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Tracing Trends in Educational Research on Creative Problem Solving: A Bibliometric Analysis (2007-2024)

Nury Yuniasih[1], Wahyu Sopandi[2], Andi Suhandi[3], Ernawulan Syaodih [4]

[1] Universitas Pendidikan Indonesia, Bandung, Indonesia; nuryyuniasih@upi.edu
[2] Universitas Pendidikan Indonesia, Bandung, Indonesia; wsopandi@upi.edu
[3] Universitas Pendidikan Indonesia, Bandung, Indonesia; andi_sh@upi.edu
[4] Universitas Pendidikan Indonesia, Bandung, Indonesia; ernawulansy@upi.edu

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ABSTRACT

Creative Problem Solving (CPS) enhances adaptability, fosters innovation, and improves productivity. However, integrating CPS in education remains challenging. This study examines trends, key themes, and gaps in CPS research within education from 2007 to 2024 through bibliometric analysis. Data was collected from Scopus due to its extensive interdisciplinary coverage and credibility in indexing peer-reviewed journals in education, psychology, and cognitive sciences. A total of 68 publications were selected based on relevance to CPS in education and journal type. The analysis focused on publication trends, thematic developments, and methodological approaches. Findings indicate that traditional curricula emphasizing rote memorization hinder CPS integration. Innovative approaches such as problem-based learning, project-based learning, and STEM education offer potential solutions. Between 2007 and 2018, research mainly explored CPS concepts. In 2019, the focus shifted towards instructional models, with 2020 marking the peak of CPS-related publications. Strategies supporting CPS development include automated assessment tools, flipped learning, and interdisciplinary approaches. Thematic analysis highlights the connection between CPS, creativity, and problem-solving. The study identifies significant advancements in CPS research, with implications for curriculum development, teacher training, and policy-making. Emerging technologies, including artificial intelligence (AI) and virtual reality (VR), show promise in expanding CPS applications in education. Future research should explore technology-enhanced CPS strategies to further enhance problem-solving skills across various educational contexts.

Corresponding Author:
Nury Yuniasih
Universitas Pendidikan Indonesia, Bandung, Indonesia; nuryyuniasih@upi.edu

1. INTRODUCTION

Creative Problem Solving (CPS) is highly relevant to the demands of the 21st century, where individuals are expected to possess the ability to solve complex and rapidly evolving problems. Creative thinking and problem-solving skills are crucial in an information era dominated by innovation and technology (Trevallion & Nischang, 2021). Modern education emphasizes non-cognitive skills such as creativity, collaboration, and communication. The CPS abilities can help students learn to think critically and find new ways to solve problems. Moreover, innovative and collaborative problem-solving is essential for addressing global challenges such as social injustice, health crises, and climate change. For example, students trained in CPS will be better equipped to participate in discussions and projects aimed at solving social and environmental issues, helping them become more responsive and responsible citizens (Tang, Vezzani, & Eriksson, 2020).

Creative Problem Solving (CPS) is a cognitive and strategic process that involves the ability to discover innovative and effective solutions to complex and unstructured problems. CPS emphasizes the development of creative thinking skills, which include the ability to generate new ideas, adapt approaches, and apply solutions across different contexts (S. Kim, Choe, & Kaufman, 2019; Puccio et al., 2020). These skills refer to an individual's capacity to address challenges or problems in innovative and effective ways. CPS is a cognitive skill that involves using creativity and critical thinking to identify solutions that may not be immediately apparent or conventional (Proctor, 2020; Treffinger, Isaksen, & Stead-Dorval, 2023). Furthermore, CPS is an ongoing process that can be strengthened through formal education. Willemsen, de Vink, Kroesbergen, & Lazonder (2024) argue that CPS not only refers to creating new solutions but also to redefining the problem itself, enabling students to identify multiple problem-solving pathways.

Research in the field of Creative Problem Solving (CPS) indicates that this skill can be taught and developed through various educational methods. Numerous studies have identified that project-based approaches and collaborative learning are particularly effective in fostering CPS among students (Chen & Chan, 2021; H.-J. Lee, Kim, & Byun, 2017). For instance, through group projects, students not only learn to generate creative solutions but also practice essential skills such as communication, negotiation, and teamwork—key components of addressing complex problems. Structured educational programs that integrate CPS elements can significantly enhance student motivation and engagement, creating dynamic and interactive learning environments. However, traditional educational practices, such as standardized curricula and conventional assessment methods, often limit the development of CPS. These practices prioritize rote learning and fixed solutions, which can stifle creativity and hinder students' ability to think critically and innovatively. Standardized tests, for example, focus more on memorization and less on creative problem-solving, making it difficult for students to engage in deeper, more meaningful learning experiences. To overcome these barriers, educators can implement more flexible curricula that encourage exploration, adaptation, and real-world problem-solving.

Moreover, there are several practical obstacles that prevent schools from fully integrating CPS into classrooms. One major challenge is the lack of resources, including access to technology, teaching materials, and time. In many schools, especially those in underfunded districts, teachers may not have the necessary tools or support to implement project-based or problem-based learning effectively. Additionally, there is often a gap in teacher training. Many educators are not adequately prepared to teach CPS abilities, as traditional teacher education programs may not emphasize creativity, critical thinking, or problem-solving strategies. This lack of professional development means that even if teachers recognize the importance of CPS, they may not have the knowledge or skills to incorporate it into their teaching practices. Furthermore, rigid curricula that focus on fixed learning outcomes can limit teachers' flexibility to engage students in innovative problem-solving activities. In such systems, the pressure to meet standardized testing requirements leaves little room for creative exploration.

Despite these challenges, research shows that students trained in CPS are better prepared to face modern life challenges, where they must continuously adapt to new technologies, evolving job demands, and complex social issues (Mumford, Martin, Elliott, & McIntosh, 2020). With strong CPS abilities, students are not only able to adjust to rapid changes around them but also contribute to innovative and relevant solutions to the problems they encounter in real life. Moreover, learning approaches centered on the development of CPS abilities, such as Problem-Based Learning (PBL) and Project-Based Learning (PjBL), have been proven effective in enhancing students' creative thinking abilities and preparing them for uncertain and challenging future situations (McCrum, 2017; Sesriani, 2022; Triyono, Senam, Jumadi, & Wilujeng, 2017). These approaches ensure that students are not only equipped with theoretical knowledge but also practical abilities to innovate and adapt to complex and rapidly changing life situations, thus preparing them for success in both school and the real world.

CPS helps students adapt to various complex life situations, highlighting the need for a supportive environment to foster their development. Factors such as teacher support, the availability of resources, and an atmosphere that encourages experimentation and risk-taking can significantly influence students' ability to think creatively. Runco (2023) explains that students who learn in an environment that is safe for experimentation are more likely to handle uncertainty and find innovative solutions. Therefore, it is crucial for educators to create classrooms that prioritize exploration and freedom of thought, allowing students to feel comfortable expressing their ideas.

Creative Problem Solving (CPS) is essential for preparing students to navigate the challenges of the 21st century, characterized by rapid change and uncertainty. By integrating CPS into the education system, students not only develop critical and creative thinking skills but also engage in innovative, collaborative, and real-world problem-solving processes. The development of these skills is supported by educational environments that encourage exploration, experimentation, and the courage to take risks. When practiced regularly, CPS equips students to address complex social, economic, and environmental challenges, fostering a generation of creative thinkers with a mindset open to change and innovation. To further this aim, this study analyzes trends in CPS research within education, focusing on key themes and challenges in its implementation. Examining publications from 2007 to 2024 identifies gaps and opportunities in current practices, providing insights for curriculum development, teacher training, and policies that support CPS integration. Additionally, the study explores how emerging technologies such as artificial intelligence (AI) and virtual reality (VR) can enhance CPS applications across various educational levels, ensuring students are well-prepared to adapt and lead in an increasingly interconnected global era.

2. METHODS

In seeking data related to "creative problem solving" (CPS) in the context of education, the researchers utilized the Scopus database due to its extensive interdisciplinary coverage, which is particularly relevant for CPS research in education. Scopus indexes a wide range of peer-reviewed journals across fields such as education, psychology, and cognitive sciences—disciplines that are central to understanding and advancing CPS. The systematic review and bibliometric analysis methods were chosen for this study as they provide a comprehensive approach to identify trends, key themes, and gaps in CPS research within education. This approach allows for a thorough exploration of the field, highlighting important developments and offering insights into the evolution of CPS in educational settings. By combining these methods, the researchers aimed to offer a detailed overview of CPS research, helping to map the trajectory of CPS studies and pinpoint areas that require further investigation. The data obtained were analyzed using systematic literature review techniques (Siddaway, Wood, & Hedges, 2019). The following are the steps taken by the researchers in conducting the literature review.

Figure 1. Systematic of the review process

1) Identification
   The first step is the identification process, where the researchers input keywords into the Scopus database search. By searching titles with the keywords (educational AND research AND on AND creative AND problem AND solving), a total of 440 articles were retrieved. Only English-language publications were included to focus on globally recognized research, and document type was restricted to journal articles to ensure academic rigor and relevance. These filters helped narrow the results to the most pertinent studies for analysis.
2) Screening
   The next step is the screening process, where the researchers filtered the results based on predetermined criteria. The screening criteria included the keywords: "Education," "Creative Problem-solving," and "Creative Problem Solving." The choice of these specific keywords was guided by the need to capture a broad yet relevant range of publications on CPS in education. The researchers used Boolean operators such as "AND" to combine keywords, ensuring that only articles containing all the relevant terms were included in the search. The inclusion of both "Creative Problem-solving" and "Creative Problem Solving" as separate criteria was intentional, as these variations account for differences in terminology and ensure that both forms of the term are represented in the search results. From this screening process, 89 publications met the specified criteria, while 351 publications were excluded for not meeting the predetermined requirements..
3) Eligibility
   During the eligibility process, the researchers manually assessed the publications deemed suitable for inclusion. They evaluated the abstracts and titles of the 89 publications to ensure their relevance to the topic of CPS in the educational context. Publications that did not focus on educational settings or those that were not directly related to creative problem solving were excluded. Additionally, only empirical studies, as opposed to purely theoretical works, were included to ensure the research had practical applicability. At the end of this phase, 76 publications were considered eligible and relevant for inclusion in the next stage. This step was critical to ensure that the selected studies contributed meaningful insights into CPS within education.
4) Inclusion
   The final stage is the inclusion process, where the publications deemed eligible in the previous phase are evaluated in greater depth. The researchers examined the full content of the 76 publications to ensure alignment with the research focus on CPS in the educational context. During this phase, the researchers specifically looked for studies that included empirical results, were methodologically rigorous, and provided substantial insights into CPS practices within educational settings. They also considered the citation impact of the studies as an indicator of their influence in the field. By the end of this stage, 68 publications met the criteria for inclusion in the bibliometric analysis. This careful selection ensured that the final pool of publications represented high-quality, impactful research on CPS in education.

The final results of this analysis reveal several key criteria, including publication trends, citation trends, visualizations using VOSviewer, and a synthesis of educational research articles. First, the publication trend indicates an increase in the number of articles published in recent years, with a primary focus on CPS topics. Second, the analysis of citation trends shows that several articles garnered significant attention, evidenced by high citation counts, indicating their impact on the advancement of research in the field of CPS. Third, the visual results produced by VOSviewer illustrate the network of relationships among variables to uncover

research novelties. The researchers analyzed several aspects of the publications in detail, including publication type (e.g., empirical vs. theoretical studies), research methodology (qualitative, quantitative, or mixed methods), and specific findings related to CPS in educational contexts. This in-depth analysis helped identify key themes and trends, as well as gaps in the existing body of research. Lastly, the synthesis of research articles provides an overview of CPS in educational research while highlighting existing research gaps and offering recommendations for future studies in the educational context. Thus, this analysis not only reflects recent developments in educational research but also guides the direction of future research endeavors.

3. FINDINGS AND DISCUSSION

The data on educational research publications related to creative problem solving, collected through analysis from Scopus, resulted in 68 publications spanning from 2007 to 2024. Subsequently, a descriptive bibliometric analysis was conducted, including publication trends, citation trends, visualizations using VOSviewer, and a synthesis of publications with the highest citations each year. The following are the results of the analysis.

3.1 Publication Trends

The trends in CPS publications, particularly in educational research from 2007 to 2024, are represented by a total of 68 publications. After categorizing them by year of publication, the results are illustrated in Figure 2 below..

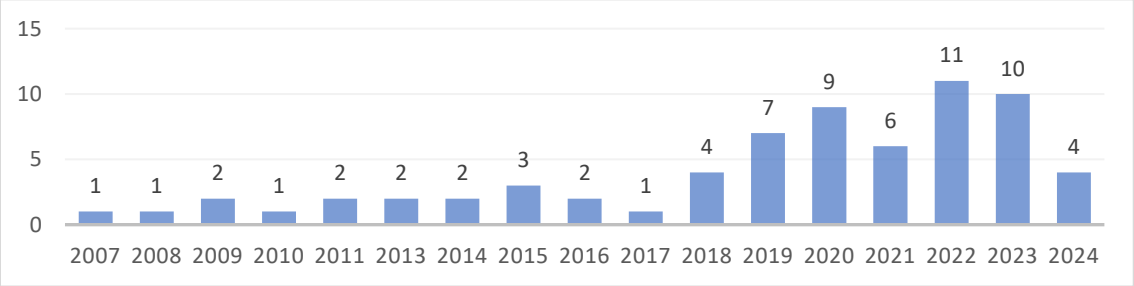

Figure 2. Publication Trends (2007-2024)

Based on Figure 2, the publication trends from 2007 to 2024 indicate that the highest number of publications occurred in 2022, with a total of 11 publications. Overall, the trend in CPS publications within educational research has shown an increase, although a decline was observed in 2024. These results reflect a growing interest in the topic of CPS, particularly in the educational context, in response to the demand for CPS abilities in the modern era. This suggests that CPS has become a key focus in educational research, aligned with the increasing need to prepare students to face the complex and dynamic challenges of the 21st century. The emphasis on CPS in educational research indicates that educators and researchers are becoming increasingly aware of its vital role in equipping students to think critically, creatively, and adapt to change. This signifies that CPS is not merely a trend but an essential educational requirement that must be addressed to meet future challenges (S.-W. Kim & Lee, 2022; Tan, 2021).

3.2 *Citation Trends*

The citation trends for CPS publications, particularly in educational research from 2007 to 2024, are categorized by year and are presented in Figure 3 below.

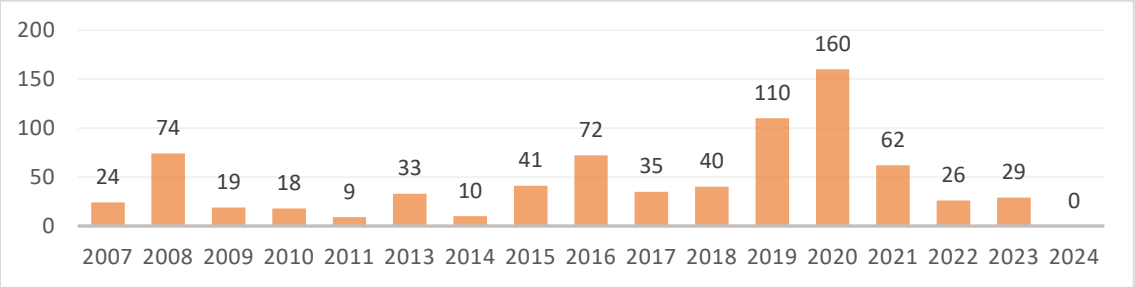

Figure 3. Citation Trends (2007-2024)

Based on Figure 3, the citation trends from 2007 to 2024 indicate that the highest number of citations occurred in 2020, with a total of 160 citations. Overall, the citation trend for CPS in educational research has experienced a decline over the last five years. This decline may be attributed to shifts in research focus or the emergence of new themes that are more relevant to the advancements in technology and education in the digital era. Nevertheless, earlier works on CPS still demonstrate significant influence, indicating that this topic remains relevant in academic discussions and the development of CPS abilities among educators. The decrease in citation counts also reflects the need for new, more contextual approaches to maintain the relevance of CPS in future educational research. This presents a challenge for researchers to innovate and align their studies with the evolving needs and dynamics of education, ensuring that CPS continues to be a critical focus in curriculum development and teaching methods (Ferrari, Cachia, & Punie, 2009).

3.3 *Visualization Results Using VOSviewer*

The following section presents an analysis of trends, visualizations, and a synthesis of influential publications related to Creative Problem Solving (CPS) in education. It includes an overview of publication and citation trends, insights from VOSviewer visualizations, and a summary of key research themes identified through bibliometric analysis. This analysis aims to highlight the evolution of CPS research and identify areas for future exploration, providing valuable insights for educators and researchers. The visualization results obtained using VOSviewer were derived by establishing a threshold based on titles and abstracts through a binary counting method. From this analysis, a total of 1,498 terms were identified, which were subsequently limited to a threshold of 13 terms. Further refinement was applied to retain 60% of these terms, resulting in 8 terms that are displayed in the following visualization.

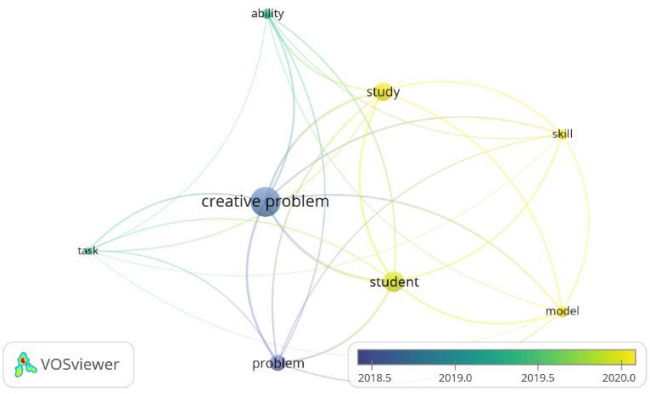

Figure 4. Visualization Results Using VOSviewer

In Figure 4, the visualization demonstrates several different colors representing research clusters related to CPS in education. Three clusters have been identified: The blue cluster, the largest of the three, is the most dominant research area. It primarily focuses on the relationship between "creative problem" and "problem," reflecting a broad interest in understanding how creativity and problem-solving intersect. This cluster suggests that a substantial amount of research is focused on conceptualizing and applying CPS to various problems. The yellow cluster, though smaller than the blue, shows a significant shift in focus towards "student," "study," "skill," and "model." This cluster represents an emerging interest in developing CPS as a skill and a model that can be taught and applied in educational settings. Research in this area seeks to explore how CPS can be incorporated into learning models and how students can develop specific skills necessary for creative problem-solving. The green cluster, the smallest, indicates an underexplored area in CPS research. This cluster is concerned with the relationship between CPS and "ability" and "task," areas that have not yet received as much attention. This gap presents an opportunity for future research to investigate which specific abilities are required for successful CPS and how tasks can be designed to enhance these abilities. Overall, this visualization provides an overview of the distribution and focus of CPS research, highlighting key trends and areas for further exploration.

The visualization results show that in 2018, research on Creative Problem Solving (CPS) has primarily focused on problems and creative problem-solving, reflecting a strong interest in understanding the relationship between creativity and problem-solving in general. This cluster indicates that a significant portion of the research is dedicated to conceptualizing and applying CPS to various types of problems. Studies during this period mainly explored how CPS could be utilized to generate innovative solutions to complex challenges. (Lewis, Knoblich, & Poe, 2018) . In 2019, the research focus shifted from merely examining creative problems to exploring tasks and abilities related to creative problem-solving. This period marked a growing interest in understanding how individuals develop the skills necessary for creative problem-solving in specific contexts. It reflects a shift toward exploring not only the general application of CPS but also how individuals can develop specific abilities that contribute to success in completing particular tasks (Royston & Reiter-Palmon, 2019). In 2020, the focus of research shifted towards innovating CPS models aimed at improving students' skills, especially in solving problems creatively. During this period, researchers began developing and testing various new learning models that not only emphasized problem-solving but also systematically and strategically strengthened students' creative thinking skills. Research during this year delved deeper into the skills needed for creative problem-solving, such as divergent and convergent thinking abilities, and how these skills could be enhanced through various educational approaches (Wigert, Murugavel, & Reiter-Palmon, 2022). This trend indicates an increased focus on more measurable, skill-based learning approaches, where teachers and educators can identify and develop students' CPS abilities for specific tasks. Additionally, research during this period opened up opportunities for the use of more focused skill assessments to measure the effectiveness of CPS approaches in more practical and structured learning contexts (Kamila Urban & Urban, 2023).

The new information reveals that many studies still focus on the relationship between CPS and creative problem-solving (Abdulla & Cramond, 2018). This indicates that, despite the contributions made, there is still room for further research. Additionally, although smaller, there is increasing attention to the connections between CPS and students, studies, skills, and models. Research has developed CPS both as a skill and as a model, with studies demonstrating that CPS learning models can enhance specific abilities (Fathonah et al., 2023). However, the smallest cluster indicates that the relationship between CPS and abilities and tasks remains underexplored. Therefore, there are opportunities for new research that can help identify specific skills that support CPS and contribute to the development of new competencies. These results suggest that researchers should shift their focus, create novel approaches, and investigate themes that are more relevant.

3.4 Synthesis of Publications with Highest Citations Each Year

This section presents a synthesis of the most highly cited publications from 2007 to 2024, focusing on trends, visualizations, and key findings that have shaped the research landscape in Creative Problem Solving (CPS). The selected publications were chosen based on their citation count, with 17 studies being included in this synthesis. These influential studies provide valuable insights into the evolution of CPS research, highlighting emerging themes, methodologies, and practical applications. The synthesis aims to provide a comprehensive overview of the major developments in CPS research, examining the different strategies used to foster creative problem-solving skills in educational contexts. Through a careful analysis of these studies, common trends, challenges, and innovative teaching methods such as problem-based learning (PBL), project-based learning (PjBL), STEM education, and collaborative learning are identified. Moreover, the integration of social-emotional learning and metacognitive strategies in CPS development is explored, and the implications for future research and practice are discussed.

Table 1. Synthesis of publications that have high citations per year 2007-2024

No	Authors	Title	Synthesis
1	Willemsen, de Vink, Kroesbergen, & Lazonder (2024)	Strengthening Creative Problem-Solving within Upper-Elementary Science Education	This study focuses on two specific techniques: random association and identification of constraints, which are integrated into five inquiry-based science lessons. The results indicate that all participating students experienced an improvement in convergent thinking overall, particularly those with stronger mathematical abilities. However, no significant improvement was observed in divergent thinking, nor were there additional benefits from the instructional support provided. This suggests that the techniques employed may be less suitable for elementary school students, warranting further research to validate these findings. The study highlights the potential for developing convergent thinking and recommends that simple exercises targeting both divergent and convergent thinking could be beneficial for teachers.
2	Urban & Urban (2023)	How can we measure metacognition in creative problem-solving? Standardization of the MCPS scale	This study demonstrates that the MCPS scale can be utilized in research to gain a deeper understanding of the relationship between metacognition and creativity, as well as in education to assist students in developing their metacognitive skills within the context of problem-solving.
3	S.-W. Kim & Lee, (2022)	Developing Students' Attitudes toward Convergence and Creative Problem Solving through Multidisciplinary Education in Korea	This study involved 50 high school students who received a convergence education program known as SMICE (Science, Mathematics, Informatics Convergence Education) compared to students who received general software education. The results indicated that students participating in the SMICE program demonstrated significantly greater improvements in Attitude toward Critical Thinking (ATC) and Creative Problem Solving (CPS) than their counterparts. Additionally, the article develops a multidisciplinary education model that has proven effective when implemented in the classroom. This study supports the importance of education that integrates various disciplines to prepare students for the complex challenges of the future.
4	Hsia, Lin, & Hwang (2021)	A creative problem solving-based flipped learning strategy for	This study demonstrates that students participating in the flipped learning strategy exhibited significant improvements in their performative creativity, as well as in creative thinking

		promoting students' performing creativity, skills and tendencies of creative thinking and collaboration	skills and collaborative tendencies, compared to those engaged in conventional learning. The research suggests that integrating creative problem solving into flipped learning can be an effective strategy for enhancing students' creative and collaborative thinking abilities. This approach can be adapted to various learning contexts to facilitate the development of students' creative skills.
5	Puccio et al., (2020)	Creative Problem Solving in Small Groups: The Effects of Creativity Training on Idea Generation, Solution Creativity, and Leadership Effectiveness	This study reveals that the group receiving creativity training generated more ideas compared to the control group. The solutions produced by the trained group were found to be more creative and innovative than those from the control group. Additionally, the training positively impacted the effectiveness of leadership within the groups. Leaders in the trained groups demonstrated enhanced abilities to facilitate the problem-solving process and encourage participation among group members.
6	S. Kim et al (2019)	The development and evaluation of the effect of creative problem-solving program on young children's creativity and character	This study demonstrates that the developed creative problem-solving program positively impacts children's character development, including improvements in aspects such as empathy, cooperation, and perseverance. These effects were assessed through behavioral evaluations and feedback from teachers and parents.
7	Nonthamand & Songkhla (2018)	The correlation of open learning, collaboration, learning tools, and creative problem solving by graduate students in Thailand	This study indicates that open learning, collaboration, and the use of appropriate learning tools can enhance creative problem-solving among graduate students. The article recommends the integration of open learning methods and collaborative-supporting tools into educational programs to develop students' creative skills. Additionally, the use of learning tools is linked to creative problem-solving. Tools that facilitate access to information and interaction can enhance students' creative abilities.
8	McCrum (2017)	Evaluation of creative problem-solving abilities in undergraduate structural engineers through interdisciplinary problem-based learning	Penelitian ini menunjukkan bahwa pendekatan pembelajaran berbasis masalah interdisipliner dapat secara signifikan meningkatkan kemampuan pemecahan masalah kreatif di kalangan mahasiswa teknik struktural. Artikel ini merekomendasikan penggunaan metode ini dalam kurikulum pendidikan teknik untuk mempersiapkan mahasiswa menghadapi tantangan kompleks di dunia profesional.
9	Dumas, Schmidt, & Alexander, (2016)	Predicting creative problem solving in engineering design	This study demonstrates that an interdisciplinary problem-based learning approach can significantly enhance creative problem-solving skills among structural engineering students. The article recommends the incorporation of this method into engineering education curricula to better prepare students for the complex challenges they will face in the professional world.
10	Scherer & Gustafsson, (2015)	The relations among openness, perseverance, and performance in creative problem solving: A substantive-methodological approach	This study indicates that both openness and perseverance are essential for success in creative problem-solving. The article suggests that education and training should focus on the development of these two attributes to enhance creative problem-solving abilities.

11	Katz-Buonincontro & Ghosh (2014)	Using workplace experiences for learning about affect and creative problem solving: Piloting a four-stage model for management education	This study demonstrates that using workplace experiences as a foundation for understanding the impact of emotions on creative problem-solving can enhance the effectiveness of management education. The article recommends the integration of this model into management curricula to improve participants' creative and managerial skills.
12	Morral, Palmon, & Kaufman (2013)	The interactive effects of self-perceptions and job requirements on creative problem solving	This study indicates that self-perception and job requirements interact to influence creative problem-solving abilities. Individuals with a positive self-perception of their creative abilities tend to be more effective in addressing creative problems, particularly when job requirements demand a high level of creativity. High self-perception can enhance performance in situations with demanding creativity requirements. Conversely, low self-perception can hinder creative performance, especially in scenarios that require innovative solutions.
13	Sak (2011)	Selective Problem Solving (sps): A Model for Teaching Creative Problem-Solving	This study demonstrates that the integration of the SPS model can be employed to enhance students' skills in selecting and applying effective and creative problem-solving strategies when faced with complex issues.
14	Cho & Lin (2010)	Influence of family processes, motivation, and beliefs about intelligence on creative problem solving of scientifically talented individuals	This research highlights the significance of family support and processes in the development of scientific creativity. Creating a supportive family environment can enhance creative problem-solving skills in gifted individuals. Furthermore, education and training should focus on enhancing intrinsic motivation and developing a growth mindset to maximize creative potential in problem-solving.
15	Kandemir & Gür, (2009)	The use of creative problem solving scenarios in mathematics education: views of some prospective teachers	This research recommends enhancing training for prospective teachers on how to design and utilize creative problem-solving scenarios. The provision of additional resources and support is also suggested to facilitate implementation. Furthermore, the integration of creative problem-solving scenarios into the mathematics education curriculum can enhance students' problem-solving skills and creativity.
16	Wang, Chang, & Li (2008)	Assessing creative problem-solving with automated text grading	This research demonstrates that an automated assessment system can be integrated into the educational context to evaluate students' creative problem-solving skills more efficiently. This can assist teachers and educators in providing quicker and more accurate feedback.
17	Lee, Bain, & McCallum (2007)	Improving creative problem-solving in a sample of third culture kids	This research indicates that TCK (Third Culture Kids) children show significant improvement in creative problem-solving skills after participating in an intervention program. They become more effective in generating creative ideas and solving problems. The program also assists children in overcoming cultural adaptation challenges, enabling them to leverage their cross-cultural experiences as strengths in the creative process.

The synthesis of highly cited publications in CPS reveals a range of themes and methodologies that have shaped the field over time. Studies have consistently emphasized the importance of various teaching methods for fostering CPS abilities, with a particular focus on problem-based learning (PBL), project-based learning (PjBL), STEM education, and collaborative learning., inquiry-based learning, social-emotional learning, self-reflection, and metacognition. In problem-based learning, students are trained to generate multiple possible

solutions, using creativity to overcome existing limitations (Handoyo, Rosbiono, & Sopandi, 2021; Kartikasari & Yurniwati, 2024; McCrum, 2017; Sak, 2011). In project-based and STEM learning, students are given the opportunity to manage projects independently or in groups, exploring various solutions and integrating creative ideas throughout the planning and implementation process (Nehru, Purwaningsih, Riantoni, & Novallyan, 2024). PjBL and STEM combine creativity, collaboration, and decision-making, thus providing students with the space to innovate while developing critical thinking skills (Anazifa & Djukri, 2017; Hajar, Milfayetty, & Damanik, 2023; Nazzal & Kaufman, 2020; Wibowo, Suhandi, & Harjoto, 2013). In collaborative learning, when working in groups, students benefit from collective thinking, allowing them to explore various perspectives. The discussion and collaboration process expands creative and innovative thinking abilities, as students must find ways to solve problems together (Hsia et al., 2021; Kai Wen, 2011; Maulana et al., n.d.). In inquiry-based learning, students are trained to think independently, explore various possible solutions, and question existing assumptions. This approach encourages students to conduct in-depth explorations of problems and create new, creative solutions based on their findings and analyses (Karamustafaoğlu & Pektaş, 2023). In social-emotional learning, this approach integrates social skills such as teamwork, empathy, and communication with CPS, encouraging students to think creatively while interacting with others and solving problems collaboratively (Cho & Lin, 2010; Politis & Houtz, 2015; Reffiane, Kristyaningrum, & Winarto, 2023). In self-reflection and metacognition, by reflecting on their own thinking processes, students can enhance their CPS abilities through the improvement of creative thinking strategies in the future (K Urban & Urban, 2023). This indicates that CPS is a ability that can be trained and enhanced through the use of innovative learning approaches.

Creative Problem-Solving abilities can be cultivated through various innovative learning approaches, including problem-based learning, project-based learning, STEM education, collaborative learning, inquiry-based learning, social-emotional learning, and self-reflection. These methods underscore the importance of diverse teaching strategies. For instance, project-based learning and STEM not only foster creativity and collaboration but also enhance students' abilities to work together effectively (Akhmad, Masrukhi, & Indiatmoko, 2020). Collaborative learning highlights the value of group discussions in developing creative thinking from multiple perspectives, while inquiry-based learning emphasizes the significance of independent thinking and deep exploration in discovering new solutions (Marcos, Fernández, González, & Phillips-Silver, 2020). Additionally, social-emotional learning can bolster CPS by improving interpersonal and communication skills (Katz-Buonincontro & Ghosh, 2014). Metacognition and self-reflection also play vital roles in refining strategies for creative problem solving (K Urban & Urban, 2023).

Despite its benefits, the implementation of CPS in schools often faces challenges due to traditional curricula that prioritize memorization and linear content delivery (Tan, 2021). Such rigid curricula limit students' flexibility to explore new ideas. Resource constraints, including insufficient teacher training and inadequate facilities, further complicate these challenges. To address these issues, educators should focus on enhancing professional development in project-based learning (PBL) methods and gradually adjusting curricula to incorporate creative projects and STEM learning. Creating a classroom environment that encourages exploration will help students feel more comfortable expressing their ideas and experimenting with innovative solutions, ultimately enriching their learning experiences and preparing them for complex real-world challenges (Calavia, Blanco, & Casas, 2021).

The practical implementation of CPS methods has been successfully applied across various educational levels, from elementary to higher education. For instance, research by Willemsen et al., (2024) demonstrated that Problem-Based Learning (PBL) in elementary science lessons enhances students' convergent thinking skills, though adjustments are needed to foster divergent thinking. In secondary schools, Project-Based Learning (PjBL), as seen in Korea's SMICE program, significantly improved students' attitudes toward critical thinking and CPS by engaging them in collaborative projects that sharpened their creative thinking and problem-solving abilities. At the higher education level, McCrum, (2017) research on collaborative STEM

approaches revealed significant improvements in creative problem solving abilities among structural engineering students, who learned to work together and develop solutions for complex technical problems. These examples provide practical recommendations for educators on effectively implementing CPS in the classroom and designing curricula that support skill development.

For future research, there are several areas that require further exploration. One notable gap is the investigation of specific abilities required for successful CPS, especially in relation to tasks and challenges. Future studies should explore how different educational contexts influence the development of CPS abilities and examine how technologies like artificial intelligence (AI), virtual reality (VR), and augmented reality (AR) can enhance the CPS process. Additionally, research on the integration of social-emotional learning and metacognitive strategies with CPS is still underdeveloped and warrants further attention (Frank, 2024; Serrano-Ausejo & Mårell-Olsson, 2024). Furthermore, global collaboration through digital platforms can enrich CPS by providing diverse perspectives from different cultures. New approaches like design thinking, metacognitive strategies, and mindfulness also have the potential to further support students in understanding their creative thinking processes (von Thienen, Weinstein, & Meinel, 2023). To reinforce these innovations, comprehensive CPS evaluation methods are needed, such as portfolio-based assessments or direct observations, to better capture cognitive processes (Rafner et al., 2022). With these technologies and new approaches, future CPS research will increasingly support education in addressing the challenges of the digital age (Bereczki & Kárpáti, 2021).

4. CONCLUSION

Creative Problem Solving is becoming more important in education, helping students develop skills to tackle complex challenges. An analysis of research trends from 2007 to 2024 shows that interest in CPS has been growing, with the most publications in 2022 and the highest citations in 2020. This increase reflects the growing recognition of CPS in education. The VOSviewer visualizations reveal a strong focus on CPS and its connection to creative problem-solving, suggesting future research should look into specific skills like divergent thinking and collaboration that support CPS. However, challenges such as rigid curricula still limit the use of CPS in schools. To overcome these, approaches like problem-based learning, project-based learning, STEM education, and collaborative learning can be used to encourage creativity and better prepare students for the future. While bibliometric analysis is useful for understanding trends, it has limitations, such as potential bias from relying on just one database. To gain deeper insights, combining this method with qualitative research would be helpful. In the future, emerging technologies like artificial intelligence (AI), virtual reality (VR), and augmented reality (AR) could be used to enhance CPS by offering more interactive learning experiences. Research could explore how these technologies help develop CPS abilities, using methods like case studies or experiments. In conclusion, while CPS is increasingly important in education, overcoming challenges like traditional curricula and exploring new skills and technologies will be key to advancing CPS research. More comprehensive evaluation methods will also be needed to better understand how students develop creative thinking skills.

REFERENCES

Abdulla, A. M., & Cramond, B. (2018). The creative problem finding hierarchy: A suggested model for understanding problem finding. *Creativity*, *5*(2), 197–229. https://doi.org/10.1515/ctra-2018-0019

Akhmad, Y., Masrukhi, M., & Indiatmoko, B. (2020). The effectiveness of the integrated project-based learning model STEM to improve the critical thinking skills of elementary school students. *Educational Management*, *9*(1), 9–16.

Anazifa, R. D., & Djukri, D. (2017). Project-based learning and problem-based learning: Are they effective

to improve student's thinking skills? *Jurnal Pendidikan IPA Indonesia*, *6*(2), 346–355.
Bereczki, E. O., & Kárpáti, A. (2021). Technology-enhanced creativity: A multiple case study of digital technology-integration expert teachers' beliefs and practices. *Thinking Skills and Creativity*, *39*, 100791.
Calavia, M. B., Blanco, T., & Casas, R. (2021). Fostering creativity as a problem-solving competence through design: Think-Create-Learn, a tool for teachers. *Thinking Skills and Creativity*, *39*, 100761.
Chen, P., & Chan, Y.-C. (2021). Enhancing Creative Problem Solving in Postgraduate Courses of Education Management Using Project-Based Learning. *International Journal of Higher Education*, *10*(6), 11. https://doi.org/10.5430/ijhe.v10n6p11
Cho, S., & Lin, C. Y. (2010). Influence of family processes, motivation, and beliefs about intelligence on creative problem solving of scientifically talented individuals. *Roeper Review*, *33*(1), 46–58. https://doi.org/10.1080/02783193.2011.530206
Dumas, D., Schmidt, L. C., & Alexander, P. A. (2016). Predicting creative problem solving in engineering design. *Thinking Skills and Creativity*. Retrieved from https://www.sciencedirect.com/science/article/pii/S1871187116300219
Fathonah, S., Cahyono, E., Iswari, R. S., Haryani, S., Sarwi, S., Lestari, N. H., & Kadarwati, S. (2023). Effects of multirepresentation-based creative problem-solving learning model on students' critical thinking and diet nutritional quality. *Journal of Turkish Science Education*, *20*(4), 669–694. https://doi.org/10.36681/tused.2023.038
Ferrari, A., Cachia, R., & Punie, Y. (2009). Innovation and creativity in education and training in the EU member states: Fostering creative learning and supporting innovative teaching. *JRC Technical Note*, *52374*, 64.
Frank, E. (2024). *The Influence of Artificial Intelligence on Education: Enhancing Personalized Learning Experiences*.
Hajar, I., Milfayetty, S., & Damanik, U. A. (2023). The Development of a Locally-Based Virtual Gallery Grounded in Folklore Wisdom for Enhancing Creative Thinking Skills at Sekolah Alam. *AL-ISHLAH: Jurnal Pendidikan*, *15*(4), 5776–5787.
Handoyo, R. F., Rosbiono, M., & Sopandi, W. (2021). Building students' creative thinking skills using problem-based learning in handling staple food waste. *Journal of Educational Sciences*, *5*(1), 89–103.
Hsia, L. H., Lin, Y. N., & Hwang, G. J. (2021). A creative problem solving-based flipped learning strategy for promoting students' performing creativity, skills and tendencies of creative thinking and collaboration. *British Journal of Educational Technology*, *52*(4), 1771–1787. https://doi.org/10.1111/bjet.13073
Kai Wen, C. (2011). When creative problem solving strategy meets web-based cooperative learning environment in accounting education. *New Horizons in Education*, *59*(1), 106–118.
Kandemir, M. A., & Gür, H. (2009). The use of creative problem solving scenarios in mathematics education: views of some prospective teachers. *Procedia-Social and Behavioral Sciences*. Retrieved from https://www.sciencedirect.com/science/article/pii/S1877042809002894
Karamustafaoğlu, O., & Pektaş, H. M. (2023). Developing students' creative problem solving skills with inquiry-based STEM activity in an out-of-school learning environment. *Education and Information Technologies*, *28*(6), 7651–7669. https://doi.org/10.1007/s10639-022-11496-5
Kartikasari, & Yurniwati, Y. (2024). *The Impact Project Based Learning of Animation-Assisted Videos on the Capability for Creative Thinking in Light of Self Efficacy*. *7*(2), 2837–2848. https://doi.org/10.31949/jee.v7i2.9305
Katz-Buonincontro, J., & Ghosh, R. (2014). Using workplace experiences for learning about affect and creative problem solving: Piloting a four-stage model for management education. *International Journal of Management Education*, *12*(2), 127–141. https://doi.org/10.1016/j.ijme.2014.03.003

Kim, S.-W., & Lee, Y. (2022). Developing Students' Attitudes toward Convergence and Creative Problem Solving through Multidisciplinary Education in Korea. *Sustainability (Switzerland)*, *14*(16). https://doi.org/10.3390/su14169929

Kim, S., Choe, I., & Kaufman, J. C. (2019). The development and evaluation of the effect of creative problem-solving program on young children's creativity and character. *Thinking Skills and Creativity*. Retrieved from https://www.sciencedirect.com/science/article/pii/S1871187118302748

Lee, H.-J., Kim, H., & Byun, H. (2017). Are high achievers successful in collaborative learning? An explorative study of college students' learning approaches in team project-based learning. *Innovations in Education and Teaching International*, *54*(5), 418–427.

Lee, Y. J., Bain, S. K., & McCallum, R. S. (2007). Improving creative problem-solving in a sample of third culture kids. *School Psychology International*, *28*(4), 449–463. https://doi.org/10.1177/0143034307084135

Lewis, P. A., Knoblich, G., & Poe, G. (2018). How memory replay in sleep boosts creative problem-solving. *Trends in Cognitive Sciences*. Retrieved from https://www.sciencedirect.com/science/article/pii/S1364661318300706

Marcos, R. I. S., Fernández, V. L., González, M. T. D., & Phillips-Silver, J. (2020). Promoting children's creative thinking through reading and writing in a cooperative learning classroom. *Thinking Skills and Creativity*, *36*, 100663.

Maulana, D., Suhandi, A., Syaodih, E., Maftuh, B., Handayani, H., & Samsudin, A. (n.d.). *The effect of creative-collaborative problem solving to enhance cognitive ability and creative thinking skills in term of facilitating pre-service primary teachers' solving thermal problems*.

McCrum, D. P. (2017). Evaluation of creative problem-solving abilities in undergraduate structural engineers through interdisciplinary problem-based learning. *European Journal of Engineering Education*, *42*(6), 684–700. https://doi.org/10.1080/03043797.2016.1216089

Morral, E. J. R., Palmon, R. R., & Kaufman, J. C. (2013). The interactive effects of self-perceptions and job requirements on creative problem solving. *Journal of Creative Behavior*, *47*(3), 200–214. https://doi.org/10.1002/jocb.31

Mumford, M. D., Martin, R., Elliott, S., & McIntosh, T. (2020). Creative Failure: Why Can't People Solve Creative Problems. *Journal of Creative Behavior*, *54*(2), 378–394. https://doi.org/10.1002/jocb.372

Nazzal, L. J., & Kaufman, J. C. (2020). The relationship of the quality of creative problem solving stages to overall creativity in engineering students. *Thinking Skills and Creativity*, *38*, 100734. https://doi.org/10.1016/j.tsc.2020.100734

Nehru, N., Purwaningsih, S., Riantoni, C., & Novallyan, D. (2024). Energizing Education: Fostering Interactive Engagement in Basic Electronics through STEM-Project Based Learning. *AL-ISHLAH: Jurnal Pendidikan*, *16*(1), 630–639.

Nonthamand, N., & Songkhla, J. N. (2018). The correlation of open learning, collaboration, learning tools, and creative problem solving by graduate students in Thailand. *International Journal of Emerging Technologies in Learning*, *13*(9), 280–289. https://doi.org/10.3991/ijet.v13i09.7835

Politis, J., & Houtz, J. C. (2015). Effects of Positive Mood on Generative and Evaluative Thinking in Creative Problem Solving. *SAGE Open*, *5*(2). https://doi.org/10.1177/2158244015592679

Proctor, T. (2020). Creative problem-solving techniques, paradigm shift and team performance. *Team Performance Management: An International …*. https://doi.org/10.1108/TPM-06-2020-0049

Puccio, G. J., Burnett, C., Acar, S., Yudess, J. A., Holinger, M., & Cabra, J. F. (2020). Creative Problem Solving in Small Groups: The Effects of Creativity Training on Idea Generation, Solution Creativity, and Leadership Effectiveness. *Journal of Creative Behavior*, *54*(2), 453–471. https://doi.org/10.1002/jocb.381

Rafner, J., Biskjær, M. M., Zana, B., Langsford, S., Bergenholtz, C., Rahimi, S., … Sherson, J. (2022). Digital games for creativity assessment: Strengths, weaknesses and opportunities. *Creativity Research*

Journal, *34*(1), 28–54.
Reffiane, F., Kristyaningrum, D. H., & Winarto, W. (2023). Improving Creative Thinking Problem Solving and Communication Skills of Prospective Teachers through Ethnoscience Learning in a Basic Science Concepts Course. *AL-ISHLAH: Jurnal Pendidikan*, *15*(3), 3538–3550.
Royston, R., & Reiter-Palmon, R. (2019). Creative self-efficacy as mediator between creative mindsets and creative problem-solving. *Journal of Creative Behavior*, *53*(4), 472–481. https://doi.org/10.1002/jocb.226
Runco, M. A. (2023). Divergent Thinking as Creative Cognition. *The Routledge International Handbook of Creative Cognition*, 3–16.
Sak, U. (2011). Selective Problem Solving (sps): A Model for Teaching Creative Problem-Solving. *Gifted Education International*, *27*(3), 349–357. https://doi.org/10.1177/026142941102700310
Scherer, R., & Gustafsson, J. E. (2015). The relations among openness, perseverance, and performance in creative problem solving: A substantive-methodological approach. *Thinking Skills and Creativity*. Retrieved from https://www.sciencedirect.com/science/article/pii/S1871187115300055
Serrano-Ausejo, E., & Mårell-Olsson, E. (2024). Opportunities and challenges of using immersive technologies to support students' spatial ability and 21st-century skills in K-12 education. *Education and Information Technologies*, *29*(5), 5571–5597.
Sesriani, Y. (2022). The Effect of Models Creative Problem Solving and Problem Based Learning to Improvability Problem Solving Students. *JMEA: Journal of Mathematics Education and …*. Retrieved from http://jurnal.umsu.ac.id/index.php/mtika/article/view/9169
Siddaway, A. P., Wood, A. M., & Hedges, L. V. (2019). How to do a systematic review: a best practice guide for conducting and reporting narrative reviews, meta-analyses, and meta-syntheses. *Annual Review of Psychology*, *70*(1), 747–770.
Tan, O.-S. (2021). *Problem-based learning innovation: Using problems to power learning in the 21st century*. Gale Cengage Learning.
Tang, T., Vezzani, V., & Eriksson, V. (2020). Developing critical thinking, collective creativity skills and problem solving through playful design jams. *Thinking Skills and Creativity*, *37*, 100696.
Treffinger, D. J., Isaksen, S. G., & Stead-Dorval, K. B. (2023). *Creative problem solving: An introduction*. Routledge.
Trevallion, D., & Nischang, L. C. (2021). The creativity revolution and 21 st century learning. *International Journal of Innovation, Creativity and Change*, *15*(8), 1–25.
Triyono, T., Senam, S., Jumadi, J., & Wilujeng, I. (2017). The Effects of Creative Problem Solving-based Learning Towards Students' Creativities. *Jurnal Kependidikan: Penelitian Inovasi Pembelajaran*, *1*(2), 229040.
Urban, K, & Urban, M. (2023). How can we measure metacognition in creative problem-solving? Standardization of the MCPS scale. *Thinking Skills and Creativity*, *49*. https://doi.org/10.1016/j.tsc.2023.101345
Urban, Kamila, & Urban, M. (2023). How can we measure metacognition in creative problem-solving? Standardization of the MCPS scale. *Thinking Skills and Creativity*, *49*(June), 101345. https://doi.org/10.1016/j.tsc.2023.101345
von Thienen, J. P. A., Weinstein, T. J., & Meinel, C. (2023). Creative metacognition in design thinking: exploring theories, educational practices, and their implications for measurement. *Frontiers in Psychology*, *14*, 1157001.
Wang, H. C., Chang, C. Y., & Li, T. Y. (2008). Assessing creative problem-solving with automated text grading. *Computers &Education*. Retrieved from https://www.sciencedirect.com/science/article/pii/S0360131508000341
Wibowo, F. C., Suhandi, A., & Harjoto, B. (2013). The implementation of model project creative learning (PCL) for developing creative thinking skills concept of electricity magnet. *JURNAL PENDIDIKAN*

FISIKA INDONESIA-INDONESIAN JOURNAL OF PHYSICS EDUCATION, *9*(2), 144–150.

Wigert, B. G., Murugavel, V. R., & Reiter-Palmon, R. (2022). The utility of divergent and convergent thinking in the problem construction processes during creative problem-solving. *Psychology of Aesthetics, Creativity, and the Arts*.

Willemsen, R. H., de Vink, I. C., Kroesbergen, E. H., & Lazonder, A. W. (2024). Strengthening Creative Problem-Solving within Upper-Elementary Science Education. *Journal of Creative Behavior*, *58*(1), 137–150. https://doi.org/10.1002/jocb.639