

Trends Research Creative Thinking Skills in Students' Physics Learning (2015-2024): A Systematic Review

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Abstract: Creative thinking skills are ability found many possible answers to a problem, where the emphasis is on quantity, appropriateness, and diversity of answers. Where the answer in question is an answer that correct and varied. This research aims to identify and analyze research trends in the creative thinking ability in physics learning. This research method is descriptive and analytical. The data used in this research was obtained from documents indexed by Google Scholar from 2015-2024 using Publish or Perish and Dimension.ai. Research procedures use PRISMA guidelines. The data identified and analyzed are the type of publication, publication source, and the title of research on creative thinking ability in physics learning that is widely cited. The data analysis method uses bibliometric analysis assisted by VOS viewer software. The results of the analysis show that research trend on the creative thinking skills in physics learning indexed by Google Scholar from 2015 to 2024 has experienced a fluctuating increase. However, in 2023 there will be a decline in the research trend on the creative thinking skills in physics learning. There are many documents in the form of articles, proceedings, chapters, preprints, edited books and monograph that discuss research into the creative thinking skills in physics learning. Key words that are often used in research on the creative thinking skills in physics learning are critical thinking, STEM, PjBL, PBL, technology, virtual laboratory, etc.

Keywords: Creative thinking; Physics learning; Review

Introduction

The level of Science and Technology (IPTEK) achieved by a nation is a benchmark to see the extent of the nation's development and progress. Moreover, in this era of globalization, the progress of a nation is largely determined by quality human resources. One means of improving the quality of human resources is through education. Education will shape a person's personality and intellectual intelligence (Muliani et al., 2019; Mynbayeva et al., 2015).

Effort to improve educational standards aims to create human resources excellence that can be identified through mastery of 21st century skills by every individual. Significance of skills the 21st century has made it a focus major in current educational research (Geisinger, 2016). This is caused by the importance of 21st century skills as preparation of students in facing various future challenges (Larson et al., 2011) and had a substantial impact on students' lives after them complete their formal education (Kaufman, 2013). The implementation 21st century skills are considered to be a must in every process learning (Dicerbo, 2014; Fry et al.,

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2011; Griffin, 2017; Jang, 2016; Lambert et al., 2010; Sibille et al., 2010).

In connection with the demand to improve the quality of human resources, the quality of education needs to be improved in all subjects including Natural Sciences (Science) subjects. Science is rational and objective knowledge about the universe and its contents. Science learning is learning that provides opportunities for children to think creatively. Science learning will be more meaningful if the learning process uses models/methods of self-discovery (Apriliani et al., 2019; Chusni et al., 2020). One branch of science is physics. The essence of physics is that it includes processes and products and attitude. Physics as a process means deep understand various information, especially physics obtained through observation activities, measurement, and publication. Physics as a product means the result of scientific activities carried out in the form of concepts, principles, theories and laws physics itself.

Therefore, physics also plays a role in advancing the Indonesian nation and also prepare quality human resources (Annam et al., 2020; Bradforth et al., 2015; Cho et al., 2019). 21st century education has focused on improving creative competence, critical thinking, cooperation and communication. This will be a challenge for schools and teachers to find ways to ensure that 21st century competencies can be possessed by students (Azizah et al., 2021; Dina et al., 2023; Ng et al., 2023). Learning outcomes are largely determined by the quality of learning implementation. The better the activities in learning, of course the learning outcomes achieved by students will be maximized. One of the factors causing the implementation of learning to not be optimal is the use of learning models that are still less varied (Kintu et al., 2017; Muliani et al., 2019).

Therefore, teacher skills are needed in implementing learning with various learning models that suit the characteristics of the learning material and the results to be achieved (Markula et al., 2022; Susilawati et al., 2022). One of the skills that can improve student learning outcomes is creative thinking. The ability to think creatively is an ability found many possible answers to a problem, where the emphasis is on quantity, appropriateness, and diversity of answers. Where the answer in question is an answer that correct and varied (Karunarathne et al., 2024; Utami et al., 2020). But the facts shows that students' creative thinking abilities are not yet optimal. This is because learning is still ongoing using conventional learning models using lecture and discussion methods. Teacher as educators still tend to dominate the process learning, so that students only act as object and not given the opportunity to discover the truth and develop creative thinking abilities (Dwivedi et al., 2023; Larráz-Rábanos, 2021; Mahmudah et al., 2022).

Academics and educational practitioners have made various efforts to improve students' creative thinking skills. Among the efforts made is implementing learning using various innovative learning models such as problem based learning (PBL) (Febriyanti et al., 2020; Widiastuti et al., 2023), project based learning (PjBL) (Nugroho et al., 2019), and various other learning models. Therefore, this research wants to know the research trend of the creative thinking. It is hoped that this research can become a reference in developing further research related to creative thinking in students' physics learning.

Method

This research method is descriptive and analytical, which aims to understand and describe research trends in the creative thinking ability in physics learning. The data used in this study was obtained from information sources indexed by Google Scholar using analytical tools such as Publish or Perish and Dimension.ai. To carry out a search on Google Scholar, keywords related to research trends on the creative thinking ability in Physics Learning.

In this research, an analysis was carried out on 1,000 documents that had been indexed by Google Scholar between 2015 and 2024. The Google Scholar database was chosen as a place to search for documents because Google Scholar applies consistent standards in selecting documents to be included in its index, and Google Scholar displays more documents than the top databases. Others, especially research in the field of education (Hallinger et al., 2019, 2020; Zawacki-Richter et al., 2019). To filter data that has been collected via Publish or Perish, researchers used the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.

Result and Discussion

This research aims to describe research trends on creative thinking skills conducted from 2014 to 2023. Research documents on research trends critical thinking ability in physics learning are taken from documents from 2015 to 2024. Figure 1 is presented below regarding research trends on the creative thinking ability in physics learning.

Figure 1 shows that the trend in research on the creative thinking ability in physics learning from 2015 to 2024 has increased. Where the research trend is with an increase in the number of publications every year, namely from 2015 to 2022. However, in 2023 the research trend on the creative thinking ability in physics learning has decreased. The increasing trend in research on the

creative thinking ability in physics learning caused by 21st century education has focused on improving creative competence.

In 2015 there were 218 publications related to the creative thinking ability in physics learning, then this will continue to increase to 1,860 publications in 2022. This increasing research trend provides a deeper

understanding the problem which is low of creative thinking skills in physics learning and ways to solve that problem. Research is able to improve creative thinking skills through various methods. Below are also presented research of creative thinking skills in physics learning based on the type of publication.

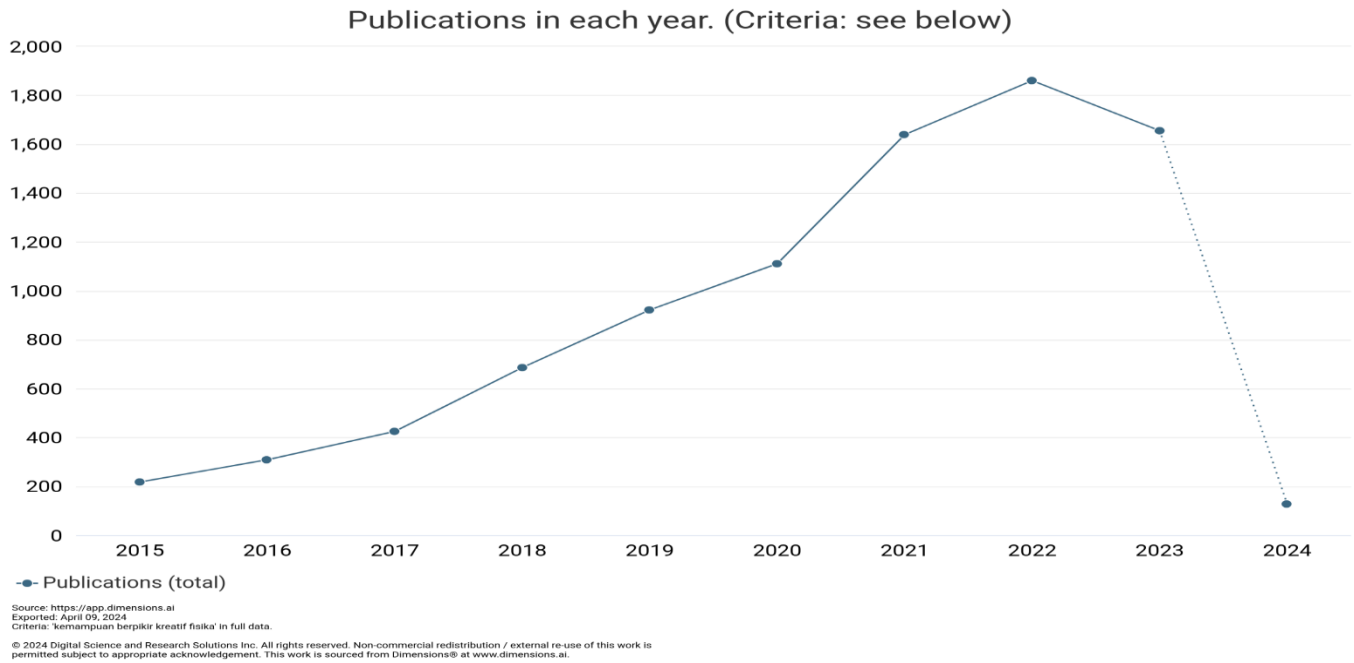


Figure 1. Research trends in creative thinking ability in physics learning

Table 1. Trends in Creative Thinking Skills in Physics Learning Research Based on Publication Types

Publication Type	Publications
Article	8,945
Proceeding	161
Edited Book	71
Chapter	21
Monograph	9
Preprint	5

Based on Table 1, it is known that research creative thinking skills in physics learning from 2015 to 2024 contained in 6 types of publications. In the form of articles there were 8,945 documents, chapters as many as 21 documents, proceedings as many as 161 documents, edited books as many as 71 documents, monographs as many as 9 documents, and preprints as many as 5 documents. Research trends creative thinking skills in physics learning in article form is the type of publication that contains the most research about creative thinking skills in physics learning compared to other types of publications. Meanwhile, the type of publication contains the least amount of research results creative thinking skills in physics learning is a preprint. Research conducted by Oltarzhevskiy (2019) states that an article

is a complete factual essay of a certain length created for publication in online or print media (via newspapers, magazines or bulletins) and aims to convey ideas and facts that can convince and educate. These articles are usually published in scientific journals both in print and online (Suseno et al., 2020).

Below are also presented top ten (10) sources title trends in research on creative thinking skills in physics learning which are often cited by other researchers related to this matter.

Table 2 shows that the most widely published source of research trends on the creative thinking skills in physics learning is the Jurnal Penelitian Pendidikan IPA, namely 188 publications with 325 citations and an average citation of 1.73. Jurnal Penelitian Pendidikan IPA contains scientific articles form of research results that include science, technology, and teaching in the field of science. The first edition were published in 2015. All edition in this journal are open access, i.e. the articles published in them are immediately and permanently free to read, download, copy & distribute. Below are also presented top ten (10) article title trends in research on creative thinking skills in physics learning which are often cited by other researchers related to this matter.

Table 2. Top 10 Sources Title Trend of Creative Thinking Skills in Physics Learning Research in 2015-2024

Name	Publications	Citations	Citations Mean
Jurnal Penelitian Pendidikan IPA	188	325	1.73
Jurnal Basicedu	175	651	3.72
INPAFI (Inovasi Pembelajaran Fisika)	145	82	0.57
Journal of Physics Conference Series	130	684	5.26
Edukatif Jurnal Ilmu Pendidikan	125	369	2.95
Advances in Social Science, Education and Humanities Research	123	163	1.33
Jurnal Pendidikan Fisika	97	165	1.70
Berkala Ilmiah Pendidikan Fisika	88	297	3.38
Jurnal Ilmiah Profesi Pendidikan	87	219	2.52
Jurnal Ilmiah Pendidikan Fisika	85	106	1.25

Table 3 shows that research on the creative thinking skills in physics learning that is widely cited by other researchers is about "Effectiveness of Problem-Based Learning Combined with Computer Simulation on Students' Problem-Solving and Creative Thinking Skills" which is 42.00 (Simanjuntak et al., 2021). Then the research entitled "The Effect of Project Based Learning with Virtual Media Assistance on Student's Creativity in Physics" was cited 28.00 times (Gunawan et al., 2017). Research by Biazus et al. (2022) entitled "The Impact of Project-Based Learning (PjBL) Model on Secondary Students' Creative Thinking Skills" is also widely cited by other researchers, namely 26.50 per year. Yulianci et

al. (2021) in their research entitled "The Effect of Interactive Multimedia and Learning Styles on Students' Physics Creative Thinking Skills" was cited 12.67 per year.

This research data is comparable to data on the increasing trend of research on the creative thinking skills in physics learning from 2015 to 2024. This means that in that year, research related to the creative thinking skills in physics learning was continuously cited by other researchers. In the articles researched and written by these researchers, there are many terms/keywords related to creative thinking. Below are presented ten (10) popular keywords related to creative thinking.

Table 3. Top 10 Citations on Trend of Creative Thinking Skills in Physics Learning Research in 2015-2024

Cites/year	Year	Author	Title
42.00	2021	MP Simanjuntak, J Hutahaean, N Marpaung, D Ramadhani	Effectiveness of Problem-Based Learning Combined with Computer Simulation on Students' Problem-Solving and Creative Thinking Skills
28.00	2017	G Gunawan, H Sahidu, A Harjono, NMY Suranti	The Effect of Project Based Learning With Virtual Media Assistance on Student's Creativity in Physics
26.50	2022	M de Oliveira Biazus, S Mahtari	The Impact of Project-Based Learning (PjBL) Model on Secondary Students' Creative Thinking Skills
12.67	2021	S Yulianci, N Nurjumiati, AA Adiansha	The Effect of Interactive Multimedia and Learning Styles on Students' Physics Creative Thinking Skills
12.50	2022	S Susilawati, A Doyan, L Mulyadi, CP Abo, CIS Pineda	The Effectiveness of Modern Physics Learning Tools Using the PHET Virtual Media Assisted Inquiry Model in Improving Cognitive Learning Outcomes, Science Process Skills, and Scientific Creativity of Prospective Teacher Students
11.33	2018	W Wartono, M Diantoro, JR Bartlolona	Influence Of Problem Based Learning Model On Student Creative Thinking On Elasticity Topics A Material
10.40	2019	R Adawiyah, A Harjono, G Gunawan, H Hermansyah	Interactive e-book of physics to increase students' creative thinking skills on rotational dynamics concept
8.33	2018	S Romli, B Riyadi	Designing students' worksheet based on open-ended approach to foster students' creative thinking skills
8.00	2018	G Gunawan, NMY Suranti, N Nisrina, L Herayanti, R Rahmatiah	The effect of virtual lab and gender toward students' creativity of physics in senior high school
6.86	2017	N Nurulsari, A Suyatna	Development of soft scaffolding strategy to improve student's creative thinking ability in physics

Table 4 shows that the keywords that often appear related to research on the creative thinking skills in physics learning are technology, 38 times with a level of 2.38. The technology like interactive multimedia and learning styles influence students' physics creative

thinking skills (Mawardani et al., 2023; Nazhifah et al., 2023; Susilowati et al., 2021; Yulianci et al., 2021). Table 4 also shows that PBL model is also a keyword that appears frequently in research trends on the creative thinking skills in physics learning, namely 22 times with

a relevance of 0.75. Problem-Based Learning combined with computer simulation has been proven effective on students' problem-solving and creative thinking skills (Djafar, 2022; Hernita et al., 2021; Shayan et al., 2022; Simanjuntak et al., 2021; Susanti et al., 2019).

Table 4. Keywords on Trend of Creative Thinking Skills in Physics Learning Research in 2015-2024

Terms	Occurrences	Relevance
Communication	19	2.56
Collaboration	19	2.53
Technology	38	2.38
Virtual laboratory	18	1.76
STEM	48	1.21
Discovery	19	0.99
PjBL	17	0.99
Critical thinking	74	0.88
PBL	22	0.75
Senior high school	36	0.50

Below are the visualization is accomplished by generating a landscape map, which offers a visual

representation of subjects related to scientific studies. The outcomes of bibliometric mapping for the co-word network in articles related to the topic creative thinking skills in physics learning are illustrated in Figure 2.

Figure 2 shows the results of bibliometric keyword mapping on research trends on the creative thinking skills in physics learning. In Figure 2 there are 70 keyword items that are often used in research on the creative thinking skills in physics learning from 2015 to 2024. Figure 2 also contains 5 clusters, where the first cluster is colored red and consists of 19 keyword items, namely 21st century, communication, collaboration, critical thinking, etc. The second cluster in green consists of 18 keyword items, namely instrument, module, PBL, validity, etc. The third cluster in blue consists of 16 keyword items, namely discovery, inquiry, virtual laboratory, learning model, etc. The fourth yellow cluster consists of 9 keyword items, namely curriculum, PjBL, science, STEM, technology, etc. The fifth purple cluster consists of 8 keyword items, namely covid, pandemic, profile, quality, etc.

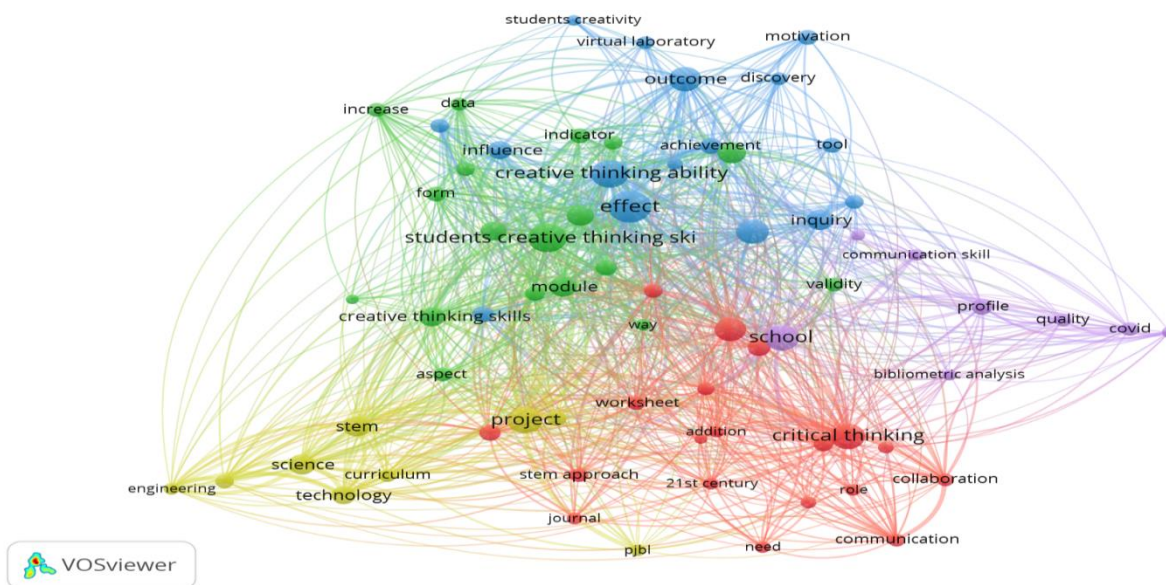


Figure 2. Network visualization on trend creative thinking skills in physics learning research

Figure 2 above also shows that network visualization shows the network between the terms being visualized. Keywords classified into five clusters are arranged in a color chart showing the divisions/clusters that are connected to each other. The results of this analysis can be used to determine keyword research trends in the last year. This analysis shows several keywords that are often used in research on the creative thinking skills in physics learning. The more keywords that appear, the wider the visualization displayed. Below are also presented keywords regarding the creative thinking skills in physics learning based on overlay visualization.

Figure 3 shows the trend of keywords related to research on creative thinking skills in physics learning in Google Scholar indexed journals from 2015 to 2024. Trends in the themes of writing articles related to the creative thinking skills in physics learning from the oldest to the newest year are marked with purple, blue themes, , turquoise, dark green, light green and yellow. In the picture above you can see that the virtual laboratory, PBL, motivation, influence, worksheet, etc. This shows that these keywords were widely used by researchers in 2020. In 2021, the keywords that frequently appeared were critical thinking, technology,

Overall, research on creative thinking skills in physics learning is important because it makes significant contributions to the 21st century education. Creative thinking is part of 4C skills that students must have. Creative thinking skills are very important so that students are able to process information to solve problems both in learning and in real life (Suantini et al., 2023; Wijayati et al., 2019). The research trend in creative thinking skills in physics learning is expected to continue to develop in the next few years. This can be done by developing new learning models, media or learning tools to facilitate students' creative thinking skills, especially in physics subjects.

Conclusion

Research on trends in the creative thinking skills in physics learning has urgency high because of its potential to provide various benefits to 21st century education. The research trend on the creative thinking skills in physics learning indexed by Google Scholar from 2015 to 2024 has experienced a fluctuating increase. However, in 2023 there will be a decline in the research trend on the creative thinking skills in physics learning. There are many documents in the form of articles, proceedings, chapters, preprints, edited books and monograph that discuss research into the creative thinking skills in physics learning. Key words that are often used in research on the creative thinking skills in physics learning are critical thinking, STEM, PjBL, PBL, technology, virtual laboratory, etc.

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Author Contributions

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Conflicts of Interest

No conflict interest.

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