flexibility of thinking), originality (originality of ideas), and elaboration (decomposition or development of ideas) (Qiara, 2024) .

A systematic study by Oktariani *et al.* , ( 2020) published in *Procedia Social and Behavioral Sciences* revealed that the application of PjBL in chemistry learning not only improves learning outcomes but also triggers emotional involvement and a sense of responsibility in producing work. PjBL provides a broad exploration space for students to develop creativity through practical activities and experiments based on contextual problems. In addition, the integration of PjBL with the use of social media such as Instagram and TikTok in basic chemistry learning has shown promising results. According to Anwar ( 2022) in the journal Inovasi Kurikulum, the use of social media as a tool for project presentations can increase student participation and improve their ability to think creatively by creating chemistry-based educational content. By using social media, learning becomes more contextual and closer to students' daily lives. This allows students to convey scientific ideas more creatively and interestingly.

This literature review is very important because it is necessary to provide a comprehensive picture of research findings related to the application of PjBL in chemistry learning to improve creative thinking skills. Many empirical studies have shown that PjBL is effective. However, there are few literature reviews that systematically discuss the trends, implementation strategies, and supporting factors for the success of PjBL in chemistry learning. The purpose of this study is to collect, critique, and present the latest empirical evidence on the effects of PjBL on students' creative thinking skills in chemistry learning.

This study is very important because it not only adds theoretical information, but also offers a practical basis for teachers, lecturers, and curriculum developers to

create innovative, effective, and contextual chemistry learning. By using PjBL based on the latest research findings, it is expected that the quality of chemistry learning in schools will increase. This will produce a generation of students who are innovative, flexible, and ready to face the challenges of the times.

## RESEARCH METHODS

### Types of research

This study uses a systematic literature review approach which aims to analyze scientific journal articles published in the period 2018 to 2025. (Rushiana *et al.,* 2023). The focus of the study is on the implementation of the Project-Based Learning (PjBL) learning model in the context of chemistry or science learning, especially in efforts to improve creative thinking skills. learners (Wuryandini, 2020) . The research stages follow a systematic flow, including planning (determining topics and inclusion-exclusion criteria), searching for articles through online databases such as Google Scholar, Scopus, SINTA, and various national and international journal portals such as kneopen.com and journal.uii.ac.id. Articles are selected based on titles and abstracts, then their contents are analyzed based on creative thinking indicators such as fluency, originality, flexibility, and elaboration according to Guilford's theory and Csikszentmihalyi's theory. such as curiosity, openness to experiences, perseverance, tolerance for ambiguity, and task commitment.

### Time and Place of Research

This research was conducted from May to June 2025 online and independently. The data collection process was carried out through searching and downloading journals in digital databases such as Google Scholar, Directory of Open Access Journals and SINTA .

### Research Targets or Subjects

The population in this study includes all scientific journal articles that discuss the implementation of Project-Based Learning and its relationship to creative thinking skills. in chemistry and science learning (Rifai *et al* ., 2021) . The analyzed sample consisted of 25 to 30 selected articles, which were selected based on inclusion criteria, namely articles published between 2018–2025, have gone through a peer-review process, are available in full-text, and include at least one indicator of creative thinking skills (Qiara, 2024) . Sample selection was carried out purposively based on the suitability of the topic to the focus of the study.

### Data Collection Instruments and Techniques

The main instruments in this study are a search log database that records all search queries (for example: "Project-Based Learning chemistry creative thinking 2023"), a spreadsheet to record article metadata such as title, author name, year of publication, research objectives, methodological design, subject context, research

instruments, and results (such as n-gain, regression, and effect size), as well as a checklist of creative thinking skills indicators based on Csikszentmihalyi's theory. (Csikszentmihalyi, 1997) . cha All data is collected systematically with documentation of the audit trail to maintain the validity of the process.

**Data Analysis Techniques**

The data were analyzed quantitatively descriptively to calculate the frequency of occurrence of the most dominant methods, types of instruments, and creative indicators ( Anggreani *et al* ., 2023) . In addition, a thematic analysis was conducted to synthesize narratives about how PjBL affects each indicator of creative thinking skills (Anwar, 2022) . Articles were also classified based on the type of research design, such as quasi-experimental, development (research and development), qualitative studies, or systematic reviews (Simalango, 2023) . Cross-study comparison is used to compare results between studies based on achievements such as n-gain value, effect size, or other significant improvements. (Jusniar *et al* ., 2024) .**Validity and Reliability**

Validity in this study was maintained through an internal peer review process, in which two researchers independently performed data selection and extraction. (Subagia, 2024) . Any differences of opinion were resolved through discussion until an agreement of at least 80% match was reached. Audit trails or search and revision logs were systematically maintained to ensure transparency of the process. In addition, source triangulation was carried out to strengthen the data: if the same findings emerged from two or more studies, then the results were considered more valid and reliable (Rushiana *et al* ., 2023) .

## RESULTS AND DISCUSSION

The results of this literature review indicate that the implementation of Project-Based Learning (PjBL) in chemistry learning has proven effective in improving students' creative thinking skills. The results show that PjBL is able to encourage an increase in students' creative thinking skills, both from the indicators proposed by Guilford (fluency, originality, elaboration, flexibility) and from the aspects of Mihaly Csikszentmihalyi (curiosity, openness to experiences, perseverance, tolerance for ambiguity, task commitment).

1. Research conducted by Subagia & Sudiatmika (2024) entitled "Implementation of PjBL in Basic Chemistry Courses to Improve Students' Creative Task Commitment" shows that the implementation of the Project Based Learning model is able to encourage students to be more active in compiling projects that are relevant to real life . This method strengthens students' understanding concept and show development in creative task commitment, especially

moment student to design project practical work contextual . This study also revealed improvement score skills think creatively significantly.

2. Another study was conducted by Anggreani, Fadiawati, and Tania (2023) entitled "Development of Instagram-Based Learning Media and Experimental Videos in Chemistry Learning". The results of the study showed that students who worked on project assignments through digital media experienced an increase in elaboration and originality aspects, as well as higher active involvement in the learning process. (Anggreani *et al.* , 2023)
3. Research by Qiara ( 2024) In his literature review entitled "The Effectiveness of Project-Based Learning in Increasing Student Creativity in Local Contexts" it was shown that PjBL is very effective in developing student creativity. that is develop learning media based on Instagram and experimental videos for assignments project Chemistry . Students who work on This project shows improvement aspects of elaboration and originality because they must develop ideas and convey them through creative visual media. Digital media has been proven to increase participation and make students more involved in the learning process . This study also emphasizes the importance of curiosity and explorative thinking in the learning process.
4. Research conducted by Jusniar, Haris, and Widiyanto (2024) entitled "Application of PjBL to the Concept of Basic Chemical Laws to Improve Critical and Creative Thinking Skills" shows that creative thinking skills students progress simultaneously through the stages of the project. The students' task commitment and perseverance aspects were prominent because the project challenged them to think in a solution-oriented manner. (Jusniar *et al* ., 2024)
5. Systematic research by Lestari and Ilhami (2022) entitled "Systematic Review of the Implementation of PjBL on Student Creativity" through a systematic review concluded that 80% of the articles that analyzed show there is an increase in student creativity through the implementation of PjBL. This study emphasizes the importance of active student involvement and meaningful project contexts in learning. (Lestari & Ilhami, 2022) .
6. Research by Alfin Anwar (2022) in the Curriculum Innovation journal entitled "Social Media as Innovation in the PjBL Model in the Implementation of the Independent Curriculum" highlights the integration of social media as a tool for project presentations. This study notes that students tend to be more confident and show high originality when they create educational chemistry content on platforms such as TikTok and Instagram. This reflects the importance of a student-centered approach in triggering creativity (Anwar, 2022) .
7. Research conducted by Setyorini, Rahmawati, and Nugraheni (2023) entitled "The Effectiveness of PjBL in Fine Arts Learning to Improve Students' Fluency

and Originality" shows that the PjBL model is also effective in the field of fine arts. Although not in chemistry learning, this study is relevant for comparison because of the similarity of project structure and exploration of creative ideas. (Setyorini *et al* ., 2023) .

8. Research by Rifai, Utomo, and Indriyanti (2021) entitled "Implementation of Project Based Learning Model to Improve Students' Creativity and Academic Performance in Thermochemistry Material" shows that the implementation of PjBL increases students' creativity in compiling reports and designing simple experimental tools. Students' flexibility and problem-solving aspects also increased significantly. because students have to adapt procedure experiment with limitations tools at school (Rifai *et al* ., 2021) .
9. Research conducted by Wuryandini ( 2020) with the title "Implementation of PjBL on Electrolyte Solution Material to Improve Student Idea Elaboration" reveals that students can compile creative reports and discuss the results of experiments in form concept maps and presentation active . This study shows that PjBL can be applied even to abstract materials.
10. Research by Rushiana, Marzuki, and Sari (2023) in a systematic review entitled "Integration of PjBL to Build Higher-Order Thinking Skills in 21st Century Learning" through a systematic review concluded that higher-order thinking skills, including creativity, can be developed sustainably with a PjBL approach that integrates collaborative and reflective elements. This study also recommends a hybrid PjBL-digital model. as well as from the Mihaly Csikszentmihalyi aspect (curiosity, openness to experiences, perseverance, tolerance for ambiguity, task commitment) (Rushiana *et al.* , 2023) .

Table 1: Summary of 10 Recent Articles on PjBL and Creative Thinking Skills in Chemistry Learning

| No | Journal Title | Author (Year ) | Method | Research result |
|---|---|---|---|---|
| 1 | Project Based Learning Implementation in Fundamental Chemistry Courses | Subagja & Sudiatmika (2024) | Quasi Experiment | PjBL increase understanding concept and creativity in lesson chemistry base |
| 2 | Instagram-Based Chemistry Practicum Project | Anggreani, Fadiawati, and Tania (2023) | R&D (Media and testing ) | PjBL-based practical videos and Instagram media improve students' creative thinking skills. |

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|---|---|---|---|---|
| 3 | Analysis of the Application of the PjBL Model in Chemistry | The Witch (2024) | Literature review | PjBL has a significant impact on all indicators of creative thinking. |
| 4 | Improving Critical Thinking through PjBL | Jusniar et al. (2024) | Quasi experiment | Critical and creative increase in high school students' concept of basic chemical laws. |
| 5 | PjBL to Improve Creative Skills of Junior High School Students | Lestari & Ilhami (2022) | Systematic review | Research trends on PjBL are effective in enhancing creativity in learning Chemistry. |
| 6 | Social media As Innovation in PjBL | Anwar (2022) | Qualitative study | Social media supports innovative and creative presentation of chemistry projects. |
| 7 | PjBL in Fine Arts and Its Impact on Creativity | Setyorini et al. (2023) | Experiment | Students' fluency and originality increased through collage projects – relevant for visual chemistry learning. |
| 8 | PjBL in Thermochemistry Material | Rifai et al. (2021) | Experiment | Creativity and learning outcomes increased significantly. |
| 9 | Skill Analysis Creative Thinking on Electrolytes | The Untamed (2020) | Descriptive study | Students demonstrate development of flexibility and elaboration through electrolyte projects. |
| 10 | Efforts to Develop Students' Critical Thinking in Chemistry (Review) | Rushiana et al. (2023) | Systematic review | A comprehensive review that the project approach strengthens higher order thinking skills |

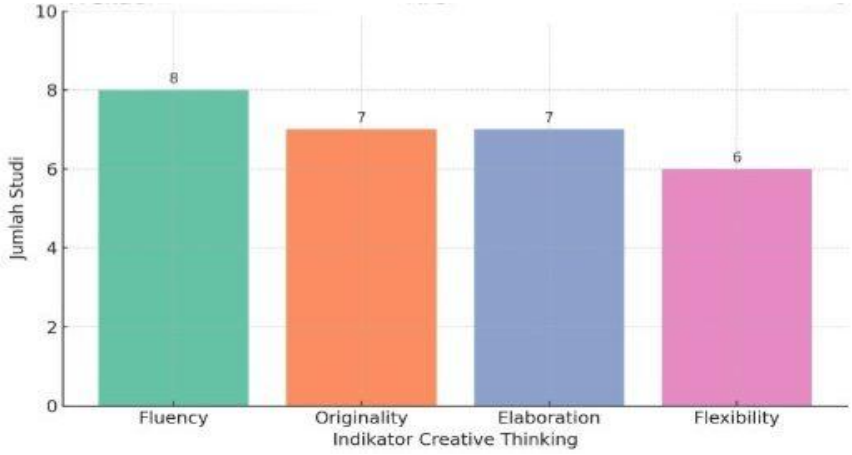
Based on Table 1, all studies show that Project-Based Learning (PjBL) not only strengthens cognitive aspects, but also activates students' affective and psychomotor aspects through authentic learning experiences. The application of PjBL has been proven to improve students' understanding of chemical concepts while developing students' creative thinking skills. Significant improvements in the dimensions of originality and fluency are most often reported, especially in experimental-based studies such as those conducted by Qiara ( 2024) through

literature review and Rifai *et al* ., (2021) in the context of thermochemistry material. The study reflects that a properly designed project is able to encourage the emergence of new ideas and fluency of creative thinking of students in completing chemistry tasks.

Meanwhile, integrative strategies such as the use of social media have also shown promising results. A study by Anggraeni *et al* . (2023) and Anwar ( 2022) shows that digital platforms such as Instagram can be an effective medium in supporting the presentation of chemistry projects in an interesting and relevant way to the characteristics of today's digital generation. The use of social media not only expands students' space for expression, but also allows them to package learning outcomes in a more contextual and applicable form.

Furthermore, several other studies such as those conducted by Setyorini *et al* . (2023) and Lestari & Ilhami ( 2022) broaden the scope of PjBL into a visual and systematic approach that is also effective in stimulating student creativity. Even in the context of descriptive and systematic studies such as those conducted by (Wuryandini (2020) and Rushiana *et al.* ( 2023) It was found that the project-based approach consistently supported the development of various aspects of creative thinking skills, including flexibility, elaboration, and critical thinking. Thus, these findings suggest that innovation in project design and presentation media is key to the successful implementation of PjBL in improving creative thinking skills in chemistry learning. Of all the articles reviewed , then there is improvement indicator skills creative thinking :

Figure 1: Frequency Skill Indicator Improvement Creative Thinking (Guilford Theory)



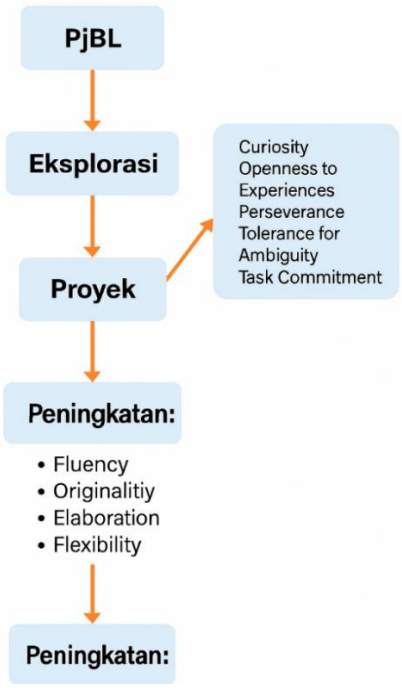

Fluency increases significantly because PjBL allows students to express various ideas without fear of being wrong. This is evident in the research of Setyorini *et al* . (2023) and Lestari & Ilhami (2022) which states that students are able to generate many ideas when faced with exploratory and open-ended projects.

Originality and Elaboration grow as students are asked to create unique and in-depth solutions or products. Students are encouraged to develop ideas through visual media and digital content such as experimental videos, as shown in the studies of Anggreani *et al* . (2023), Wuryandini (2020), and Qiara (2024). Flexibility is demonstrated in students' ability to change approaches when a project encounters challenges, as in the study by Rifai *et al* . (2021) which observed how students adapted to tool limitations during chemistry project practice.

Meanwhile, five indicators from Mihaly Csikszentmihalyi were also found implicitly in the study results:

1) Curiosity: Students' curiosity is increased because projects often begin with an exploration of open-ended problems. Students are challenged to find out for themselves through observation and experimentation, as shown in the studies of Qiara (2024) and Rushiana *et al.* (2023).
2) Openness to Experiences: In Anggreani *et al* .'s (2023) study, students were open to trying new formats in delivering chemistry content through Instagram and experimental videos, indicating an open attitude to new experiences. This suggests that contextual and digital approaches can trigger students' openness to learning.
3) Perseverance: In Jusniar *et al* .'s (2024) study, students demonstrated perseverance when completing complex projects, such as experiments on the basic laws of chemistry. Despite technical and theoretical difficulties, they still completed the task with perseverance and commitment.
4) Tolerance for Ambiguity: Many projects require students to face uncertain situations, such as experimental results that do not match predictions (Wuryandini, 2020). This develops students' ability to remain open-minded and not frustrated in uncertainty, strengthening scientific attitudes and resilience in facing academic challenges.
5) Task Commitment: Almost all studies have noted increased student engagement in projects. They feel responsible for the success of the project, devoting significant time and energy, as reported by Subagia & Sudiatmika (2024) and Jusniar *et al* . (2024).

Figure 2: Relationship between the Project-Based Learning ( PjBL ) learning model and development skills students' creative thinking




The image above is a flowchart that explains the relationship between the Project-Based Learning (PjBL) learning model and the development of students' creative thinking skills, which refers to Guilford's creative thinking indicators and the characteristics of creative personality according to Mihaly Csikszentmihalyi. PjBL is an initial approach in the learning process that emphasizes real projects that require exploration and problem solving.

The exploration stage invites students to observe, ask questions, and seek information before starting a project, while also generating intrinsic motivation that activates the creative personality dimension. The results of this exploration are manifested in the form of projects such as experiments, digital products, or learning media. On the other hand, the characteristics of creative personality are based on Mihaly Csikszentmihalyi's theory. namely curiosity, openness to experiences , perseverance, tolerance for ambiguity, and task commitment. strengthen the exploration process and projects being carried out. Furthermore, the resulting projects contribute to improving students' creative thinking skills based on four main indicators from Guilford, namely fluency (fluency in generating ideas), originality (novelty of ideas), elaboration (development of detailed ideas), and flexibility (diversity of ideas generated). The improvement of these four indicators will have a further impact on the development of students' creative thinking skills as a whole. Thus, this figure serves to illustrate the flow of the relationship between the implementation of PjBL and the internal process of students in forming

personality and creative thinking skills, and can be used as a conceptual basis in educational research that focuses on developing creativity through project-based learning.

## CONCLUSION

Based on the results of the literature review conducted, it can be concluded that the Project-Based Learning (PjBL) learning model provides a significant contribution to improving students' creative thinking skills in chemistry learning. The indicators that most often appear in various studies are fluency, elaboration, originality, and flexibility from Guilford's theory, as well as curiosity, perseverance, and task commitment from Mihaly Csikszentmihalyi's theory. These findings indicate that PjBL not only equips students with conceptual knowledge, but also encourages emotional involvement and resilience in completing projects. Innovations such as integration use technology (social media , experimental videos), and projects related to life real . also proven effective in increasing students' motivation and creative expression . Therefore, PjBL is highly recommended as a contextual learning approach that is able to form a generation of creative and adaptive thinkers in the digital era.

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