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LITERATURE REVIEW

Identification of Physics Learning Models in Improving Learners' Creative Thinking Skills: A Systematic Literature Review

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Abstract

Learners' creative thinking skills are important to be trained in because they are the 21st-century skills that must be possessed by learners. This study aims to identify various physics learning methods that effective in improving students' creative thinking skills through a systematic literature review (SLR). This research was conducted by identifying research results from 32 scientific articles on physics learning published in the last ten years (2014-2024) using reputable databases such as Sinta 1, Sinta 2, Scopus, and Google Scholar. There were 13 Sinta 1 articles used. There were 19 Sinta 2 articles used. There were 8 Scopus articles used. The method used was to identify various physics learning models on creative thinking skills. The results showed that the learning models that proved effective in improving students' creative thinking skills were problem-based learning (PBL), guided inquiry, STEAM learning model, and project-based learning (PjBL) which included aspects of fluency, flexibility, originality, and elaboration. This study concluded that the utilization of innovative learning models in physics learning not only has a positive impact on concept understanding, but also encourages the development of higher order thinking skills, including creative thinking ability. Based on this SLR analysis, researchers or teachers can try to use PjBL in improving creative thinking skills.

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INTRODUCTION

Physics education plays an important role in the development of critical and creative thinking skills among learners. Creative thinking skills, defined as the ability to generate new and innovative ideas, are increasingly considered an essential competency in facing the challenges of the 21st century (Binkley, 2012). In the context of education, these skills are not only beneficial for learning physics but also for the development of other life skills. Therefore, there needs to be special attention to learning methods that can encourage and improve students' creative thinking skills.

Physics learning should not only teach theory, but it can also involve active students in triggering their creativity. This creativity can be developed through the application of active learning models that involve students directly in exploration, innovation and problem solving activities. This is in accordance with the principles of active learning, students are involved in the learning process through experimentation, discussion, and collaboration (Ningsih et al., 2023).

Physics is a science that relies heavily on understanding concepts and applying principles that exist in everyday life, therefore students who have creative thinking skills tend to be able to solve complex problems and adapt to changing situations (Suardipa, 2019). In the era of innovation and technological development, creativity is also an important factor needed in the current era of globalization.

The demand for creative thinking is not in line with the reality in the field. According to Umamah and Andi (2019) research, improving creative thinking skills through PjBL did not show significant differences. This indicates that the success of the learning model may depend on other factors such as the learning environment, student engagement, or the implementation strategy used. This is in line with the findings by in line with research conducted by Khoiri et al (2023) and Malik and Ubaidillah (2022) All three of them both show that the PjBL model is effective in encouraging students' creative thinking skills. In Umamah and Andi (2019) although it did not show significant differences, this PjBL model was considered effective for encouraging original thinking skills, similar to the findings of Khoiri et al (2023) who emphasized that PjBL can improve students' creative thinking skills and collaboration. According to Malik and Ubaidillah (2022), this learning model not only helps students understand the material but also trains them to convey ideas with confidence. All three are in line in seeing the effectiveness of PjBL as a method to develop creative thinking skills in the context of physics learning.

Indicators of creative thinking skills are developed in various studies. Based on the data in the table, many studies mention specific indicators of creative thinking skills, such as fluency, flexibility, originality, elaboration and redefinition. However, not all studies evaluate the same indicators consistently, which can be an obstacle in making general conclusions regarding the effectiveness of a particular learning model. For example, some research conducted by (Khoiri et al., 2023) used Confirmatory Factor Analysis (CFA) to analyze the contribution of each indicator of creative thinking skills, including fluency, flexibility, originality, elaboration, and redefinition. This study shows that each indicator makes a significant contribution in improving creative thinking skills. Meanwhile, the research conducted by Pratiwi et al (2019) also evaluated several indicators of creative

thinking skills through an ethnoscience approach. This study found that indicators such as fluency, flexibility, originality, elaboration, and redefinition have an important role in improving students' creative thinking skills. Thus, several studies indicate the importance of using various indicators to measure creative thinking skills as a whole.

According to research by Khoiri et al (2023) on diversity in the application of learning models has significant potential. In line with Pratiwi et al (2019) namely with an ethnoscience approach also shows that various alternative learning models can contribute to improving creative thinking skills, especially in indicators such as fluency, flexibility, originality, and elaboration. Then in (Yulianti et al., 2022) also highlighted the STEM approach using Scratch assistance in physics learning, which also contributed to students' creative thinking skills in the 4C category.

Creative thinking can be addressed by the application of diverse learning models that focus on improving students' creative thinking. Several articles show that interactive and student-centered models tend to be more effective in improving creative thinking skills compared to traditional methods that are more passive. Some innovative models, such as PjBL, collaborative learning, and the use of technology in teaching, have been shown to increase students' active participation, thus encouraging the creative thinking process according to Asriadi and Istiyono (2020).

Some previous studies, such as those conducted by Umamah and Andi (2019) and Malik and Ubaidillah (2022), show that PjBL models and scientific approaches can enhance students' creative thinking skills. However, a significant gap remains concerning the impact of misconceptions in physics on students' creative thinking skills. Misconceptions in physics often hinder students from thinking critically and creatively because they struggle to relate correct physics concepts to the problems they face. Previous studies, such as the one by Khoiri et al. (2023), have focused more on developing critical thinking or problem-solving skills, without addressing how misconceptions might affect students' ability to think creatively. This suggests that although there is an understanding of the importance of learning models that stimulate student creativity, the role of misconceptions in obstructing the creative process has not been extensively explored in related research. Therefore, this research aims to examine various physics learning models that can improve students' creative thinking skills and explore a wide variety of physics learning models that have proven effective in improving students' creative thinking skills with a systematic review of the existing literature. The review of this research can provide a clearer insight into the indicators of creative thinking skills that can be measured and the models that can be applied in physics education learning.

METHOD

Systematic literature review (SLR) is a disclosure, evaluation, and clarification that is relevant to the formulation of the problem or topic area under study according to Santyasa et al (2022). SLR is defined as the process of identifying, assessing and interpreting all research evidence with the aim of providing answers to specific questions (Andreini & Bettinelli, 2017). In this article, the SLR method used is to identify how learning with creative thinking skills models for students. The data collected on September 20, 2024 there are 32 scientific journal articles indexed in Sinta 1 and Sinta 2 through the *website*

of the Indonesian Journal of Physics Education (JIPF), the Scientific Journal of Physics Education Al-BiRuNi, and the *Journal of Natural Science and Integration*. This research aims to explore what learning models are effectively used for students to be able to improve creative thinking skills in using various learning process models. The keywords used in the data search were "skill" AND "creative thinking" AND "learning" AND "physics". The articles used focused on creative thinking skills in students. The software used for literature management is Mendeley. There are 32 articles related to creative thinking skills, 19 other articles are related to students' creative thinking skills. The articles were studied more deeply and then concluded the results of the study in the conclusion section.

Search Strategy

The initial search for articles focused on three databases, namely the sinta.kemdikbud.go.id website to search for Scopus and Sinta 1, Sinta 2 articles. The focus of this study limited the range of new article years to the last ten years from 2015 to 2024. The articles used as review materials were referred to in december 2024 using the search terms "creative thinking", "skills", "ability", "education", and "physics". Table 1 shows the search strategy created:

Table 1. Article's search strategy

Database	***sinta.kemdikbud.go.id and Scopus***
Keyword	Title-abs-keywords ("skills" "ability" AND "creative thinking" AND "physics" AND "education" AND "physics")
Publication period	2015-2024
Data is accessed	October - December 2024

Screening Criteria

Participation and exclusion criteria are established to ensure the review is conducted using a proper literature study. Articles that meet the inclusion criteria will be maintained for further screening, while articles with exclusion criteria will be separated and deleted. This screening can be seen in the PRISMA procedure diagram. Table 2 shows the calculation of inclusion criteria and exclusion criteria.

Table 2. Inclusion and Exclusion Criteria

	Inclusion Criteria	Ekclusion Criteria
IC 1:	Year of publication between 2015-2024	Exclusion Criteria
IC 2:	The research is related to physics, secondary school, learning, creative thinking skills.	EC 1: Published before 2015
IC 3:	Articles are open access (*open access*)	EC 2: Research not related to physics and high school
IC 4:	Articles are accredited with Sinta 1 and Sinta 2.	EC 3: Articles are not open access (not open access)

Data Extraction and Analysis

The first step was to search for articles reviewed related to the topic discussed by entering keywords in the database, as shown by Figure 1. The search results from the sinta.kemdikbud.go.id database obtained 19 articles related to creative thinking skills and 13 articles related to the relationship of several learning models to students' creative thinking skills and abilities with the keywords “creative thinking” AND “science” AND “education” AND “physics” AND “skills” AND “science” AND “education” AND “physics”. After screening, only 19 articles with the context of creative thinking skills and 13 articles with the context of creative thinking abilities and creative thinking skills related to concept understanding and included in the inclusion criteria.

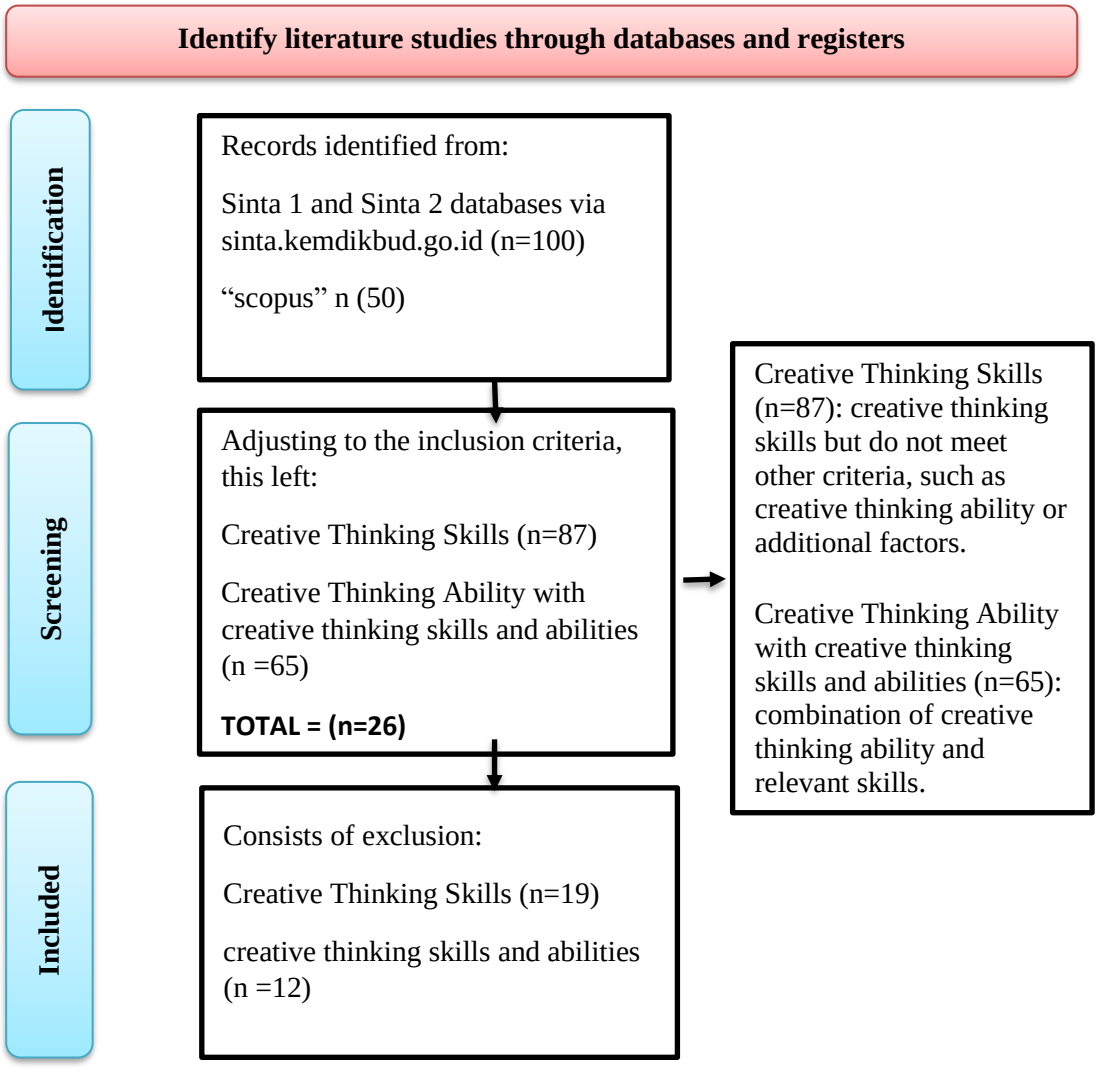

Figure 1. PRISMA Flow Diagram

RESULT AND DISCUSSION

From the research results, several problems can be identified related to students' creative thinking skills in physics learning. First, there are variations in the effectiveness of the learning models applied in improving creative thinking skills. Although many studies show that PjBL models and scientific approaches can improve students' creative thinking skills, not all studies show the same significant results. For example, in some studies, such as the one conducted by Umamah and Andi (2019) the improvement of creative thinking skills through PjBL and inquiry models did not show significant differences. This indicates that the success of the learning model may depend on other factors such as the learning environment, student engagement, or the implementation strategy used.

Indicators of creative thinking skills developed in various studies based on data in tables available in many studies mention several specific indicators on creative thinking skills such as fluency, flexibility, originality, elaboration, and redefinition. However, not all studies evaluate the same indicators consistently which can be an obstacle in making general conclusions regarding the effectiveness of a particular learning model. For example, some studies focus more on improving indicators of originality and flexibility, while others prioritize indicators of fluency and elaboration. Differences in the indicators evaluated can hinder a holistic understanding of how effective a learning model is in improving overall creative thinking skills.

Another issue is the lack of diversity in the application of learning models to assess the improvement of creative thinking skills. Many studies have used PjBL models, while other learning models such as problem-based learning (PBL), ethnoscience approaches, or traditional game approaches have received less attention. This could limit the choice of potentially effective teaching methods to improve students' creative thinking skills. Some studies, such as the one by Khoiri et al (2023), show that traditional game-based learning models have a positive impact on students' creative thinking, critical thinking, and collaboration skills, indicating the need for exploration of other learning models that suit the context and needs of students. This aligns with Lave and Wenger's situated learning theory, which suggests that learning should be more contextual and relevant to students' real-life experiences.

Validity and reliability in the development of test instruments also need to be considered. Several studies in the table show the development of specific instruments to measure creative thinking skills, such as those conducted by Tanjung and Nasution (2023) and Almuharomah et al. (2023), which mentioned the high reliability value of the instrument developed. Effective and consistent measurement instruments are needed to obtain reliable results, so further research in this area can ensure that the instruments used truly reflect the creative thinking skills they aim to measure. This also relates to the theory of measurement in educational psychology, which emphasizes the importance of the reliability and validity of instruments in measuring psychological variables, including creative thinking skills.

From the results of the *review* research using the SLR method by collecting 26 articles, the *review* results are obtained in tabular form.

Table 3. Results related to Students' creative thinking skills on various Physics Learning models

No.	Article's Identity	Results
1	(Wibowo & Suhandi, 2013). Improving Creative Thinking Skills Through Project-Based Learning Assisted by Open Online Physics Instructional Game.	The results showed that the application of the PjBL model supported by GOOPI had a significant positive impact with an increase in the average value of the normalized gain score <g> with an increase score of 0.72 which was classified as high.
2	(Wibowo & Suhandi, 2013). Application of Science creative learning (SCL) model of project-based physics to improve cognitive learning outcomes and creative thinking skills.	The project-based physics SCL model successfully improved students' cognitive learning outcomes and creative thinking skills, although the improvement did not reach the expected high category.
3	(Wibowo *et al*., 2014). Application of project-based physics Science creative learning (SCL) model to improve Cognitive learning outcomes and creative thinking skills.	The results of the PCL model are effective in improving students' creative thinking skills, especially in questioning activities, guessing cause and effect, and improving output results.
4	(Hakim *et al* ., 2017). Interactive multimedia thermodynamics to improve creative thinking skill of physics prospective teachers.	The results of the standardized gain analysis showed that all indicators of creative thinking skills had a significant increase in the experimental group compared to the control group, with a moderate gain category, thus improving overall creative thinking skills.
5	Pratiwi *et al* (2019). Students' creative thinking skills on heat phenomena using pogil learning model.	The results showed N-gain values of 0.56, 0.60, 0.46, and 0.53, respectively. These values indicate that students' creative thinking skills are in the moderate category.
6	(Umamah & Andi,2019). The effect of project-based learning model on creative thinking skills in applied physics learning.	The results obtained by the PjBL model and the inquiry model did not have a significant effect so that both models were good in improving students' original thinking skills.
7	(Widyasmah et al., 2020). Implementation of STEM Approach Based on Project-based Learning to Improve Creative Thinking Skills of High School Students in Physics.	STEM approach can improve students' creative thinking and improved the indicators of creative thinking skills. The indicators of creative thinking in the moderate category are originality, elaboration, and evaluation while indicators included in the high-level category are flexibility.
8	(Habibi et al., 2020). Phet simulation as means to trigger the creative thinking skills of physics concepts.	The study reveals that the N-gain analysis for creative thinking skills (CrTS) in basic physics learning predominantly falls under the "medium" category, with fluency showing the highest improvement. Flexibility and originality are mostly categorized as "medium,"

		while elaboration is distributed across "medium," "high," and "low" categories. Factors such as intellectual differences and restrictive learning approaches can hinder creativity, emphasizing the need for open-minded attitudes and innovative teaching strategies. Fluency is identified as a foundational skill that influences the success of other creative processes.
9	(Siahaan *et al*.,2020). Designing Environmental Physics Lecture Instruments on Ocean Wave Energy to Improve Students' Creative Thinking Skills.	The ability to examine and develop ideas in detail, on the Indicators also showed a high increase with an N-gain value of 0.72, indicating that students could go deeper into physics concepts From the results of the pre-test and post-test analysis, there was a very significant increase in students' creative thinking skills, especially in the flexible thinking and detailed thinking categories.
10	(Satriawan *et al*.,2021) Designing of Environmental Physics Course Instruments about Ocean Wave Energy to Enhance Students' Creative Thinking Skills.	The results of the instrument designed in Environmental Physics, especially related to ocean wave energy, are able to improve students' creative thinking skills. The application of this instrument not only encourages the development of creativity in science, but also significantly increases students' learning motivation. Students became more motivated to be actively involved in the learning process, which contributed to increased participation and enthusiasm during the learning.
11	(Rahayu *et al*., 2022). The Effectiveness of Creative Problem Solving-Flipped Classroom for Enhancing Students' Creative Thinking Skills of Online Physics Educational Learning.	The better post-test results (N-Gain value of 60.5% in TG group compared to 46.4% in CT group) indicated that combining CPS with flipped classroom is effective in improving students' creative thinking skills, especially in online physics learning.
12	(Tanjung & Nasution, 2023) The Development of Creative Thinking Test Instruments with Torrance Indicators on Direct Current Electricity Materials.	The results of the research, the test instrument developed has high reliability with a score of 0.756. The difficulty level of 71% of the questions was in the easy category and 29% was in the medium category, 83% of respondents indicated that the test instrument was feasible to use to test students' creative thinking skills.
13	(Almuharomah *et al*., 2023). Development of STEAM-LW Based Creative Thinking Skill Test Instruments for Grade IX Junior High School Students.	The results showed that this instrument has a validity of 0.88 which is classified as valid and a reliability of 0.81. Thus, this test instrument proved to be effective in improving students' creative thinking skills.
14	(Buhungo *et al*., 2023). The Effectiveness of Educational Tools Grounded in Local Knowledge in Enhancing High School Students'	The observation results showed that in the creative thinking skills test, most students showed high creativity, with 56.52% of students at the “creative” level and 21.7% at the “very creative” level.

	Creative Thinking Skills in the Context of Sound Waves.	
15	(Khoiri *et al*., 2023). Project-based learning via traditional game in physics learning: Its impact on critical thinking, creative thinking, and collaborative skills.	The results of this study indicate that the application of the traditional game-based PjBL model can improve students' creative thinking, critical thinking, and collaboration skills.
16	(Yulianti *et al*., 2022). *S*cratch assisted physics learning with a STEM approach in the pandemic era to develop 21st century learning skills.	The results showed that the 4C skills on average were in the medium category so that they had increased. So that the STEM approach is effective in developing students' creative thinking skills.
17	Rahayu *et al.* (2022). The Effectiveness of Creative Problem Solving-Flipped Classroom for Enhancing Students' Creative Thinking Skills of Online Physics Educational Learning.	The CPS-flipped classroom model improves learning outcomes and creative thinking skills, making it effective for online learning. It fosters independence, flexibility, and active participation, suitable for the digital era and recommended for blended learning strategies.
18	Saputri *et al.* (2022). Analysis of momentum and impulse on students' creative thinking skill through project based learning integrated STEM (science, technology, engineering, mathematics).	The study shows that implementing PjBL with a STEM approach improves students' creative thinking skills in momentum and impulse topics. The average creative thinking score was 68.27, categorized as "creative," with 35% of students rated as very creative. Fluency was the highest-performing indicator, while flexibility was the lowest. This approach effectively enhances creativity through structured and collaborative learning activities.
19	(Rambe *et al*., 2024). Identification of HOTS creative thinking, science process skills and digital literacy in physics subject.	The results of this study show a strong correlation between creative thinking skills (HOTS), science process skills (KPS), and students' digital literacy.

Based on the review results of the articles in Table 3, contains the results of research studies related to students' creative thinking skills on various physics learning models that have been conducted by various researchers. These studies cover a variety of approaches, ranging from PjBL models, Science Creative Learning (SCL), to the use of interactive multimedia and STEM approaches. Overall, the research shows that these innovative learning models have a positive impact on improving students' creative thinking skills, although the level of success varies. Some learning models, such as GOOPI and project-based SCL, show significant improvement with high *gain score* values, while some other models provide moderate improvement. In addition, the creative test instrument-based approach also showed high validity and reliability in measuring students' creative thinking skills.

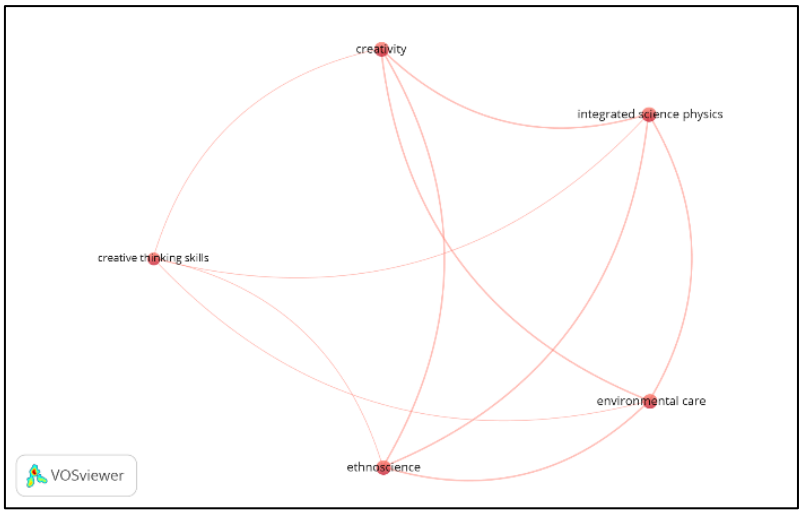

Figure 2. The connection between keywords and the author's research

The research also shows that the relationship to the application of learning models has a relationship to the improvement of creative thinking skills. Some of the models and approaches in the table have their own improvements in creative thinking skills. Research by Trianggono (2017)which shows the relationship between concept understanding and creative thinking skills with a level of relationship that reaches more than 90%, shows that increasing concept understanding directly contributes to the development of creative thinking skills.

Another study by Umamah and Andi (2019) showed that the PjBL model with an inquiry approach had a similar impact on improving creative thinking skills. Although there was no significant difference, the study emphasized that the model was effective in encouraging original thinking skills. The application of this model also involves students actively in the learning process, which is effective in improving students' creative thinking skills.

On learning harmonic vibrations effectively improves students' creative thinking skills (Malik & Ubaidillah, 2022). The PjBL model not only helps students in understanding the material, but also trains their ability to convey ideas with confidence. The application of this model also involves students actively in the learning process, on this model is effective for improving creative thinking skills. Meanwhile, research conducted by Khoiri et al (2023) through *Confirmatory Factor Analysis* (CFA) shows that each creativity indicator such as *fluency*, *flexibility*, *originality*, *elaboration*, and *redefinition* has a significant contribution specifically to improving students' creative thinking skills.

Based on the analysis of the research results above, the learning model that is effective in improving students' creative thinking skills is PjBL. The model focuses on students' active involvement, project-oriented learning, and independent exploration of new concepts. Overall, the use of PjBL model and scientific approach in active and collaborative learning proved to be effective in improving students' creative thinking skills, both from the aspects of originality, fluency, and flexibility.

Table 4. Models and approaches have been applied to improve students' creative thinking skills and abilities.

No.	Identity article	Results
1.	E. Rahayu, H. Susanto (2011) Science learning with process skills approach to improve learning outcomes and students' creative thinking ability.	The evaluation results showed an increase in all aspects of creative thinking indicators from cycle I to cycle III, with significant improvements especially in flexible and original thinking, and elaboration.
2.	Yuliani (2017). Creative Thinking Skills in Secondary School Students in Palangka Raya Using the Scientific Approach.	The results of research on students' creative thinking skills after applying the scientific approach using the CLIS (Children's Learning) learning model with a total N-Gain average of 0.45, guided inquiry obtained an average N-gain of 0.34, with the experimental method, an N-gain of 0.40 was obtained.
3.	(Nurulsari et al., 2017). Development of soft scaffolding strategy to improve student's creative thinking ability in physics.	The soft scaffolding strategy can be used to improve student's creative thinking in physics especially in optical instruments. The soft scaffolding strategy can help the teacher to help students who have difficulties in learning physics. Students also learn better because the strategy not only develops their creative thinking but also their mathematic skill and conceptual understanding in physics so that the soft scaffolding strategy can promote higher order thinking skills.
4.	Wahyudi *et al.* (2019). Development of inquiry-creative-process learning model to promote critical thinking ability of physics prospective teachers.	The ICP learning model was developed consist of five phases of learning, those are; establishing set and finding problem; creating hypotheses; designing experiment creatively; solving problem science creatively; and designing product creatively. The results showed that the ICP learning model have been valid, practice, and effective to improve the CT ability of physics prospective teachers, including aspects of analysis, inference, evaluation and decision making.
5.	Berlianti *et al* (2019). Improving Students Creativity in Producing Instructional Aids for Physics Lesson from Waste and Garbage.	This increase in creativity can be seen from the students' ability to create unique teaching aids, use simple and used materials, and apply the principles of physics effectively in the tools they make.
6.	Athifah and Syafriani (2020). Development of physics student's worksheet based on inquiry training model to improve students creative thinking ability.	The results of the student worksheet validation on the feasibility aspect of the content are in the valid category with an average of 0.92, the construct aspects are in the valid category with an average of 0.91, the aspects of the language in the valid category with an average of 0.94 and graphic aspects also in the valid category with an average of 0.96.

		The product is said to be valid if each indicator is ≥ 0.6 and invalid <0.6. Overall LKPD based on inquiry training is valid which can be implemented in the learning process.
7.	Asriadi & Istiyono (2020). Exploration of creative thinking skills of students in physics learning.	The results of the study, the creative thinking ability of students in class XI MIA 1 SMA Negeri 6 Yogyakarta is in the average and good enough category.
8.	Pratiwi et al (2019). How is students' creative thinking skills? an ethnoscience learning implementation.	The results of the analysis using the CFA model show that all creativity indicators-fluency, flexibility, originality, elaboration, and redefinition-have a significant contribution to the improvement of students' creative thinking skills.
9.	Athifah and Syafriani (2019). Analysis of students creative thinking ability in physics learning.	The aspect of creative thinking ability that can be achieved by students with the highest percentage is evaluative aspects and the lowest percentage in the original aspect is 51.67%. Overall based on the results of the questionnaire, evaluative aspects and elaborate aspects can be achieved in the less category. Flexibility and originality aspects with very lacking categories. (a) For teachers, this research is expected to help teachers understand the ability of students' creative thinking indicators so that teachers can design learning that can improve students' creative thinking skills. (b) For other researchers, it is expected to conduct further research that has the potential to improve students' creative thinking skills.
10.	Malik & Ubaidillah (2022) Creative thinking skills of students on harmonic vibration using model student facilitator and explaining (SFAE).	The result is that it can improve students' creative thinking skills, introduce variety in learning, and train students in expressing opinions and ideas confidently.
11.	Amelia *et al* (2021) Analysis of creativity and attitudes caring the environment of junior high school students: study of environmental physics learning using learning modules.	The results of statistical test research show a significant difference between the two learning methods, with a calculated t-value of 2.06 which is greater than the 5% error rate.
12.	Rahmawati *et al* (2023). Electronic Portfolio Assessment Instruments in Improving Students' Creative Thinking Skills.	The results of the average value of student creativity in the experimental class (60.65) are higher than the control class (56.42), with a t-count value of 2.06 which is greater than the t-table value of 1.684 at a relative error rate of 5% then there is a significant increase.
13.	Tanjung & Nasution (2023) The Development of Creative Thinking Test	The results of the research, the test instrument developed has high reliability with a score of 0.756. The difficulty level of 71% of the questions was in

	Instruments with Torrance Indicators on Direct Current Electricity Materials.	the easy category and 29% was in the medium category, 83% of respondents indicated that the test instrument was feasible to use to test students' creative thinking skills.

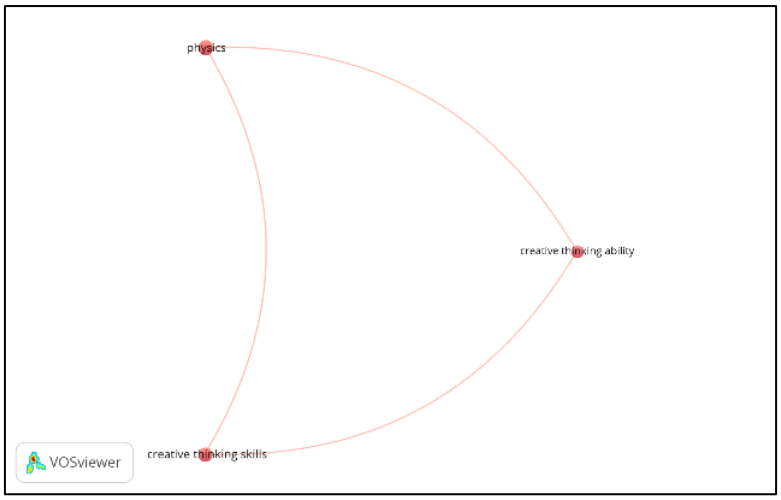

Figure 3. An image about the connection between keywords and the author's research

The results of the review of articles Table 4 presents the results of a review of various models and approaches that have been applied to improve students' ability and creative thinking skills in learning. These studies cover a variety of approaches, ranging from science learning with process skills, scientific approaches, to the application of innovative learning models such as CLIS, guided inquiry, and SFAE. In addition, the results also show the significant contribution of ethnoscience-based learning models, the use of learning modules, and electronic portfolio-based assessment in improving student creativity. Through the evaluation of various creative thinking indicators, such as fluency, flexibility, originality, elaboration, and redefinition, these findings provide a comprehensive picture of the success of these approaches in supporting the development of students' creative thinking skills.

Research by Berlianti et al. (2019) which utilized used materials to make physics teaching aids showed that the use of simple materials not only trains students' creativity, but also connects physics theory with practical applications in everyday life. This supports the contextual learning theory that links learning with real-life experiences. Furthermore, Pratiwi et al. (2019) through an ethnoscience approach showed that integrating local cultural contexts in learning encourages students to think flexibly and creatively in solving problems.

The SFAE model (Malik & Ubaidillah, 2022) also stands out because it involves students as facilitators who strengthen their understanding through the process of discussion and explanation of physics concepts. This research is in line with Vygotsky's theory of scaffolding, where social interaction contributes to the development of students' thinking skills. In addition, Rahmawati et al. (2023) demonstrated the effectiveness of electronic

portfolios as a structured evaluation tool to monitor the development of students' creative thinking skills.

CONCLUSION

The results of 26 scientific journals that have been *reviewed*, it can be concluded that the application of various physics learning models, such as PBL, guided inquiry, STEAM learning models, and PjBL, CLIS, ethnoscience, and SFAE have a significant effect on improving students' creative thinking skills and abilities. The results of the study indicate that certain learning models, especially PjBL, provide the most optimal results in stimulating creativity and creative thinking skills to solve complex problem solving among students but also develop dimensions of creative thinking skills which include fluency, flexibility, originality, and elaboration of ideas. The improvement of students' creative thinking skills depends not only on the method used, but also on the active involvement of students in the learning process.

Suggestions that can be given for further research are the need to study and research further in implementing innovative learning models. Future research is also recommended to explore other variables that may affect creative thinking skills, such as social and cultural factors, as well as utilizing educational technology that can support the learning process. Thus, efforts to improve students' creative thinking skills in physics learning can be more integrated and sustainable.

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