



Research Trends in Creative Thinking Skills in Mathematics Education

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Abstract: Creative thinking is an important ability mastered by students in the 2nd century learning world 1. Publications related to creative thinking can be found in various scientific journals. However, the trend of publications on the topic of creative thinking of students in the realm of education in Indonesia does not yet exist. This study aims to review learning trends and methods to improve creative thinking by using content analysis from several mathematics education scientific articles published in Indonesia, from 2016 to 2022. The method used is Systematic Literature Review. The source of this research data is Science and Technology Index (SINTA) indexed articles in the 2016-2023 period. Research data was analyzed based on 7 aspects, namely: research design, research subject, treatment, year of publication, and number of citations with mathematical topics. This study produced the following findings. First, three types of research designs were used in the article, namely: 28 quantitative research, 16 qualitative research and 6 mixmethod research. Second, four types of research subjects, namely: 12 elementary schools, 20 junior high schools, and 18 high schools. Third, aim for the learning model used in the study, namely: 17 PBL, 12 conventional, 7 inquiry, 5 problem solving, 5 STEAM, 2 cooperative and 2 RME. Fourth, the publication year in the study is: in 2016 there were 1, in 2018 there were 4, in 2019 there were 12, 2020 was 15, in 2021 there were 10, and in 2022 there were 8 studies. Finally, the number of citations per article ranges from 3 to 300 citations. This study concludes that R&D research should be conducted to better understand how to develop products to increase the level of creativity of learners using learning media. A project-based R&D approach can create products in the form of learning media that can encourage students' creative thinking skills.

Keywords: Creative Thinking Ability, Journal of Mathematics Education, Research Design.

1. INTRODUCTION

21st century education refers to an approach that has been adapted to the skills needed in the 21st century. These skills involve critical thinking, *communication*, *creative thinking* and *collaboration* which is often called the 4Cs (Bayley, 2022). 4C skills need to be instilled through learning so that learners are able to solve problems well (Kocak et al., 2021). This is in line with Voogt which states that success indicators are based on a person's ability to create solutions to a problem (Voogt & Pareja Roblin, 2023). Even with the ability of the 4Cs students are able to adapt and innovate to create a problem (Black, 2020). Through educational facilities in the 21st century that transfer conventional learning into learner-centered learning activities (Afriana, 2015). Such as, investigation, which is carried out collaboratively to project-based learning (Taar & Palojoki, 2022). Thus, learning carried out in the 21st century is an activity that can stimulate the abilities that must be possessed by every student. One of the abilities that must be possessed by students in the development of the 21st century is the ability to think creatively.

Creative thinking is a core skill in the 21st century that must be applied globally in education systems (Marrone et al., 2022). The importance of creative thinking in education in the 21st century is based on the changes and demands that exist in the learning environment (Hemdan et al., 2023). Creative thinking can develop the skills necessary to adapt to change, find new solutions to solve problems (Misrochah, 2021) Creative thinking can also stimulate learners to develop innovation and complex problem solving (Muslimin et al., 2020). Thus, creative thinking can help students to hone 21st century skills through innovative thinking, exploration, new ideas, and productive collaboration (Uno & Nina Lamatenggo, 2022). In the theory of learning and learning, creative thinking is a complex process that occurs in each

individual so that it can be done until the end of life (*long life education*) (Suherman & Vidákovich, 2022). There are four indicators of creative thinking namely *fluency*, *flexibility*, *originality* and *elaboration* that can be applied in learning methods (Voogt & Pareja Roblin, 2023). With an integrated learning model, creative thinking students can provide various solutions to the problems being faced (Suherman & Vidákovich, 2022). Thus, the ability to think creatively becomes important in helping students face challenges and opportunities that continue to grow in the 21st century.

However, the application of creative thinking skills has not been fully implemented or it can be said that creative thinking students in Indonesia are still less empowered in the field of education. According to G. Kudrna *et al.* stated that the creative thinking ability of students in Indonesia is still relatively low or can be said to be not optimal (Kudrna et al., 2022). In line with the study, the level of creative thinking of students is still relatively low (Satrio Ardiansyah et al., 2012). Not only in Indonesia has problems in creative thinking but found in other countries such as Sweden and Hong Kong (Bashkin et al., 2022; Chan & Yuen, 2014). Because the lack of creative thinking of students is the curriculum, learning methods and lack of training for educators (Zawacki-richter & Jung, 2023). Because this is a very important thing to overcome to improve the creative thinking of students. One of the reasons that can be overcome today is the learning method (Smyrniou et al., 2020). Because by applying appropriate learning methods can improve the creative thinking of their students. In line with this question, learning methods have an important influence in increasing student creativity (Mursid et al., 2022). Thus, the level of creative thinking can also be developed by providing appropriate learning methods such as student-centered learning.

Student centered learning is a learning approach where students are placed as the center of the learning process (Goda et al., 2022). This method aims to stimulate active involvement, independence and understanding in learners. Student-centered learning allows learners to play an important role in the learning process (Chen et al., 2023; Khoury, 2022; Lahdenperä et al., 2022). Some student centered learning models include, Discovery learning, cooperative learning, inquiry, problem based learning (PBL), contextual instruction, and project based learning (PJBL) (Chen et al., 2023). By applying student-centered learning methods will provide opportunities for students to develop creative thinking skills, expand knowledge and explore new ways of solving complex problems (Muslimin et al., 2020). In line with previous research says that the level of creative thinking can be developed and can even be increased by using special learning methods such as in student centered (Ramdani & Apriansyah, 2018; Suherman & Vidákovich, 2022). In this study it was found based on how often it is used as a fundamental basis for government policies towards the ability of students. As well as learning planning to a curriculum that is specifically intended to help develop one of the 4C abilities in Indonesia, namely creative thinking. So that it can be able to accommodate and optimize the empowerment of creative thinking of students in full carried out in Indonesia.

Indonesia is a country where the most research is found related to the ability to think creatively, especially in mathematics learning. As such, previous research that has been done has focused on how to improve learners' creative thinking (Cahyaningsih & Ghufron, 2016; Nurhayati & Rahardi, 2021). Thus, the creative thinking ability of students needs to be improved to create innovation, problem solving and solutions to every problem that is being faced. However, there is no research directly related to the skills or methods that are suitable for creative thinking ability can be seen in figure 1.

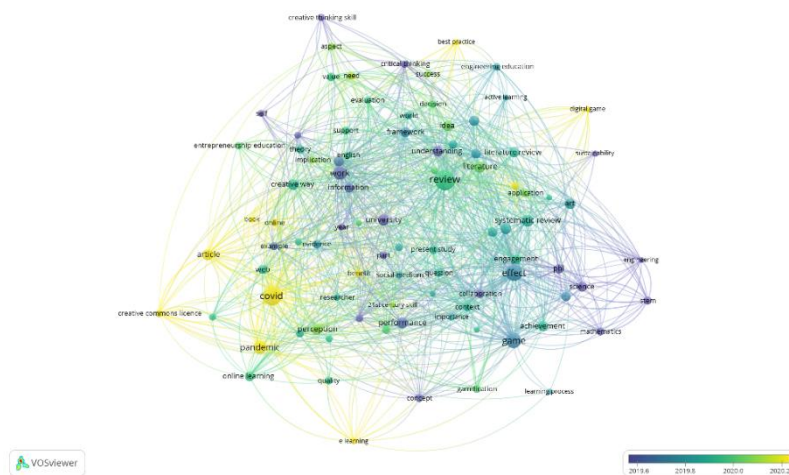


Fig.1 Learning process to achieve creative thinking skills with VOSViewer

There are no directly related studies on creative thinking skills from 2019 to 2023, as shown in Figure 1. However, from 2019 to 2023, there are many studies on critical, collaborative, and communicative thinking. Along with the ability to think collaboratively, communicatively, and critically, the 21st century also demands the ability to think creatively. Therefore, this phenomenon was used to review the ability to think creatively in this study. In addition, this study will serve as a guideline for future researchers.

This research is useful for reviewing trends and learning methods that are suitable for use in improving creative thinking. In detail this research is intended to answer the following questions, 1) What is the trend of the number of creative thinking skills research from year to year? 2) What is the diversity of research designs used to investigate creative thinking skills in Indonesia? 3) What topics are most often used to investigate creative thinking skills? 4) What treatments do researchers apply to improve creative thinking skills? And 5) the usefulness of research in collecting the most citations? 6) How to describe the series of research that has been carried out by researchers in investigating creative thinking skills. This study aims to collect information on creative thinking skills research in Indonesia.

In some respects, this study is different from previous research that showed critical thinking, collaborative, and communicative thinking skills. This research is focused on Science and Technology Index (SINTA) accredited articles from sinta 1-3 published in 2016-2023. The study also focused on investigating articles with creative thinking skills as the focus. And as a parameter of research methods to treatment to improve creative thinking skills.

2. METOHODOLOGY

This study focuses on previous findings from various articles that have been published in scientific journals in Indonesia in the field of mathematics education. The method used is a systematic literature review (SLR) with stages following the flow chart Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) (Page et al., 2018). The stages in PRISMA include identification, screening and inclusion as described in figure 2. The first stage (Identification) detected 200 articles Publish or Perish rocky <https://sinta.kemdikbud.go.id/journals/index> , by entering keywords of students' creative thinking skills in mathematics education from 2016 to 2023, then choosing article titles and abstracts that are in accordance with mathematics education. The second stage (Screening) classifies in the form of, the suitability of the title used, an index of journals that have a reputation of sinta 1 to 3 so that 28 journals with 150 articles are obtained in accordance with the content used, classifying based on the number of citations in each article, so that 100 articles are issued. The third stage (Included) produced 50 articles that could be accessed openly.

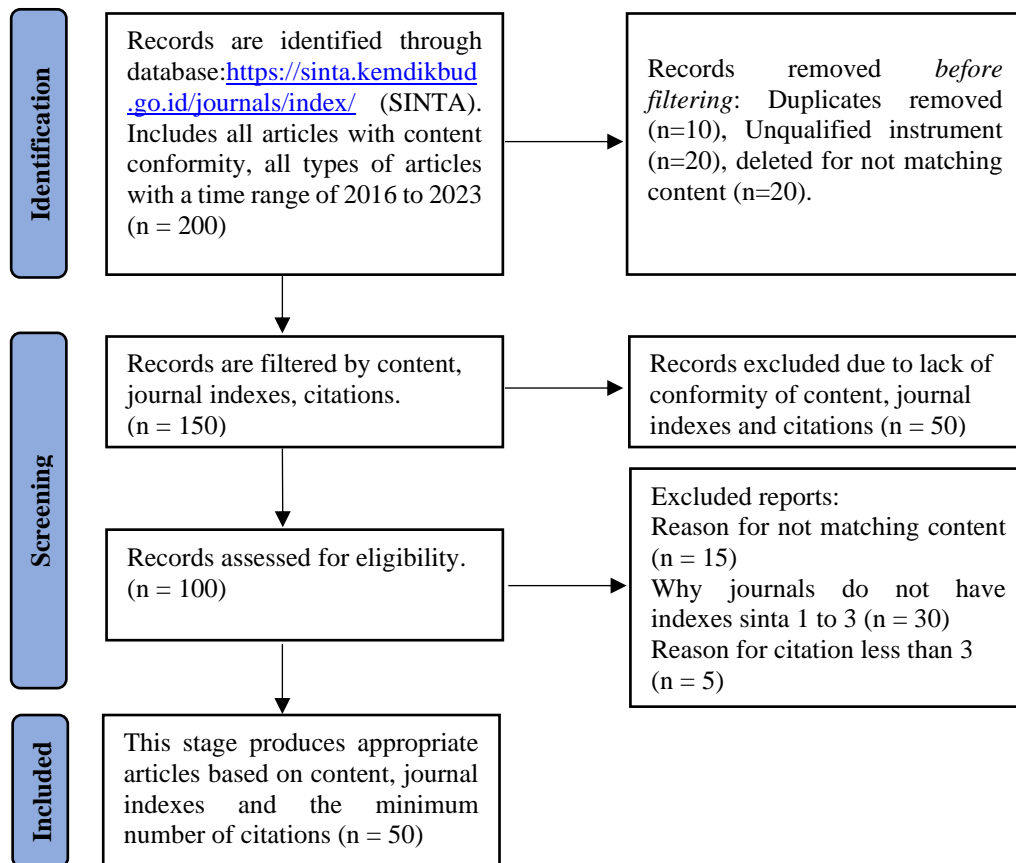


Fig. 1 PRISMA diagram (Page et al., 2018)

2.1 Data Sources

The source of data in this study is SINTA. Sinta is a platform designed and developed by the ministry of research, technology and higher education in Indonesia (Fry et al., 2023). Sinta provides information about scientific research and development conducted in Indonesia. Through Sinta, researchers found data sources from 28 scientific journals of

mathematics education indexed by Sinta 1 to 3. From the journal, 150 articles were obtained which were then classified based on the suitability of the required content and the publication year 2016 to 2023. Furthermore, researchers classified based on the number of citations starting from 3 to 300 citations. The last step of the researcher is to analyze the content that has been determined based on the research design, research subject, treatment, index, year of publication, number of citations and subjects or courses.

2.2 Research Instrument

The instrument used for this study is to classify the related aspects observed in Table 1. There are 7 main aspects in this study including. Number of publications per year, research design, research subject, mathematics are the topics chosen in the study, given treatment, data collection instruments, analytical methods. Furthermore, researchers make exceptions to the aspects of data collection instruments and analysis methods provided, because this aspect allows it to be very common in previous studies. This existing category is addressed in table 1, then the research design is divided into three categories, namely R & D, quantitative, qualitative, and not applied to general research conducted. The subjects of the study include, Elementary School (SD), Junior High School (SMP), Senior High School (SMA), Students and Lecturers. The treatment provided includes Problem Based Learning (PBL), Conventional, Realistic Mathematics Education (RME), Cooperative, inquiry, Project Based Learning (PJBL), Problem Solving and STEAM. The artifact has been indexed sinta 1 to sinta 3 which was published in 2016 to 2023. And the number of citations that have been selected from 3 to 300 in mathematics education journals.

Tabel 1. Research Instrument

Aspects	Category	
Research design	1. PTK 2. R&D 3. Experiment	4. Qualitative 5. Quantitative 6. Mixmethod
Subjects of study	1. Primary School (SD) 2. Junior High School (SMP) 3. Senior High School (SMA)	4. Student 5. Lecturer
Treated Given	1. Problem Based Learning 2. Konvensional 3. RME 4. Kooperatif	5. Inkuiri 6. Projek Based Learning 7. Problem Solving 8. STEAM
Index	Sinta 1 – Sinta 3	
Year of Publication	2016 – 2022	
Number of citations	3 – 300	
Subject/Study Program	Mathematics/Mathematics Education	

2.3 Data Analysis

Each article that has been found is classified based on predetermined categories based on predetermined aspects with a note that each article must meet each predetermined category. This decision making is based on every information that exists in abstracts, research methods, discussions, and research results. Furthermore, the data that has been set is presented in the form of a bar chart. So that it can obtain data systematically, transparently and documented in detail.

3. FINDINGS

3.1. Research Design

The focus of research is determined by the nature and design of the study. Figure 2 shows that the most popular research design researchers use to study creative thinking skills is quantitative research. Several previous studies have found that researchers prefer quantitative rather than qualitative research designs in education [(Ashabulkahfi, 2020; Fauzia et al., 2017; Haka et al., 2020). In addition, researchers also chose to research mixmethod design designs to conduct research. In qualitative research with R&D methods it is considered as new and complicated research to be done in educational research [(Bianchini, 2019; Zhang et al., 2017).

Such circumstances are closely related to the benefits of using R&D techniques to define phenomena thoroughly and deeply (JIA et al., 2020). As a result, the dearth of R&D research has presented lucrative opportunities for subsequent researchers. So they can use R&D design and concentrate their studies on creative thinking skills. In this study R&D is classified into qualitative research and experiments are classified into qualitative research, so that the topic of discussion of this research design is classified in three research designs, namely quantitative, qualitative and mixmethod can be seen in figure 2.

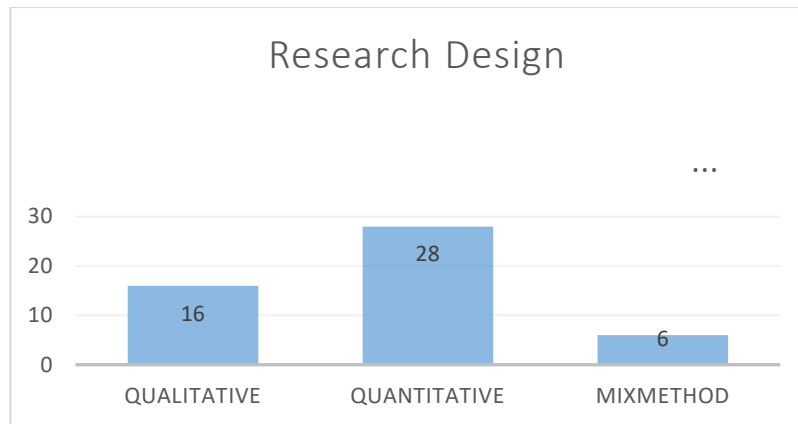


Fig.2 Research Design

With the data in figure 2, it is known that there is a scarcity in qualitative research in R&D research methods on creative thinking. This is supported by research conducted by G. Liu et al. which states that, there is still a lack of R&D research carried out this happens because there are too many instruments needed to conduct the research (Liu et al., 2023) while quantitative research is a trend of educational research in Indonesia. In quantitative research, researchers often apply results in the form of numbers, then calculate using statistics and produce accurate data. But not infrequently in this quantitative research there is fraud in data processing so that it can produce the desired data (L. Zhao et al., 2022). Based on the study, it was found that there was fraud in the form of data manipulation among quantitative studies conducted by researchers. Thus, the ability to think creatively is still lacking as a vital foundation for research progress because it has not reached the diversity of research designs used.

In addition, this study also found the type of qualitative research conducted by previous researchers. This research is research that is often chosen by previous researchers because with this qualitative research researchers can easily apply learning methods during class. So, this research is the number 2 most research after quantitative. Next is mixmethod research used by researchers because this research can be used and produce quantitative and qualitative data simultaneously (Yingprayoon, 2017).

In conducting the analysis that has been carried out, it is known that there is still little use of research design using R & D. In the literature study conducted by researchers, several advantages were also found in the use of R&D research such as the use of the right target according to needs. Until the use of output results such as books, student worksheets that can be used practically in accordance with the development of the 21st century. Therefore, every result carried out on this R&D research is expected to fully contribute to the use and suitability of educational needs. This R&D research can contribute to enriching the teaching materials used as well as enriching future research on creative skills in Indonesia.

3.2. Research Subjects

The goal is to empower learners' critical thinking skills. Based on Figure 3, junior high school students were most selected as research subjects, followed by high school and elementary school students. This result is in line with previous research examining the content of mathematics education studies published in Indonesia (Chowdhury & Villez, 2023). Previous studies have also shown the dominance of junior high school students (Andiyana et al., 2018) According to his research, junior high school is often chosen as a subject over the past 5 years is the learning process and conceptual understanding of students. These results align with previous research, stating "junior high school" is the most frequently searched keyword and the easiest to find in education research (Purwasih, 2019). Junior high school students are the most frequently used research sample in education articles in Indonesia.

In addition to comparing elementary, middle, and high school levels, Figure 3 also illustrates how often an education level as a research topic the higher the education level. The findings in this study are known that related research is very dominant in junior high school students with a total of 20 articles. Likewise, high school students showed the highest frequency of research participation number 2, with 18 articles. And also carried out in elementary schools, namely with a total of 12 articles. But research related to creativity is not yet available in universities. This incident is in line with the rampant practice of selective universities in granting permission to conduct research in universities. So that research related to the creative abilities of students has never been carried out in universities.



Figure 3 Research Subject

3.3. Treatment

Treatment attempts to verify research claims or establish the importance of a particular treatment within each parameter investigated. The most frequently used interventions in the study of critical thinking skills are problem-based learning (PBL), conventional learning, inquiry, problem solving and STEAM, can be seen in figure 4. PBL has been used in twelve publications, while conventional has been used in twelve publications, inquiry has been used in publications, problem solving has been used in five publications, STEAM is used in five publications, RME is used in 2 publications, cooperative is used in two publications and there is no use of project-based learning (PJBL) learning methods in publications. The scientific method ranks as the eight most popular learning methods after the procedures. PBL and Conventional are not comparable. It is said that the latter serves as the main base of the former. In addition, both are included in the learning methodology. The scientific method, PBL, Cooperative, RME, inquiry, STEAM problem solving and PJBL all naturally share the same basic principles by which students are encouraged to engage in a variety of scientific activities (Zawacki-richter & Jung, 2023). The results of this study are presented in a diagram image that can be seen in figure 4. 21st century education must foster creative thinking (Y. Zhao & Wang, 2022). In fact, any learning exercise that introduces learners to learning activities has the potential to maximize their creative thinking capacity.

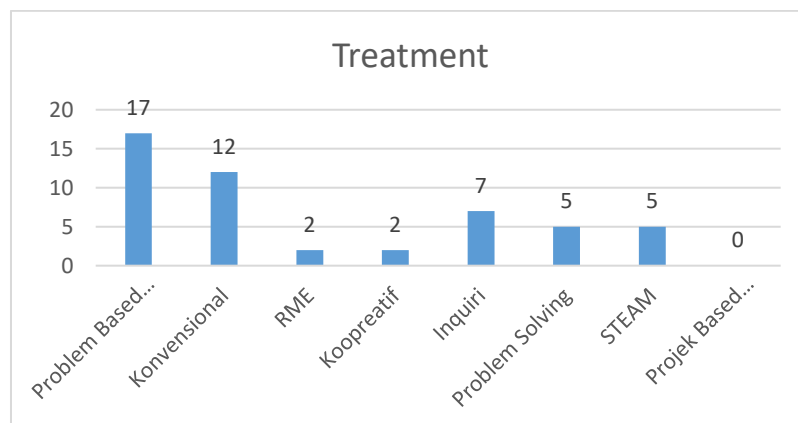


Figure 4 Treatment

The results of this review also revealed that most researchers chose to use certain instructional designs as treatments or independent variables in their research. On the other hand, although the activeness of learners is one of the determining elements directly related to the attachment of skills to be improved. However, research focuses on the influence of student activeness factors in producing creative thinking skills. Various studies on the impact of learning activities on students' creative thinking ability have produced mixed findings. Various studies show that students' creative thinking ability is influenced by project-based learning methods (Smyrnaïou et al., 2020). In addition, many studies have shown that project-based learning methods significantly affect students' creative thinking abilities (Y. Zhao & Wang, 2022) Therefore, more needs to be learned about how project-based learning methods affect the ability to think creatively.

3.4. Year of Publication

The number of articles published reveals how often research is conducted over a period. Referring to the graph in Figure 5, articles examining creative thinking skills have been available from 2016 to 2023. The number of publications does not change in a particular pattern from year to year. However, referring to Figure 5, more articles have been

published in 2020 compared to previous years, but there has been a decrease from 2021 to 2022. There has been a marked increase in 2020 in the number of researchers wanting to review learners' creative thinking levels. In accordance with the trend of increasing the number of publications about creative thinking, researchers are expected to be able to conduct research related to creative thinking so that they can achieve one of the abilities of the 21st century.

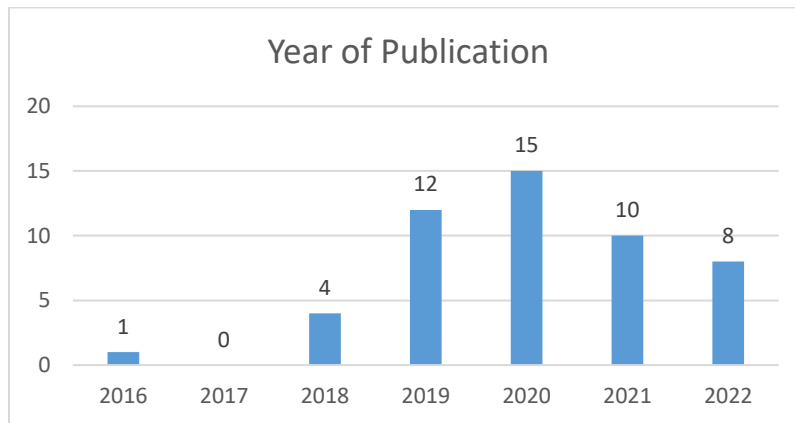


Fig. 5 Year of Publication

Much of the research is based on researchers' awareness of common difficulties in the immediate environment in education. One of the problems that often occurs today is the level of creative thinking ability of students in Indonesia which is still relatively low. Therefore, conducting studies is a suitable and best strategy to overcome and solve problems of students' creative thinking skills. By conducting studies, researchers can determine the most efficient learning strategies or media that may be able to support students' creative thinking abilities and can also review learning models that are suitable for use to provide novelty in accordance with existing studies.

The positive impact of education growth in Indonesia is getting stronger with the increasing number of studies conducted on the ability to think creatively. This concept is supported by the assumption that the main purpose of research is to improve educational practice (Uno, 2022). In addition, a study will affect educational practices for several reasons, including: (1) the conclusions can be considered as reliable information that can be used by educators. (2) They may serve as a fundamental basis for decisions regarding education in national, local, or specialized institutions. (3) Conclusions can affect the perspective of educators in determining the learning method to be used.

3.5. Number of Citations

The topic of students' creativity ability is the topic that is most cited by other researchers so that this research has a good influence on other researchers and has a great influence on educational research or becomes a study published in educational journals in Indonesia. Table 2 shows the number of citations in each article so that the article can contribute to future research. It can also be known that the trending topic is the ability of students' creativity to fulfill one of the 4C abilities.

Table 2. Number of Citations

No	Number of Citations	Author	Article Title
1.	3	Ujjiati Cahyaningsih Dan Anik Ghufro	The influence of the use of problem-based learning models on creative character and critical thinking in mathematics learning
2.	18	Masita Ulil Syahara	Analysis of students' creative thinking in solving Spldv problems in terms of mathematical ability
3.	78	Ikhsan Faturohman	Improving Students' Mathematical Creative Thinking Ability through Creative Problem Solving
4.	17	Farah Febrianingsih	Systematic Literature Review: Creative Thinking Skills in Mathematics Learning
5.	6	Ijce Hormadia	Students' creative thinking skills in solving mathematical problems
6.	13	Rati Dillan	The ability to think creatively mathematically of junior high school students in terms of self-confidence
7.	18	Istikomah Istikhoroh	Using Framing to Foster Creativity In Learning: Reflective Tool To Analyze And Discuss Practice

8.	28	Novi Nurhayati	Students' Creative Thinking Ability in Developing Mathematics Learning Media During the Covid-19 Pandemic
9.	46	Dadang Apriansyah	Analysis of the Comprehension and Creative Thinking Ability of Mathematics Mts Students on Flat Side Space Building Material
10.	105	Delpita Ulandari	The effectiveness of the inquiry learning model on students' creative thinking abilities on Pythagorean theorem material
11.	13	Rini Fauziah Sari	Students' ability to think creatively mathematically and belief in linear equations and inequalities
12.	50	Asri Muslim Sanusi	Mathematical creative thinking skills using Android-assisted education games on rows and series
13.	26	Iik Nurhikmayati	Development of Problem Based Learning Based on Local Wisdom Oriented to the ability to think creatively and learning independence
14.	82	Ai Rasnawati	Analysis of the Mathematical Creative Thinking Ability of Vocational Students on the Material of the Two Variable Linear Equation System (SPLDV) in Cimahi City
15.	19	Yulianto	Improve creative thinking skills and mathematical adaptive reasoning through instructional packages based on creative problem solving
16.	6	Yohanes O. Jagon	The Creative Thinking Process of Junior High School Students in Solving Math Problems Based on Learning Styles
17.	24	Erlinawati	Analysis of Creative Thinking Ability in Problem Solving in terms of Gender Differences
18.	10	Narita	Analysis of the Level of Creative Thinking Ability of Trigonometric Material
19.	37	Ratni Purwasih	The ability to think creatively mathematically of junior high school students in solving problem solving problems is reviewed from the climber-type adversity quotient
20.	119	M Arfan	Analysis of the Mathematical Creative Thinking Ability of Junior High School Students on Building Space Material
21.	45	Cut Ardhila	Students' Mathematical Creative Thinking Ability through Brain-Based Learning Learning Model
22.	32	Oktaviani	Improving students' mathematical creative thinking skills through problem-based learning models with a STEAM approach
23.	83	Risnawati	Analysis of the Mathematical Creative Thinking Ability of Vocational Students on the Material of the Two Variable Linear Equation System (SPLDV) in Cimahi City
24.	30	Caicy	The influence of the open-ended learning model on the ability to think creatively in mathematics in terms of learning motivation
25.	31	Ari Septian	Learning with Creative Problem Solving (CPS) models to improve students' mathematical creative thinking skills
26.	33	Subakti	The development of e-LKPD with Jambi cultural characteristics uses a stem-based discovery learning model to improve mathematical creative thinking skills
27.	38	Nanda	Mathematical Creative Thinking Process of Extroverted and Introverted Students of Junior High School Class VIII Based on Wallas Stages
28.	11	Nurchahyo	Didactic Design of Arithmetic Line and Series Concepts in High School Mathematics Learning
29.	26	Lik Nurhikmayanti	Development of Problem Based Learning Based on Local Wisdom Oriented to the ability to think creatively and learning independence
30.	105	Nelpita	The effectiveness of the inquiry learning model on students' creative thinking abilities on Pythagorean theorem material

31.	51	Anis Fitriyah	The effect of PBL (Problem Based Learning) Steam learning on creative thinking and critical thinking skills
32.	18	Lilis Setianingsih	The ability to think creatively of junior high school students in solving open-ended problems
33.	19	Yulianto	Improve creative thinking skills and mathematical adaptive reasoning through instructional packages based on creative problem solving
34.	35	Tina Sri Sumartini	Students' Creative Thinking Ability Through Mood Learning, Understanding, Recall, Detect, Elaborate, And Review
35.	67	Nukhbatul Bidayati Haka	The effect of blended learning assisted by Google Classroom on students' creative thinking skills and learning independence
36.	16	Debby Arisandy	Educational Game Development Using Construct 2 Software Assisted by Phet Simulation Oriented to Students' Creative Thinking Skills
37.	10	Sabina Ndiung	The effectiveness of the Tre finger learning model in cultivating the creative thinking skills of elementary school students
38.	7	Maya Herlina	Preliminary Research on PBL Model LKPD Related to Mathematical Thinking Skills
39.	16	Nindi Sri Rahayu	Mathematical Creative Thinking: A Literature Mapping by Bibliometric Analysis Using VOSViewer
40.	28	Nur Eva	Implementation of Problem Based Learning to explore students' creativity and mathematical creative thinking skills
41.	12	Farida	Building Students' Mathematical Creative Thinking Skills with STEM Learning
42.	4	Yusril	Description of Creative Thinking Ability in Solving Flat Wake Problems in Class VIII Students of SMP Negeri 3 Sungguminasa
43.	200	Yulianti	Technology-Assisted Learning: Honing Students' Affective Outcomes
44.	14	Muslimin	Increase student creativity in understanding the concept of the nature of light through contextual learning
45.	17	Nana Misrochah	Problem-Based Learning PBL Development Model to Increase Student Creativity
46.	200	A Erni Ratna Dewi	Implementation of the Strategy for Strengthening the Independent Learning Curriculum
47.	300	Kiki Septia	Implementation Of Problem Based Learning On Student Reasoning On Covid-19 Disaster Mitigation
48.	17	Putu Widiarini	The Influence of the Virtual Lab Assisted Inquiry-Based Learning Model on Student Creativity
49.	12	Laely	Analysis of Cambridge Curriculum Development in Mathematics Learning with Problem Based Learning in Islamic Elementary Schools
50.	10	Kiki Fatmawati	Project Based Learning: Best Practice and Optimizing Students' Creativity of Teacher Training for Islamic Elementary School

4. DISCUSSION

Given the importance of one of the 4C abilities needed by every learner is the ability to think creatively. Because with the ability to think creatively, students can explore problems that are being faced in the academic and non-academic fields. So that increasing the ability to think creatively becomes a trend that can be applied in future research. Of course, with appropriate treatment. This is in line with previous research, stating that the trend of creative thinking research is very important to do, in order to develop creative thinking skills [(Fleet & Dobson, 2023; Wu & Wu, 2020). Until it becomes a recommendation intended for the next researcher to get a new research design.

Research designs that are still little done are useful in providing potential novelty for future research. In figure 2 it is explained that the dominance of research that occurs is in quantitative research, namely with a total of 28 studies

from 50 articles used in this analysis. Qualitative research with a total of 16 studies in 50 articles and then mixmethod with a total of 6 studies from 50 studies. Based on a review of articles that have been conducted, it was found that there has been no research using the R&D research method. This is in line with previous research, stating that in developing creative thinking skills can be assisted with learning tools to support learning activities [(Wiedenmann et al., 2020; Yeo & Jeong, 2020). Thus, researchers recommend using R&D research methods to improve creative thinking skills.

In addition to the design in the research used, the treatment given has an important influence on the ability to think creatively. Based on figure 3 it is known that the dominating treatment is using problem-based learning then conventional methods, cooperative methods and the RME approach. However, in the analysis that has been done, it was found that there has been no treatment using the learning method (PJBL). The PJBL learning method is a learning method that can stimulate the level of creative thinking of students in terms of the syntax used [(Runco & Pritzker, 2020; Y. Zhao & Wang, 2022). In line with previous research, the PJBL learning method is a project-based learning method by applying students' creative thinking skills. So, using the PJBL learning method can improve the creative thinking ability of students.

Improving learners' creative thinking skills has many significant benefits in solving every complex problem. With the ability to think creatively, students can also generate new ideas. It can also create interactive solutions by combining concepts learned during learning (Stehling & Munzert, 2018). In addition, the trend of creative thinking research of students needs to be carried out in order to develop complexity in 21st century education (Ramírez-Montoya et al., 2022). To be able to improve creative thinking skills can be done using project-based learning methods (Smyrniou et al., 2020). With project-based learning methods learners are encouraged to freedom of thought, complex challenges, and implement ideas. So that students can apply existing ideas creatively. In addition to project-based learning methods, students also need a learning medium that can support the level of creative thinking ability (Cook, 2021; Maksum & Purwanto, 2022; Misrochah, 2021) One of the media that can be used to improve creative thinking skills such as books and LKPD. Therefore, this study recommends research methods and treatments needed to be carried out by future researchers.

Researchers recommend the use of R&D research methods by applying PJBL learning methods. This is based on the data that has been obtained in this study produces findings, namely, the absence of the use of R&D research designs and the absence of treatment using PJBL learning methods. Using project-based R&D research methods will produce a learning medium and can be used by students. So that in the learning process it will indirectly increase the ability of the level of creative thinking of students. Creating media based on PJBL syntax implemented in learning media can be in the form of e-Book, e-LKPD and others.

5. CONCLUSION

In this study, a review was conducted on publications on the topic of creative thinking skills and publications in mathematics education journals in Indonesia between 2016 and 2023. Over the past seven years, there has been an increase in the number of publications emphasizing creative thinking skills. Quantitative studies dominated the articles found. Most research subjects are in junior high schools, and the subjects that are most interesting are information related to the development of students' creative thinking abilities. The most dominant treatment used is PBL.

To better understand how to build creative thinking skills, R&D research must be carried out more often to build students' creative thinking skills that still need to be improved. Project-based R&D methods can produce practical educational products and can also develop learners' creative thinking skills.

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