



## Effect of Design Thinking Based on the PjBL Model on Students' Creative Thinking in Science Learning: a Bibliometric Analysis

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### ABSTRACT

The purpose of this study is to analyze the collaboration pattern and the impact of the Project-Based Learning (PjBL) model based on design thinking on student creativity. The method used in this study is the bibliometric analysis method on articles from 2019-2024 totaling 100 articles. The articles used were obtained using the Publish or Perish database using VOS Viewer software. VOS Viewer visualization can display bibliometric data analysis mapping in three types, namely network visualization, overlay visualization, and density visualization. There are three research results obtained, namely 1) based on network visualization, the design thinking cluster still has minimal research related to this, but it is related to the PjBL model and creative thinking skills, 2) based on overlay visualization, the keyword design thinking has only emerged since 2022, and 3) based on density visualization, the term that has not been widely studied is design thinking. The results of the analysis show that the PjBL model based on Design Thinking is still rarely used in learning. In fact, the learning model with design thinking is able to increase student creativity, strengthen skills, and improve learning models. Therefore, research on the effect of using the Project-Based Learning (PjBL) model based on design thinking on student creativity in learning is included in the novelty in research so that more in-depth research is needed to prove the increase in students' creative thinking skills.

**Keywords:** PjBL; Design Thinking; Creativity; Science Learning.



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## I. INTRODUCTION

In the evolution of global education, the use of innovative learning models has become a major focus in efforts to improve the effectiveness of classroom learning. The project-based learning model is one model that is increasingly gaining recognition for its potential to provide in-depth and meaningful learning experiences for students. In the context of learning, subjects that are often considered complex and abstract, the use of this model offers the potential to change the learning paradigm to be more interactive, contextual, and engaging. Through carefully designed projects, students are not only given the opportunity to understand physics concepts in depth but also to develop creative skills so that the use of innovative models can support students' creativity in learning. Learning in the 21st century should be contextual, related to community life, student-centered, and collaborative [1]. Graduates of education must have good competencies to compete in the 21st century [2]. The problems of education in the industrial era 4.0 include students' abilities and shaping their character. The goal of education in the industrial era 4.0 is to produce students who are able to use ICT, think critically, solve problems, communicate, cooperate, and have strong character traits [3]. In social and personal life, critical thinking skills are important to deal with various problems [4].

The improvement of the quality of education carried out is part of the response to developments in the 21st century, namely an increasingly advanced era, so the quality of education must also be improved [5]. The PjBL model is a model that is identical to science learning, meaning that students are involved in the entire project,

starting from choosing a topic, deciding on an approach, conducting experiments, drawing conclusions, and communicating project results [6]. Research by looking at the trend of the effects of the Project-Based Learning (PjBL) model based on Design Thinking on student creativity in science learning is very important considering the need for graduates who not only have theoretical knowledge but also critical and creative thinking skills. In the era of globalization and the industrial revolution 4.0, the ability to innovate and solve problems creatively is a competency that is very much needed. The PjBL model based on Design Thinking offers a learning model that places students at the center of the learning process, encouraging them to collaborate, imagine, and develop innovative solutions to real problems. The ability to think creatively is very important because creative thinking is a skill that is needed and must be mastered in the 21st century to face future challenges where changes and advances in science and technology occur very quickly.

Creative thinking skills can help students solve problems with creative solutions. This thinking ability is important because it helps students to understand learning more easily. The importance of this creative thinking ability as real preparation for facing the world of work [7]. Creative thinking is the activity of thinking to produce something creative and original. Baer (2008, 2011) [8], [9] put forward the indicators of creative thinking, namely (1) fluency, which is the ability to produce many ideas; (2) flexibility, which is the ability to produce varied ideas; (3) originality, which is the ability to produce new ideas or ideas that did not previously exist; and (4) detailing, which is the ability to develop or add ideas so that detailed ideas are produced. This is that creative thinking has several indicators for producing new ideas [10]. A person's creativity is shown in various things, such as thinking habits, attitudes, disposition or personality, or problem-solving skills. According to [11], creative thinking skills have 5 aspects, including fluent thinking, flexible thinking, originality, elaboration, and evaluation.

The current problem is the low thinking skills of students, as evidenced by students who are still confused in working on questions, grouping elements in questions, steps to take in working on questions, and so on [12]. The low creative and critical thinking skills are partly caused by the learning activities carried out so far, which are still limited through teacher direction (teacher-centered learning). PISA summarizes the average scores and results of the scientific proficiency (IPA) ranking of OECD countries. Students in Indonesia had an average IPA score of 396 in 2018. According to Hewi & Shaleh (2020) [13], Indonesia's 2018 PISA score was ranked 74th out of 79 participating countries. The results that have been obtained indicate the need for learning by improving creative thinking. The low PISA score is due to the inequality of the quality of national education, resulting in low creative thinking skills. Creative thinking is very important for students to have because students can develop skills and knowledge to develop their businesses and discover new things and innovations [14].

One effort that can be made to solve the problems that occur is to implement effective learning in improving creative and critical thinking skills. Project-Based Learning (PjBL) is a more effective learning model in bringing students to a better world of work [15]. The curriculum mandate emphasizes that students have thinking and creative skills that are productive, creative, independent, collaborative, and communicative [16]. In the PjBL learning model, students will be able to see their ability to complete research projects that can describe the Human Development Index (HDI) of a country [17]. This study is in line with research conducted by Apriany et al. (2020) [18] showing that the quality of the projects produced by students after implementing the PjBL learning model is good. Based on the overall display indicators, the composition of the parts of the ecosystem, the resulting project has high aesthetics (color combination, harmony in object placement, neatness of the product), and the quality of detail of each part of the diorama. Then the research conducted by Atmojo et al. (2023) [19] entitled *The Influence of Project-Based Learning with Design Thinking on Creative Thinking Skills in Science Learning for Grade IV Elementary Schools* showed that the results of the study showed that based on a simple linear regression test on the SPSS 16.0 application, a significance value (2-tailed) of  $0.025 < 0.05$  was obtained, indicating that there is an influence of project-based learning with design thinking on creative thinking skills.

In school learning, in addition to implementing appropriate learning processes, to improve creative thinking skills, innovations must continue to be made in order to produce learning models that can maximize students' creative thinking skills. One step that can be used is to apply and utilize design thinking in a project-based learning model. It can be said that the design thinking process is still new in the learning process. However, design thinking is considered a suitable instrument for teaching 21st-century skills, one of which is creative thinking skills [20]. Design thinking itself is defined as a methodology that provides solutions to solve a problem and produces creative, critical, and innovative individuals [21]. Design thinking in the learning process is a mindset and approach to learning, collaboration, and problem solving. Design thinking can certainly complement the learning process to make it more effective so that students can think creatively and critically [22]. Research shows that design thinking is an interesting and revolutionary learning process that can increase creativity and critical thinking skills, making it suitable as an efficient and effective alternative to problem solving [23]. The application of design thinking is

also considered to be able to make students highly motivated to complete the tasks given and also produce high metacognitive skills [24]. In addition, design thinking can also make the learning process more creative and effective.

Based on the background, the purpose of this study is to analyze the trend effect of the design thinking-based PjBL model on student creativity in science learning. By reviewing the bibliometric distribution mapping using the Publish or Perish database using VOS Viewer software, a visualization of the relationship between subjects is obtained, and later it is able to describe the trends in existing articles.

## II. METHOD

In this study, the author uses the bibliometric analysis method. Bibliometric analysis is a study of bibliographic analysis of scientific activities, which is based on the assumption that a researcher conducts his research and must communicate the results. The bibliometric analysis used in this study is descriptive bibliometrics which describes the characteristics or features of a literature. Bibliometric analysis is used to provide progress and development of knowledge if researchers carry out joint activities to study specific research topics [25]. Bibliometric analysis techniques are divided into two categories, namely performance analysis and mapping.

For the general public, especially the scientific community, bibliometric mapping is considered beneficial because it can make it easier to visualize literature data into a chart that is easier for researchers to process so that it can be used as useful insights [26]. Analyzing data bibliometrically can help to understand the current research intensity on a topic from various research fields explored by researchers [27]. In line with this research, this study analyzes articles between 2018-2024 that specifically examine creative thinking skills in the design thinking-based PjBL model.

In this study, the Scholar database was chosen as a place to search for documents because Scholar applies consistent standards in selecting documents to be included in its index. This study also uses the Publish or Perish application to collect data related to the study of creative thinking skills from the Google Scholar and Scopus databases. Then, to analyze bibliometrics, VOS Viewer software is used. VOS Viewer can visualize the relationship between subjects and citations, group articles, create publication maps, and is able to describe trends in existing articles.

The steps in analyzing data in bibliometric analysis research begin with defining the objectives and scope of the research, including determining the variables and time period to be analyzed. Data is then collected from scientific databases such as Web of Science, Scopus, or Google Scholar using relevant keywords. After the data is collected, filtering is carried out to ensure the relevance and quality of the data, eliminating duplication and irrelevant publications. Analysis is carried out to identify patterns and trends in the data. The results of the analysis are then visualized using diagrams to help interpret the data and convey the findings. Furthermore, the results are analyzed to understand trends and patterns, and identify research topics found.

## III. RESULTS AND DISCUSSION

Based on the results of the article search and analysis that has been carried out regarding the influence of the use of the PjBL model based on design thinking on student creativity in learning, 100 article metadata were obtained from the publish or perish search from 2019-2024. The authors found were not only from Indonesia but also from various countries in the world. Meanwhile, the keywords used were the PjBL model, design thinking, and creative thinking. The next stage is that the article is saved in RIS format to be read in the VOS Viewer application. In the VOS Viewer data analysis, there are three types, namely: network visualization, overlay visualization, and density visualization.

### Network Visualization

The first result is obtained in network visualization. Network visualization in bibliometric analysis is a method used to describe the relationship and interaction between various elements in a bibliometric data set. The visualization of the relationship between each keyword in this study can be explained through Figure 1. Different colors distinguish each of its clusters.

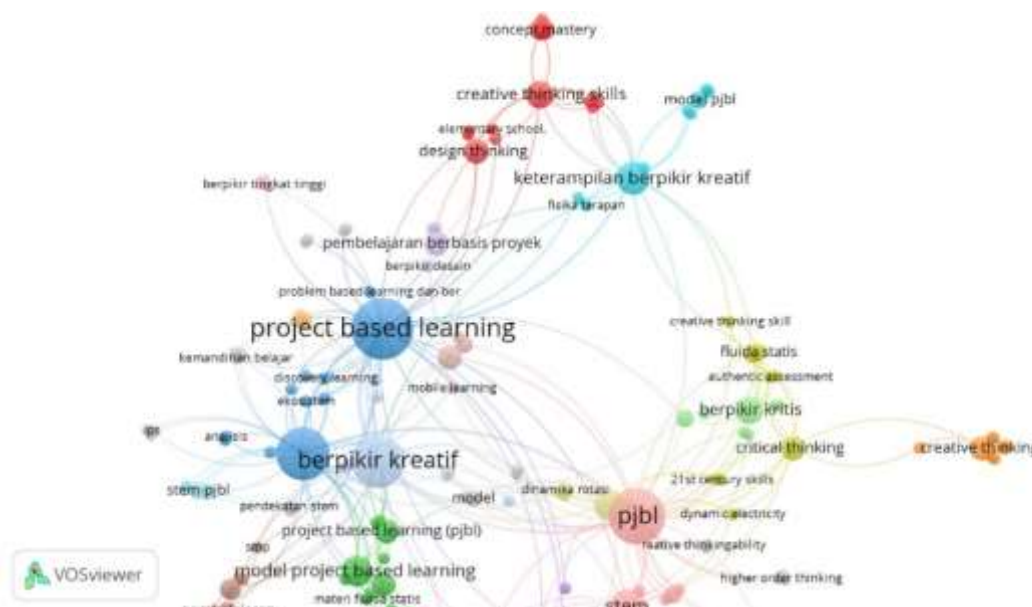


Fig. 1. Network Visualization

Based on Figure 1, the relationship between one cluster and another cluster can be described. Project-Based Learning is one of the studies that is often found. In this PjBL, it has a relationship with 60 other tribes. The terms that are often used are creative thinking skills, science process skills, STEAM, and design thinking. Then in the creative thinking cluster, it shows a relationship with 43 other tribes. Among those that are often found are PjBL, STEAM, and lesson study. Then for the design thinking cluster, there is still minimal research related to this; there are only 10 relationships with other tribes. However, in this design thinking, it has been found in the PjBL model and creative thinking skills. Thus, it is necessary to find new research from the visualization networks that have been found.

**Overlay Visualization (OV)**

The second result is obtained from the overlay visualization. The overlay visualization analysis displays research updates related to project-based learning. The articles were obtained from 2019 to 2024, or the last five years. The results of the analysis can be explained in Figure 2.

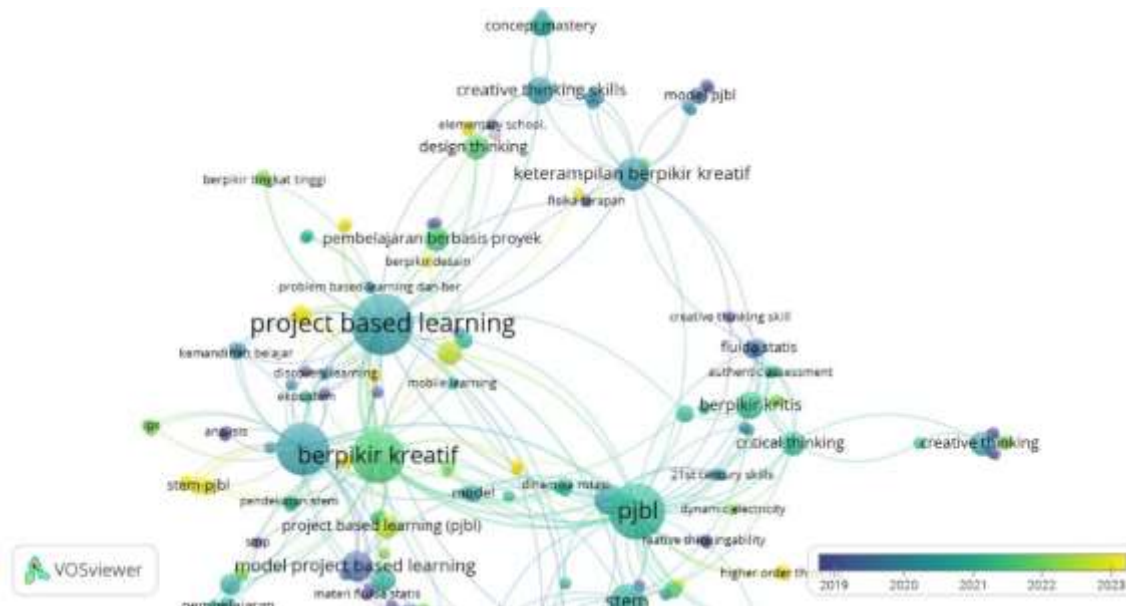


Fig. 2. Overlay Visualization

Based on Figure 2, it is described that there is a spectrum of dark and light colors. The meaning of this color is that the darker the color displayed by the VOS viewer, the longer the research has been done, and vice versa. When the color displayed is lighter, it indicates that the research has just been done. For the keywords used, namely

project-based learning and creative thinking skills, this is research that has been done for a long time. However, for design thinking, this is new research that began to appear in 2022.

### Density Visualization (DV)

The third result is obtained from density visualization. Density visualization is a technique in network analysis used to describe the density of relationships or connections between elements in a network. In the context of bibliometrics, density visualization helps to show how closely related the various entities are to the keywords found. Figure 3 shows the results of the VOS viewer density visualization with the keywords project-based learning, design thinking, and creative thinking skills.

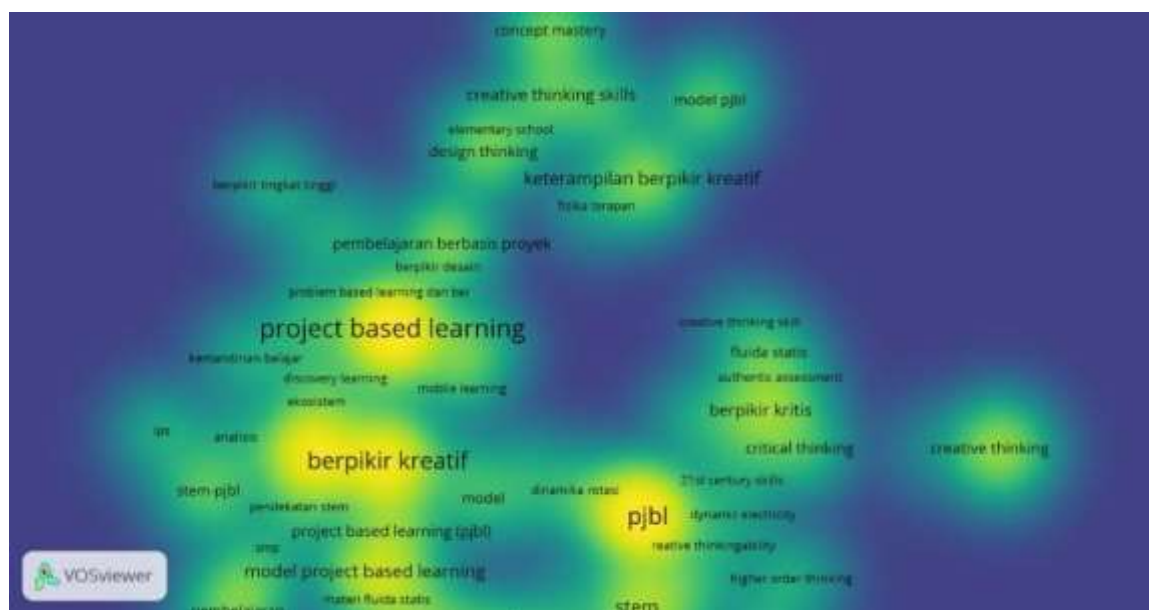


Fig. 3. Density Visualization (DV)

Based on Figure 3, terms that have a light and bright background color, such as yellow, indicate that research with these terms has been studied frequently, and vice versa. The density visualization display can show that the background color is increasingly blurry, as shown by the VOS Viewer on this term. This means that further research is still needed by researchers. Terms that are often used include project-based learning and creative thinking. Previous researchers have studied this term a lot related to the term. However, the term that has not been studied extensively is design thinking. The image can be described from the results of the VOS viewer shown, namely that the resulting color is still dark and blurry. This term is important for further researchers because it can be a reference for further research on this matter, for example, investigating the correlation between variables.

From the results obtained, it can be stated that the PjBL model in improving students' thinking skills has been applied for a long time. The diagram produced in the VOS Viewer is described through overlay visualization. However, this design thinking has only recently been carried out, which has been widely found in 2022. In network visualization, the use of the PjBL model to improve creative thinking skills is still rarely used with a design thinking approach because this design thinking approach is an approach that has just been used. Generally, the only one that is often used in learning is the PjBL model. However, now there is a novelty in the PjBL model by using design thinking to improve students' creative thinking skills. In the third diagram, it can be stated through density visualization that there have been many studies that have conducted research related to the use of this PjBL model in improving students' creative thinking skills. In design thinking, this has not been widely applied. However, the use of the PjBL model based on design thinking is able to improve students' creative thinking skills. The PjBL model based on design thinking is a novelty of learning innovation in an effort to improve students' creative thinking skills. In increasing this novelty, of course, there are several challenges faced by teachers in implementing this learning model: (1) increasing size and diversity of students, (2) increasing requirements for quality assurance, and (3) rapid technological change. This research is also relevant to research conducted by Sinta et al. in 2023 [28]. Sinta stated that the learning model with design thinking is able to make students solve problems and find the right solutions by producing a project and making the classroom atmosphere more active because learning is carried out in groups with a discussion process, questions and answers, and presentations. The use of the PjBL model based on design thinking is an innovation in learning in realizing interactive learning.

#### IV. CONCLUSION

From the results of the study, three conclusions can be put forward. First, based on network visualization, the design thinking cluster still has minimal research related to this; there are only 10 relationships with other tribes. However, in this design thinking, it has been found in the PjBL model and creative thinking skills. Second, based on the overlay visualization of the keywords used, namely project-based learning and creative thinking skills, this is research that has been done for a long time. However, for design thinking, this is new research that began to appear in 2022. Third, based on density visualization, the term that has not been widely studied is design thinking. In the image, it can be explained from the results of the VOS viewer shown, namely the colors produced are still dark and blurry. So from these results it can be concluded that the relevance of the trend of the effect of the PjBL model based on design thinking on student creativity in science learning is dominated by the learning model and skills. In design thinking, it began to be found in 2022 until now. The trend of the PjBL model based on Design Thinking on student creativity in learning, especially science, needs to be researched related to this as proof of improving students' creative thinking skills.

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