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Systematic Review of Research Trends on Creative Thinking Skills in Science Learning (2016-2025)

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Abstract: Creative thinking skills are one aspect that is part of 21st century skills. However, students' creative thinking skills are still relatively low, so it is very important to improve these skills. This study aims to identify and analyze research trends on creative thinking skills in science learning from 2016-2025. This research method is descriptive and analytical, with data obtained from documents indexed by Google Scholar using Publish or Perish and Dimension.ai. The research procedure uses the *PRISMA* guidelines and data analysis is carried out using bibliometric analysis assisted by VOSviewer software. The results of the analysis show that the trend of research on creative thinking skills in science learning has increased and decreased during the period 2016-2025. The increase in the number of publications occurred from 2016 to 2021, then decreased in 2022, and increased again from 2023-2024. There are many documents in the form of Chapters, Articles, Edited Books, Monographs, Proceedings, and Preprints that discuss research on creative thinking skills in science learning. Keyword analysis shows that the most frequently occurring terms in this study include Higher order thinking skill as many as 52 times and collaboration as many as 33 times. This trend reflects the growing attention to creative thinking skills in science learning and indicates the need for further efforts to improve research and application in this area.

Keywords: Creative Thinking; Science Learning; Bibliometrics; PRISMA; VOSviewer

Introduction

In the era of globalization, 21st-century skills such as critical thinking, communication, collaboration, and creativity are essential foundations for students (Dishon & Gilead, 2021). Today's learning demands a paradigm shift, where the focus is not only on mastering knowledge, but also a combination of competencies, including skills, expertise, and character. This new paradigm requires students to have the ability to think, act, and live (Ghifari et al., 2025).

Preparing active learning is also a government strategy to face the era of globalization and answer the demands of the 21st century (Stehle & Peters-Burton, 2019; Van Laar et al., 2020; Larson & Miller, 2011; González-Pérez & Ramírez-Montoya, 2022). This strategy is expected to produce individuals who are competent in technology and science so that they can advance the nation (Muliani & Citra Wibawa, 2019; Mynbayeva et al., 2015). It is known that the demands of the 21st century are the main things that must be considered, especially in the field of education to face future challenges (Geisinger, 2016; Larson & Miller, 2011; Kaufman, 2013). So, in other words, the skills needed in the 21st century must be mastered (DiCerbo, 2014; Fry & Seely, 2011; Griffin, 2017; Jang, 2016; Lambert & Gong, 2010; Sibille et al., 2010).

Although globalization brings various opportunities, in reality many students are not fully prepared to face the demands of this era. The results of research by Khoiri et al., (2021) show that the assessment of learning success is still too focused on mastery of material alone, and ignores the development of 21st century skills such as 4C (Critical Thinking, Communication, Collaboration, and Creativity) and other essential skills needed to face the challenges of the

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21st century (Ghifari et al., 2025).

Creative thinking ability is one of the abilities that is very necessary to have to keep up with the development of existing technology. Creative thinking ability according to Munandar in (Sarmiasih et al., 2020) is the ability to produce something new, such as conveying new ideas to solve problems, or finding new relationships between existing elements.

Creative thinking skills are included in high-level thinking skills (Fazriyah, 2016). However, based on data from (World Intellectual Property Organization, 2023), Indonesia still occupies the lowest position in creative thinking or innovation. In reality, this ability is very much needed in facing the demands of the 21st century, especially in the field of technology. This opinion is supported by (Ghufron & Risnawita, 2017) who argue that creative thinking skills are considered the main force driving human progress in research, development, and new discoveries in various fields, including technology and science.

Damayanti & Kartini's (2022) research shows that students' creative thinking abilities in terms of fluency only reach 78%, flexibility 58%, and novelty 25%. Similar results were also expressed by Kamal et al. (2020) who found that students' fluency aspects reached 83%, flexibility 33%, novelty 25%, and elaboration 167%. These data show that many students still face difficulties in developing creative solutions to given problems (Astuti et al., 2019).

In science learning, students are not only equipped with mastery of a number of sciences, but are also given sufficient space to apply the knowledge they have learned in everyday life (Astalini et al., 2022; Kurniawan et al., 2019; Nurlia, 2023; Darmaji et al., 2021; Kurniawan et al., 2023; Ayu Sri Wahyuni, 2022). This is because in science learning, students not only memorize concepts and answer questions, but students are also expected to be able to understand, observe, analyze, and solve problems that will later be useful in everyday life (Maison et al., 2020). With the right learning, students can participate more actively in solving problems and finding creative solutions, which ultimately increases their creative thinking competence (Sari & Wulandana, 2019).

One of the main causes of low creative thinking skills in students is the use of direct learning models that rely more on lecture methods, assignments, and practice questions. This approach tends to make students learn passively, only listening and recording the information given without being actively involved in the problem-solving process (Rosa & Pujiati, 2017; Ulandari et al., 2019). Therefore, teachers need to adopt learning methods that encourage more creative thinking and problem-solving skills in students (Zulkifli et al., 2022; Yusuf et al., 2020; Ferdyan et al., 2021).

This study aims to identify and analyze research trends on creative thinking skills in science learning. It is hoped that this study can be a reference for developing more effective learning methods in improving students' creative thinking skills in the future.

Method

This study uses descriptive and analytical methods that aim to understand and describe research trends on creative thinking skills in science learning. Research data were obtained from documents indexed by Google Scholar using analysis tools such as Publish or Perish and Dimension.ai.

Inclusion and Exclusion Criteria

1. Inclusion Criteria:
   - Documents indexed by Google Scholar from 2016 to 2025.
   - Documents covering the topic of creative thinking skills in science learning.
   - Documents in the form of journal articles, conference proceedings, book chapters, and edited books.
2. Exclusion Criteria:
   - Documents that are not relevant to the topic of creative thinking skills.
   - Documents that are not available in full text.
   - Documents published before 2016 or after 2025.Penggunaan Software VOS viewer

The use of VOSviewer software in this study aims to conduct bibliometric analysis. VOSviewer was chosen because of its ability to visualize bibliometric networks, such as co-citation, bibliographic coupling, and co-authorship, which can provide in-depth insights into research patterns and trends. By using VOSviewer, researchers can easily identify frequently occurring keywords, author collaborations, and research trends from year to year.

In this study, an analysis was conducted on 1,000 documents that have been indexed by Google Scholar between 2016 and 2025. 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 other top databases, especially research in the field of education (Hallinger & Chatpinyakoop, 2019; Hallinger & Nguyen, 2020; Zawacki-Richter et al., 2019). To filter the data that has been collected through Publish or Perish, the researcher used the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA).

Result and Discussion

This study aims to describe research trends on creative thinking skills conducted from 2016 to 2025. Research documents on research trends on creative thinking skills in science learning are taken from documents from 2016 to 2025. The following is Figure 1 regarding research trends on creative thinking skills in science learning. The following is Figure 1 regarding research trends on creative thinking skills in science learning.

Figure 1 shows that the research trend on creative thinking skills in science learning from 2016 to 2025 has increased and decreased. In 2016 there were 25 publications related to creative thinking skills in science learning then continued to increase to 175 publications in 2021. However, these publications decreased to 135 publications in 2022. Then publications related to creative thinking skills increased again to 225 publications in 2024.

The increasing trend of this research provides a deeper understanding of the problem of low creative thinking skills in science learning and ways to overcome this problem. This trend also shows an increase in awareness and attention to the importance of creative thinking skills in science learning among researchers.

Critical Analysis

To provide a more comprehensive analysis, the results of this study are compared with research trends in other countries. For example, research in developed countries such as the United States and Germany shows a similar trend in the increasing number of studies related to creative thinking skills in science learning. However, the focus of research in these countries is more on the development of innovative and technology-based learning models, while in Indonesia research concentrates more on traditional pedagogical approaches.

Factors influencing this research trend in Indonesia include limited educational facilities, lack of training for teachers in implementing learning methods that encourage creative thinking, and lack of support from the government in terms of funding educational research.

Theoretical Implications

The findings of this study have significant theoretical implications. The increasing number of studies on creative thinking skills suggests that existing learning theories need to be updated to include elements that encourage student creativity. For example, constructivism theory can be enriched with learning strategies that emphasize problem solving and innovation. In addition, these findings can also contribute to the development of new theories that are more relevant to the needs of education in the digital era.

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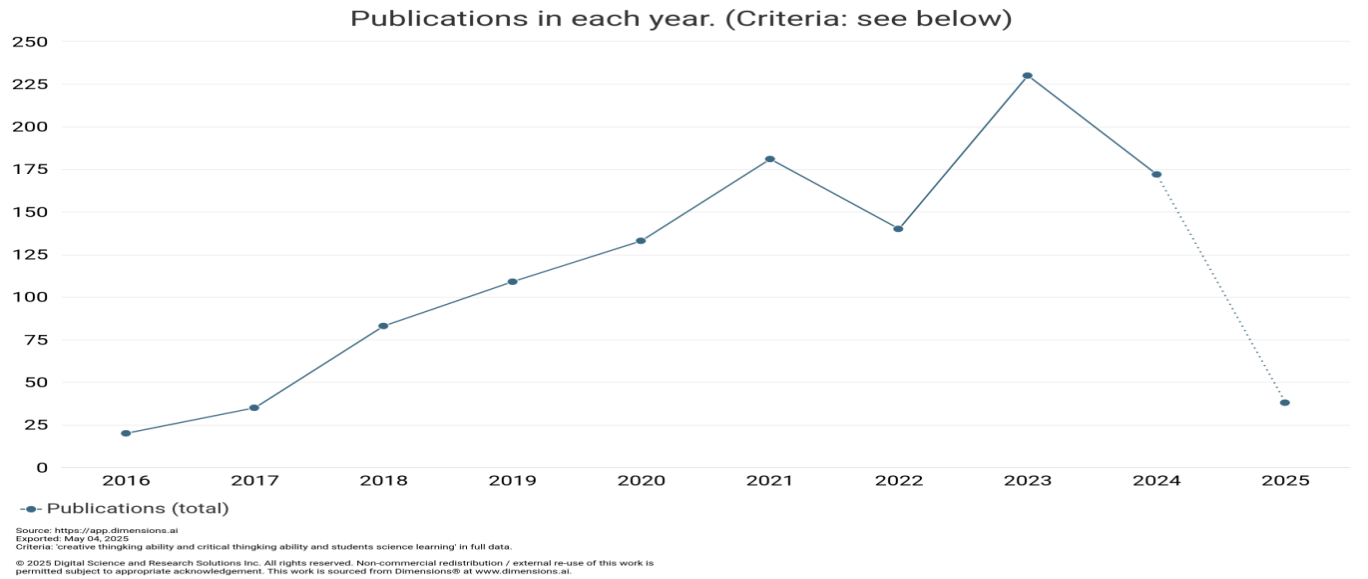

Figure 1. Research Trends on Creative Thinking Skills in Science Learning

Table 1. Trends in Creative Thinking Skills in Science Learning Research Based on Publication Type

Publication Type	Publications
article	1.347
proceeding	136
chapter	56
Edited book	55
Monograph	8
preprint	3

Based on Table 1, it is known that research on creative thinking skills in science learning from 2016 to 2025 is contained in 6 types of publications. In the form of articles as many as 1,347 documents, proceedings as many as 136 documents, chapters as many as 56 documents, edited books as many as 55 documents, monographs as many as 8 documents and preprints as many as 3 documents. The trend of research on creative thinking skills in science learning in the form of articles is the type of publication that contains the most research on creative thinking skills in science learning compared to other types of publications. While the type of publication that contains the least research results on creative thinking skills in science learning is preprint. Below are also presented ten (10) source titles that are trending in research on creative thinking skills in science learning that are often cited by other researchers related to this matter.

Table 2. Trends of Top 10 Source Titles on Creative Thinking Skills in Science Learning Research in 2016-2025

Name	*Publications*	*Citations*	*Citations Mean*
Journal Of Physics: Conference Series	165	822	4.98
Advances In Science, Education And Humanities Research	115	162	1.41
Jurnal Penelitian Pendidikan IPA	63	280	4.44
Aip Conference Procedings	29	102	3.5
Aksioma Jurnal Program Studi Pendidikan Matematika	28	108	3.6
Social Humanities And Educational Studies (SHEs) Conference Series	17	18	0.76
Jurnal Basicedu	18	179	18.77
JPBI (Jurnal Pendidikan Biologi Indonesia)	12	48	4.00
Jurnal Pendidikan MIPA	12	11	0.92
Jurnal Obsesi Jurnal Pendidikan Anak Usia Dini	10	64	6.40

Table 2 shows that the source that most frequently publishes research trends on creative thinking skills in science learning is the Journal of Physics Conference Series, which is 165 publications with 822 citations and an average citation of 4.98. Journal of Physics: Conference Series (JPCS) is an international journal published by IOP Publishing, specifically designed to publish scientific conference proceedings in various fields of physics and related sciences. This journal is an important forum for disseminating the latest research results presented in academic forums to the global community quickly and in a standardized manner. Through a selection and review process carried out by the conference committee, JPCS covers broad topics such as applied physics, materials, energy, optics, astrophysics, to physics education and other interdisciplinary fields. With this approach, JPCS acts as a dynamic forum for the exchange of scientific ideas and documentation of the latest research developments, as well as supporting global collaboration in the advancement of science.

Also presented below are the top ten (10) article title trends in research on creative thinking skills in science learning that are frequently cited by other researchers related to this topic.

Table 3. Top 10 Citations in Creative Thinking Skills Research Trends in 2016-2025

Cites/year	Year	Author	Title
8.00	2023	F Kiraga	Literature Review: Efforts To Improve Creative Thinking Ability In Science Learning
6.00	2020	Ida Madyani, Sri Yamtinah, Suryadi Budi Utomo, Sulistyo Saputro, Lina Mahardiani	Profile of Students' Creative Thinking Skills in Science Learning
8.17	2019	S U Putri, T Sumiati and I Larasati	Improving creative thinking skill through project-based-learning in science for primary school
10.00	2020	*Y Yamin, Anna Permanasari, S Redjeki, W Sopandi*	Project Based Learning To Enhance Creative Thinking Skills Of The Non-Science Students
20.83	2019	N Wijayati, W Sumarni, and S Supanti	Improving Student Creative Thinking Skills Through Project Based Learning

Cites/year	Year	Author	Title
88.00	2020	S Supanti, and S Kadarwati	Ethno-Stem Project-Based Learning: Its Impact to Critical and Creative Thinking Skills
64.83	2019	Alfi Syahrin, Dawud, Heri Suwignyo, Endah Tri Priyatni	Creative Thinking Patterns In Student's Scientific Works
2.00	2022	Julianto, Wasis, Rudiana Agustini, Suprayitno, Asri Susetyo Rukmi, Fitria Hidayati, Endah Rahmawati	Creative Attitude in Science Learning Model to Improve Creative Thinking Skills and Positive Attitude of Students Towards Science
1.50	2019	Husniawati, Hobri, A C Prihandoko, B T Utomo	Students' creative thinking skill on scientific approach based on lesson study for learning community
110.00	2021	Parama Kwangmuang, Suwisa Jarutkamolpong, Watcharee Sangboonraung, Srisuda Daungtod	The development of learning innovation to enhance higher order thinking skills for students in Thailand junior high schools

Table 3 shows that the research on creative thinking skills in science learning that is most often referred to by other researchers is the research entitled "Literature Review: Efforts To Improve Creative Thinking Ability In Science Learning" by F Kiraga (2023), with the number of references as many as 08.00 times per year. The research entitled "Profile of Students' Creative Thinking Skills in Science Learning" by Ida Madayani et al. (2020) is referred to 6.00 times per year. The research of S U Putri et al. (2019) entitled "Improving creative thinking skills through project-based-learning in science for primary schools" is referred to 8.17 times per year. In addition, the research by Y Yamin et al. (2020) entitled "Project Based Learning to Enhance Creative Thinking Skills of The Non-Science Students" is referred to 10.00 times per year.

This data is in line with the increasing trend of research on creative thinking skills in science learning from 2016 to 2025. This shows that research related to creative thinking skills in science learning continues to be an important reference for other researchers during this period. The articles researched and written by these researchers contain many terms or keywords related to creative thinking skills. Below are ten popular keywords related to creative thinking.

Table 4 shows that the keywords that often appear related to research on creative thinking skills in science learning are Higher order thinking skills as many as 52 times with a level of 3.04. This indicates that creative thinking skills in science learning are often studied together with science learning, for example research conducted by P Kwangmuang., (2020) which studied The development of learning innovation to enhance higher order thinking skills for students in Thailand junior high schools. Table 4 also shows that Creative Thinking Skill is also a keyword that often appears in research trends on creative thinking skills in science learning, which is 56 times with a relevance of 0.94.

Table 4. Keywords of Creative Thinking Skills Tendency in Science Learning Research 2016-2025

Terms	Occurrences	Relevance
Higher order thingking skill	52	3.04
collaboration	33	2.32
Higher order	39	2.10
creativity	35	1.76
Technology	47	1.58
Students creative thingking skill	38	1.32
effect	80	1.28
Influence	45	1.04
Critical thingking	64	0.99
Creative thingking skill	56	0.94

Below is a visualization done by generating a landscape map, which offers a visual representation of the subjects related to scientific studies. The results of bibliometric mapping for the co-word network in articles related to the topic of creative thinking skills in science learning are illustrated in Figure 2.

Figure 2 shows the results of bibliometric keyword mapping against research trends on creative thinking skills in science learning. In Figure 2, there are 1169 terms and 37 keyword items that are often used in research on creative thinking skills in science learning from 2016 to 2025. Figure 2 also contains 4 clusters, where the first cluster is red and consists of 13 keyword items, namely creative thinking skills, science learning, project, design thinking, etc. The second cluster is green and consists of 9 keyword items, namely thinking skills, higher order environment, etc. The third cluster is blue and consists of 8 keywords, namely science education, development, school, activity, etc. The fourth cluster is yellow and consists of 6 keyword items, namely model, analysis, collaboration, etc.

Figure 2 above also shows that the network visualization shows the network between the visualized terms. Keywords classified into 4 clusters are arranged in a color chart that shows the divisions/clusters that are connected to each other. The results of this analysis can be used to determine the trend of keyword research

in the past year. This analysis shows several keywords that are often used in research on creative thinking skills in science learning. The more keywords that appear, the wider the visualization displayed.

Also presented below are keywords regarding creative thinking skills in science learning based on overlay visualization.

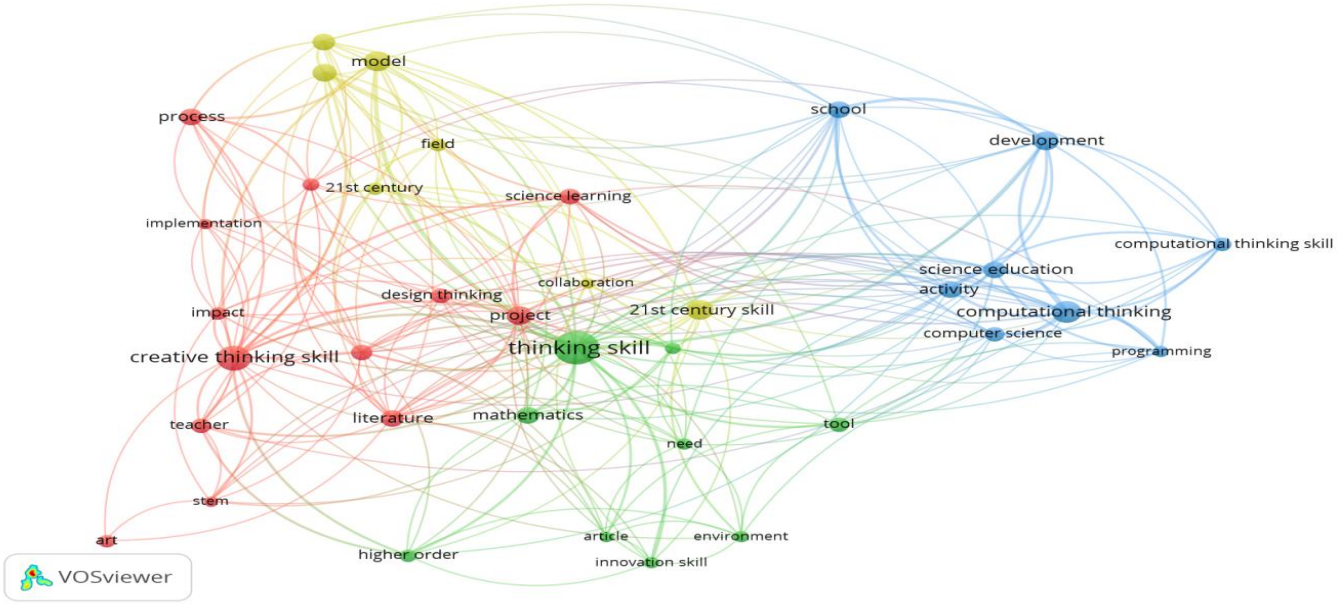

Figure 2. Visualization of the Network of Creative Thinking Skills Tendency in Science Learning Research

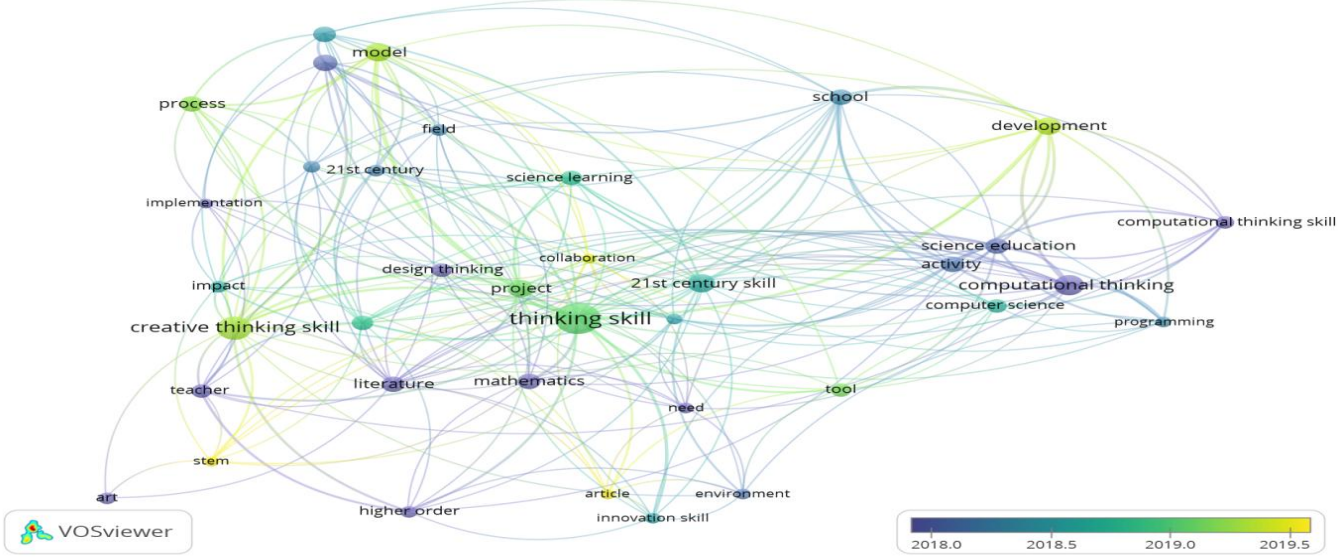

Figure 3. Visualization of Creative Thinking Skills Tendency Network Overlay in Science Learning Research.

Figure 3 shows the trend of keywords related to research on creative thinking skills in science learning in Google Scholar indexed journals from 2016 to 2025. The trend of article writing themes related to creative thinking skills in science learning from the oldest to the newest years is marked with purple, blue, turquoise, dark green, light green and yellow. The image above shows science education, analysis, school, 21st century and others. This shows that these keywords were widely used by researchers in 2018. In 2019, the keywords that often appeared were thinking skills, creative thinking skills, development, model, project, etc. Research on creative thinking skills in science learning is one of the fields of research that has grown rapidly in recent years.

The following also presents the keywords for research on creative thinking skills in science learning based on density visualization in Figure 4.

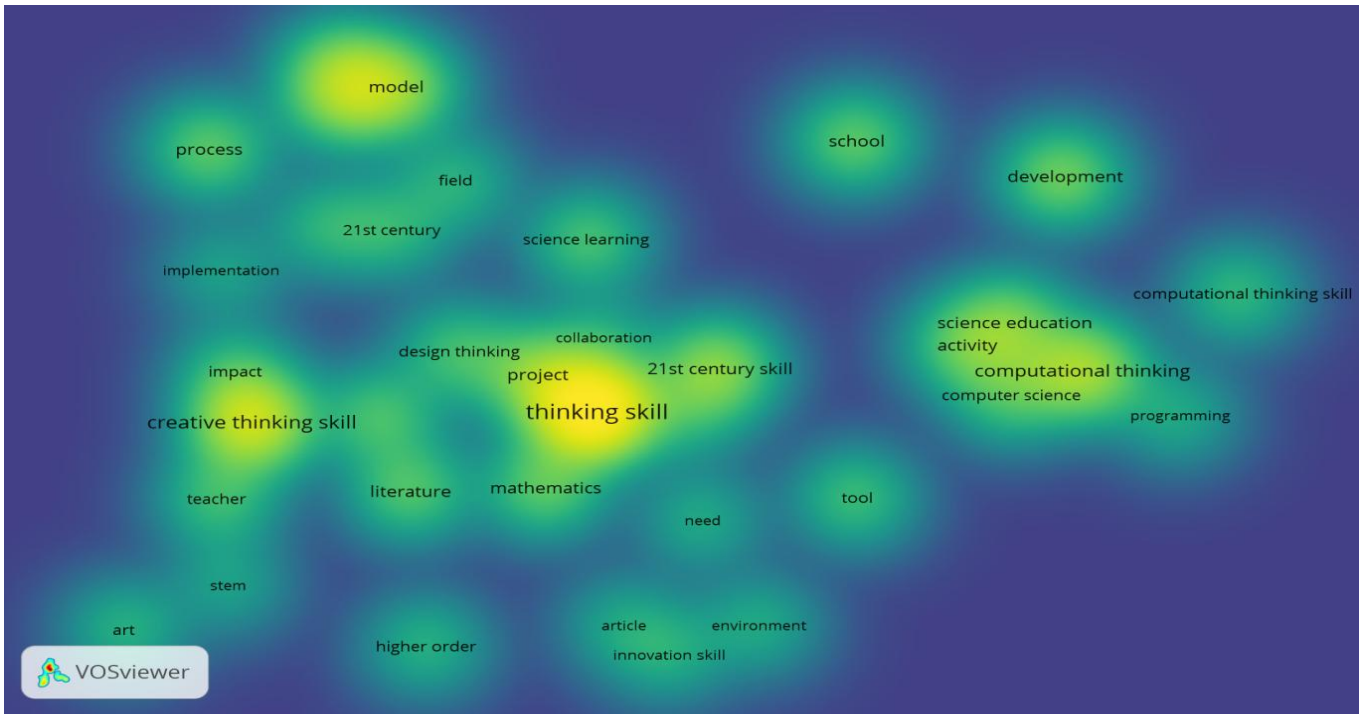

Figure 3. Density Visualization of Creative Thinking Skills Trends in Science Learning Research

Figure 4 shows the density visualization. The density of the research theme is indicated by the bright yellow color. The brighter the color of a theme, the more research has been done. The dimmer the color means that the theme is rarely studied (Kaur et al., 2022; Liao et al., 2018). Dimly colored themes such as implementation, need, science learning, STEM, high order are dimly colored keywords. This indicates that these keywords can be used as references for further research. Doyan et al., (2023) and Bahtiar et al., (2023) stated that the yellow color indicates keywords that are currently and frequently used in research.

Overall, research on creative thinking skills in science learning is important because it provides a significant contribution to 21st century education. Creative thinking skills are part of the 21st century 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.

The research trend on creative thinking skills in science learning is expected to continue to grow 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 science subjects.

Conclusion

Research on the trend of creative thinking skills in science learning has a high urgency because it provides various benefits for 21st century education. Based on the results of research indexed by Google Scholar from 2016 to 2025, the trend of research on creative thinking skills in science learning shows a fluctuating increase. The number of publications increased from 2016 to 2021, then decreased in 2022. In 2023 to 2024. Many documents in the form of Chapters, Articles, Edited Books, Monographs, Proceedings, and Preprints discuss creative thinking skills in science learning. Keywords that are often used in this study include thinking skills, and creative thinking skills.

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Author Contribution

Conceptualization, A. D.; methodology, A. H.; validation, G. H.; formal analysis, A. H.; investigation, A. D.; resources, G. H.; data curation, G. H.: writing—original draft preparation, A. H.; writing—review and editing, A. D; visualization, G. H. All authors have read and agreed to the published version of the manuscript.

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