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Original Research Article

Systematic Review on Creative Problem-Solving Ability among School Going Adolescents: A Research Trends

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Abstract: This systematic review explores the research trends of Creative Problem-Solving Ability (CPSA) of adolescents in school from 2010-2024, using the guidelines of PRISMA. The review considered 27 of the selected research literature found in databases of Scopus, Elsevier, ProQuest, and Sage. Findings suggest interest in CPSA continues to grow in academia for the years 2019-2021, and research utilizing quantitative methods (88.9%) and a cross-sectional design (63%) were most prevalent. Studies commonly utilized surveys as an approach to conducting research as well as random sampling to create the samples used. Studies primarily examined college level students, followed by elementary, and secondary. Although research on CPSA can be found in many countries, Indonesia touted the most research output on CPSA over the years, with India, and Turkey following. The review found collaborative learning models, project-based learning models, and seamless learning environments to be an effective means to increase CPSA. The review identified the lack of qualitative research focusing on CPSA, and the necessity of research that was culturally contextualized or included diverse populations. The review established the imperative role CPSA plays in developing critical thinkers, adaptability, and academic success in all learners, and demonstrated the need for further research inclusive of varied methodologies to further develop adolescents' creative capacities around the world.

Keywords: *Creative Problem-Solving Ability, School Going Adolescents, Systematic Review.*

INTRODUCTION

Adolescents play a crucial role in the development of school-going children as they provide social, emotional, and cognitive support, often serving as role models. It is in this phase that they develop academic performance, personal identity and future adversities handling skills. At this stage the students become able to think critically and learn how to solve problems which are core values to learning. They start to be able to reason more and are able to deal with content in school like mathematics, science and literature (Blakemore and Choudhury, 2006). This knowledge development helps to develop their future intellect. During this developmental stage learners develop and begin to establish a personality and identify their values, beliefs and interests. This stage is important in regard to ego identity importance, as well as conceit, which enables them to be productive in an academic and social context (Erikson, 1968). Just like in the occupational stage, in the social stage, the adolescents develop more positive correlation between the academic results achieved and the eventual goal in life, hence making this stage very crucial in goal decisions or formation. It's the necessary period to foster various academic and emotional and behavioural competencies, including those needed to respond to academic stress and social frustrations. It should be noted that accumulating positive emotional regulation skills will reconsider the youth and give them the ability to study at school with less focus on emotions (Steinberg & Morris, 2001). More so peer pressure is more influential during the adolescent period where learners become more influenced on their behaviours, attitudes and even their choices of subjects to pursue. This indicated that positive peer influence can compel students to increase their participation in school activities while on their part negative influences contribute to students' disengagement on school activities. In developing appropriate skills for relationship management, it becomes important that the student's

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gains appropriate social skills in order to formally learn how to relate in school environments (Brown & Larson, 2009). During this stage children start to aspire to be more responsible for themselves and be more selective in choices they make, individually as well as between them and their teachers. This is important so that they are on their own when it comes to managing the academic and other areas of their lives. While learning time management, decision making over their education and personal goal setting the students acquire abilities that are vital for success throughout college and adulthood (Zimmer-Gembeck & Collins, 2003). students begin to weigh their educational options for the future. The choices made during this time range from the classes that have to be taken, the extra curriculum physical activities, and career choices determines the destiny of their post-secondary education. Regarding academic choices, youth are expected to act autonomously in their educational planning, enhancing this stage as the opportunity to match aspirations, abilities as well as the purpose (Eccles & Roeser, 2011).

Creative Problem-solving ability is highly relevant for students at this age because it enables students to develop skills that are useful in education, life experience, and career build-up. Student development, it enables him/her to reason as well as analyze situations hence enabling him /her to experience new challenges. As observed at the elementary and secondary youth, boys and girls experience different learning situations and contexts that define creativity. The ISCO ability: Thinking Critically enables them to grasp more fundamental ideas and knowledge and, therefore, excel in their academic endeavours (Fisher, 2005). Various sources prove that learners who practice creating and solving problems get good results. Sternberg and Lubart (1995) posit that higher achievement in such domains as mathematics, science and reading result from a student's improved involvement in the learning process when they are trained to think creatively. It is crucial at the elementary and secondary level especially because it is establishment of key frameworks. Autonomy to students by which the students are expected to look for answers to complex questions on their own; The amount of responsibility that they have to take to manage their learning experience is empowering to them, and enhances what is known as Personal Moral Agency, which is profoundly connected to learning self- efficacy. As concluded by Bandura (1997) in his research self-efficacy is very primary in academic environment because it enables students to persist with challenging undertakings. It also helps to orient a person in social space, which is a significant problem in the course of adolescence. Finally, by inventing kinds of solutions to social issues like how to solve conflict with friends, conflict solution makes students develop their social and emotional aspecto including empathy, social communication, and social cooperation as highlighted by Sak (2004). This is important for students' social relationships during learning and also outside learning context. In the contemporary environment this is valued more and more, as employers and the society expect to get a person who would be able to think out the ways to solve actual practical tasks (Robinson, 2006).

All these abilities should be nurtured when one is young; during their initial education in elementary and secondary schools so that they can handle future tasks in college and at the workplaces. Grouping of pupils enhances creativity and ownership of learning and thus fosters better and more effective learning process as well as promotes sustained learning interest among students (Craft, 2003). At this age, the brain still continues to develop most especially in the areas that have do with functions such as reasoning, planning, and solving problems. These functions are impaired during adolescence but the prefrontal cortex which is responsible for these functions in a continued maturation process and this results in better abstract thinking and coming up with better and creative solutions to most problems which may cropped up (Blakemore & Choudhury, 2006). Research also reveals that young people are more capable of performing extra-ordinary tasks than ordinary tasks because they are creative problem solvers (Runco & Acar, 2012). School is a place where the young person interacts with peers, endeavours to establish an identity, as well as faces academic challenges all of which need creativity abilities. Such social demands compel adolescents to come up with new tactics of handling their conflicts, moderating feelings, and balancing between responsibilities, all these foster problem-solving abilities (Larson, 2011). Since the students are being assigned more freedom and freedom is more encouraged in adolescents, adolescents learn how to be creative and solve problems in school settings. In extracurricular activities, group assignments, create independent opportunities for adolescents they learn how to approach different situations independently (Beghetto, 2007). Emotional intelligence is at its peak in adolescence, this is major improvement to creativity. Fong noted that there is evidence of the emotional predictors of creativity by showing that positive and negative emotions predict how adolescents frame and solve problems. Moreover, peer relations do offer the social setting which fosters brainstorming due to people's shared experiences in relation to problem solving.

Rationale of the Study

Creative problem-solving (CPS) is a vital cognitive ability, increasingly emphasized in education systems worldwide to prepare students for the challenges of the 21st century. Adolescents, in particular, are at a critical stage of cognitive development, where the capacity for creative thinking and adaptive reasoning can be cultivated. Understanding the factors that influence CPS abilities during this period is essential for developing educational practices that foster creativity, flexibility, and problem-solving ability. The need for a systematic review of CPS among school-going

adolescents arises from the diverse approaches and outcomes reported in current literature, which highlight both successes and challenges in promoting CPS. Several studies have shown that teaching strategies and learning environments significantly impact CPS development. Michele Gaglione (2021) found that social science elective classes positively affected students' perceptions of their CPS attributes, with classroom environments accounting for 29% of the variance. This indicates that contextual factors, such as how teachers structure the learning environment, play a substantial role in developing CPS. Similarly, Nonthamand & Songkhla (2017) demonstrated the strong correlation between group discussions and CPS abilities, underscoring the importance of collaborative learning environments in fostering creativity. Different educational models have also been linked to enhanced CPS ability. Ida Fiteriani *et al*., (2021) highlighted the positive impact of Project-Based Learning (PjBL) with a STEM approach, which improved both CPS abilities and metacognitive skills. In contrast, Fatmawati (2020) showed that students struggled with creatively solving problems related to environmental pollution, indicating gaps in how certain subjects are taught in terms of fostering creativity. These variations suggest that the application of creative problem-solving models in different contexts is uneven, with some approaches proving more effective than others. Cognitive flexibility, fluency, originality, and elaboration are recognized as core components of CPS, with Khamcharoen *et al*., (2021) emphasizing flexibility as the most crucial aspect. However, as Sipayung *et al.,* (2021) pointed out, many students exhibit low levels of fluency, flexibility, and originality in solving problems, indicating a need for more targeted interventions to develop these skills during adolescence. The findings of Maker *et al*., (2023) support the notion that age-related development, teaching methods, and cultural factors interact in the growth of CPS abilities, emphasizing the role of tailored educational strategies in different contexts. Moreover, gender and socio-economic factors also play a role in CPS development. Rakesh & Geetha (2016) revealed that male students generally outperformed females in CPS ability, and urban students outperformed their rural counterparts, suggesting that access to resources and differing learning environments could be influential. However, Kumar (2020) found no significant correlation between creativity and problem-solving abilities in higher secondary students, which complicates the understanding of how creativity directly influences CPS in adolescent populations. Recent studies across various contexts have shown the significance of CPS in improving academic performance, particularly in STEM fields, as well as enhancing social and emotional development. However, the development of CPS skills among adolescents can be influenced by multiple factors, including teaching methods, classroom environments, gender, socio-economic background, and exposure to creative problem-solving models. Some studies highlight the positive impact of project-based learning (Chen & Chang, 2021), group discussions (Nonthamand & Songkhla, 2017), and creative teaching methods (Hu *et al.,* 2017) in fostering CPS abilities. In contrast, others emphasize challenges such as gender disparities (Rakesh & Geetha, 2016) and a lack of flexibility and originality in adolescent problem-solving approaches (Sipayung *et al*., 2021). In the present study will aim to consolidate the evidence on how Creative Problem Solving abilities are fostered among school-going adolescents. By synthesizing findings from diverse educational contexts and identifying gaps in current research, this review will provide educators, policymakers, and researchers with insights into effective strategies for promoting CPS during adolescence. It will also explore how factors such as year, nature of the study, method, design, educational level, sapling technique, sample size, and countries influence adolescents' creative problem-solving abilities, ultimately contributing to more refined and inclusive approaches to CPS education. It will highlight how different educational models and environments contribute to CPS development and offer recommendations for enhancing the creative capacities of adolescents in school settings, better equipping them for future challenges.

Objective of the Study

The objective of this study is to examine the research related on creative problem-solving ability concerning school going adolescents from 2010 to 2024 by using the Systematic Reviews and Meta-Analysis criteria (PRISMA).

Research Questions

The research questions this study aimed to answer are:

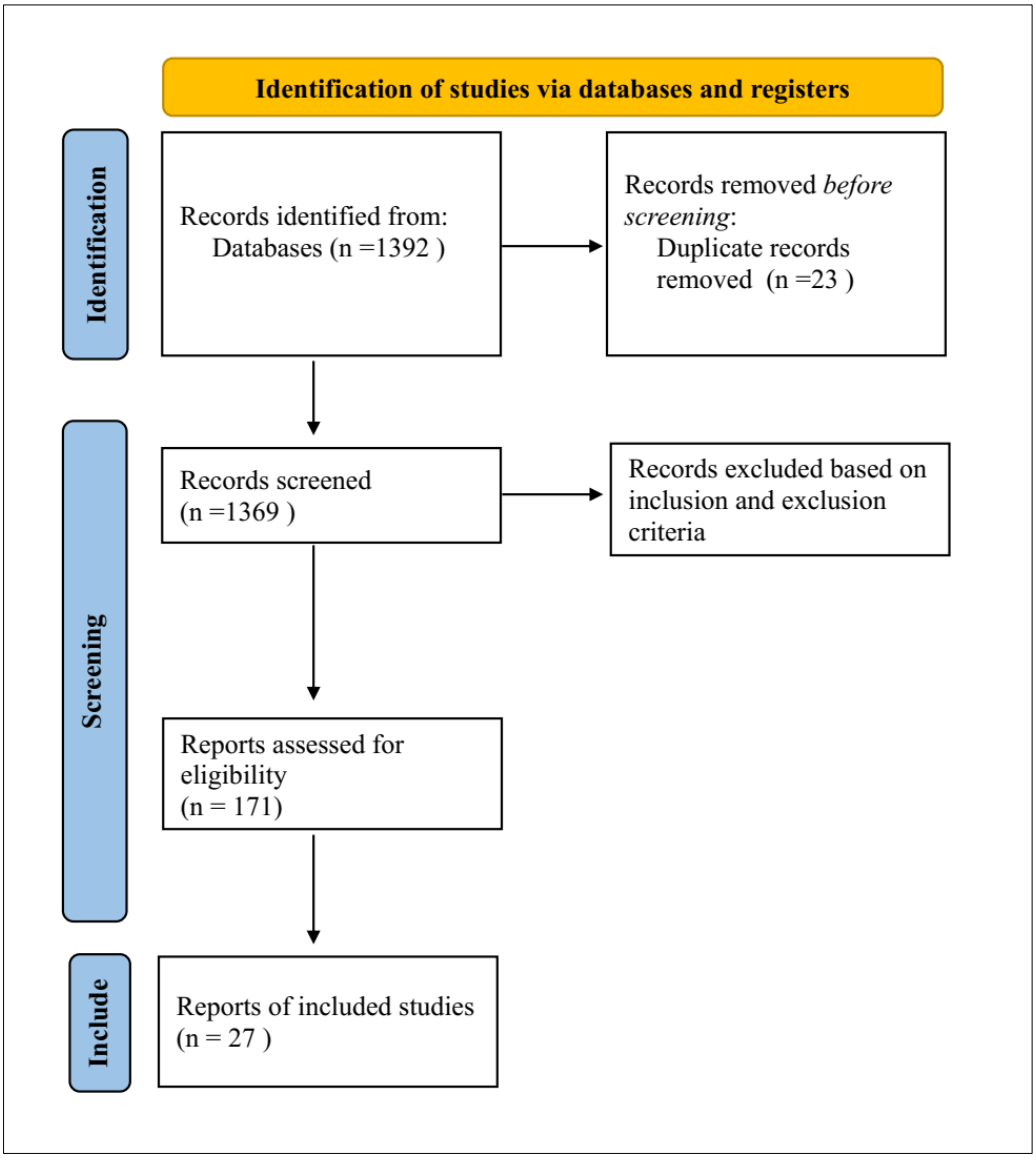
1. What are the publication years selected on creative problem-solving ability among school going adolescents?
2. What is the nature of study selected on creative problem-solving ability among school going adolescents?
3. What are the research methods used in selected on creative problem-solving ability among school going adolescents?
4. What are the research design used for selecting on creative problem-solving ability among school going adolescents?
5. What are the education level used for selecting on creative problem-solving ability among school going adolescents?
6. What sampling techniques have been used to assess the effectiveness on creative problem-solving ability among school going adolescents?
7. What are the sample size used for selecting on creative problem-solving ability among school going adolescents?
8. Which are the countries that have conducted studies on creative problem-solving ability among school going adolescents?

METHODOLOGY

The present study uses descriptive method. Data were collected using documentation studies from the Scopus database and bibliometric analysis of academic articles related to creative problem-solving ability. This study uses a bibliometric analysis strategy. This study based on Preferred Reporting Items for Systematic Review and Meta Analyses (PRISMA) guidelines (Chuane *et al*., 2022). The study comprehensively reviews existing literature on creative problem-solving ability conducted from 2010 to 2024.

Data Sources and Search Strategy

The articles included in this study were generated through a systematic search in online databases like Elsevier, ProQuest, Scopus, and Sage. Keywords used to search relevant research articles in the databases included "Creative Problem Solving" AND "Adolescents" AND "Cognitive Ability" AND "Education". The time range chosen for the literature was from 2010 to 2024. The total number of records identified through database searching is 1392. The PRISMA flow diagram used to search and refine articles is shown in Figure 1.



Inclusion and Exclusion Criteria

In order to determine which studies need to be included in the review, criteria of inclusion and exclusion were formulated. After 23 duplicate articles remove, the criteria applied. The criteria are based on publication year, subject area, documents type, key words, publication language, publication Stage, and publication access as shown in Table 1. After criteria applied 171 article saved as CSV file then screened the titles and abstracts to check the articles against inclusion and exclusion criteria. Accordingly, 27 research articles met the inclusion criteria and 144 articles were screened out.

Table 1: Inclusion and Exclusion Criteria

Year	2010 - 2024
Subject Area	Social Science; Psychology; and Arts and Humanities
Document Types	Articles
Key Words	Creative Problem solving; Adolescents; Creative Thinking; Convergent and Divergent Thinking; and Students
Publication Language	English
Publication Stage	Final
Publication Access	Open Access

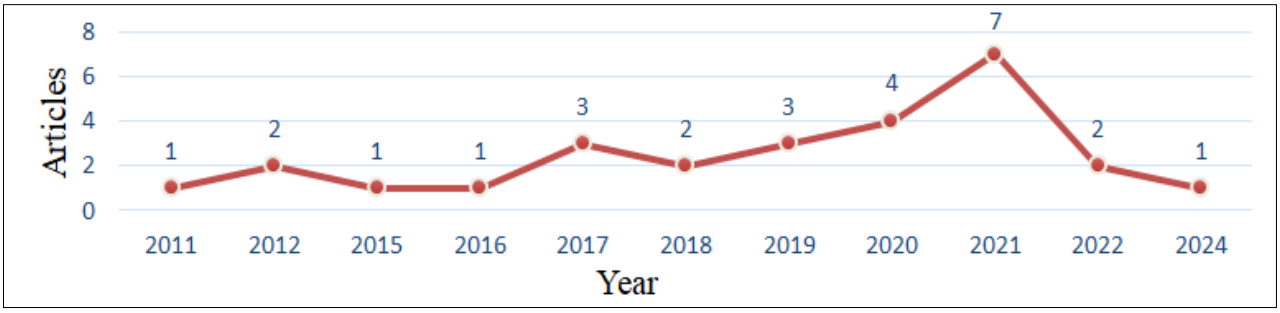
Selection of Article and Data Extraction

After the full-text articles were assessed using quality assessment criteria, all 27 articles were included in the review. The data from the publications considered in the systematic review are then entered in a Microsoft Excel sheet. This method assisted in coding the essential details from pertinent publications. Generally speaking, the articles were coded according to the author's name, title, year, nature of the study, method, design, educational level, sapling technique, sample size, and countries. The conclusions of all the articles that were chosen were then compiled.

RESULTS

Table 2 and Figure 1: Showing publication years selected on creative problem-solving ability among school going adolescents

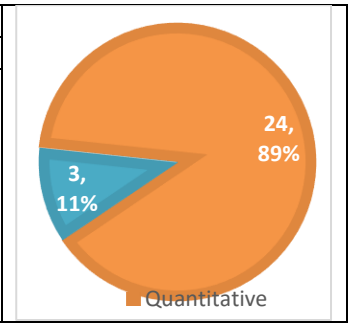
Year	2011	2012	2015	2016	2017	2018	2019	2020	2021	2022	2024
N	1	2	1	1	3	2	3	4	7	2	1
%	3.7	7.4	3.7	3.7	11.1	7.4	11.1	14.8	25.9	7.4	3.7



The data on creative problem-solving research among school-going adolescents, spanning 2011 to 2024 with 27 studies, highlights an evolving focus in this field. Initial low interest gave way to a surge in publications from 2019 to 2021, reflecting growing recognition of these abilities in education, aligning with global goals emphasizing creativity and critical thinking. However, the decline in 2024 suggests a need for sustained research. Future studies should investigate targeted interventions and teaching strategies to ensure the recent momentum in enhancing creative problem-solving abilities leads to lasting educational improvements.

Table 3 and Figure 2: Showing the nature of study selected on creative problem-solving ability among school going adolescents.

Nature of Study	N	Percentage (%)
Quantitative	24	88.9
Qualitative	3	11.1

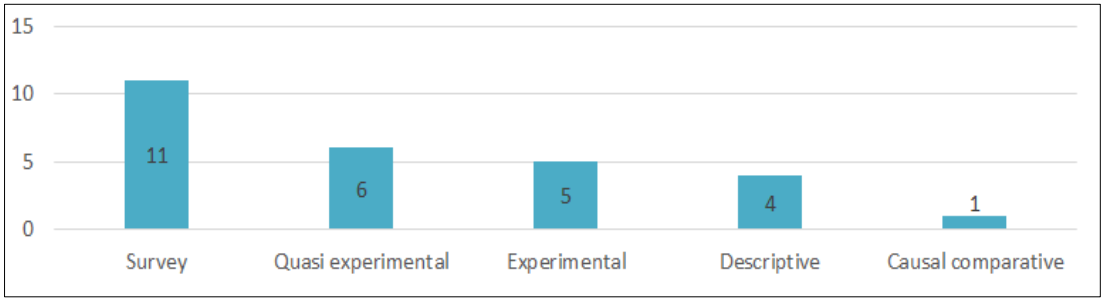


The analysis of 27 studies on creative problem-solving among adolescents reveals a strong preference for quantitative methods (88.9%), emphasizing statistical analysis to assess creative abilities and educational outcomes. While effective for generalizable conclusions, the limited use of qualitative research (11.1%) offers an

opportunity for deeper insights into students' experiences and contextual factors influencing creativity. Qualitative studies can capture nuances not easily measured quantitatively. Future research should strive for a balance between both approaches to gain a more comprehensive understanding of how adolescents develop creative problem-solving skills, enhancing educational strategies and outcomes.

Table 4 and Figure 3: Showing the research methods used in selected on creative problem-solving ability among school going adolescents.

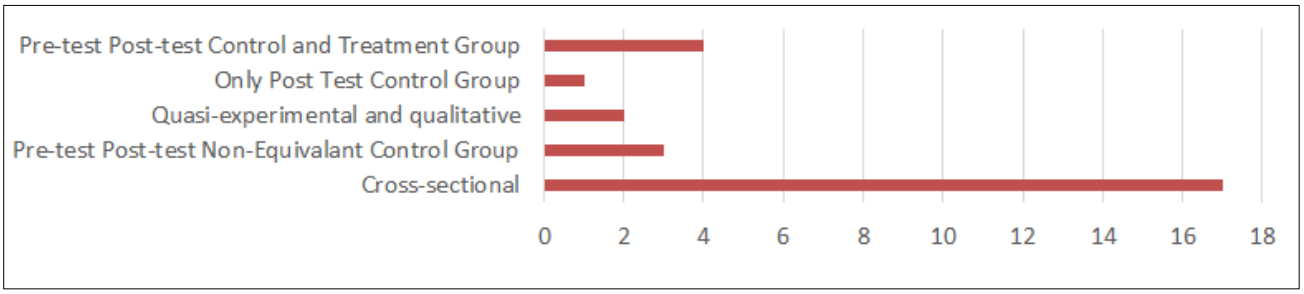
Method	Survey	Quasi Experimental	Experimental	Descriptive	Casual Comparative
N	11	6	5	4	1
Percentage (%)	40.7	22.2	18.5	14.8	3.7



The analysis of 27 studies on creative problem-solving among adolescents reveals a dominance of survey methods (40.7%), emphasizing large-scale data collection for generalizable trends. Quasi-experimental methods (22.2%) and experimental methods (18.5%) are also common, reflecting a focus on evaluating interventions and establishing causal relationships. Descriptive methods (14.8%) provide contextual insights, while causal comparative methods (3.7%) are rarely used, indicating a gap in exploring demographic or contextual differences. The preference for surveys highlights a quantitative focus, but future research should incorporate more diverse methodologies to better understand and improve creative problem-solving in educational settings.

Table 5 and Figure 4: Showing the research design used for selecting on creative problem-solving ability among school going adolescents.

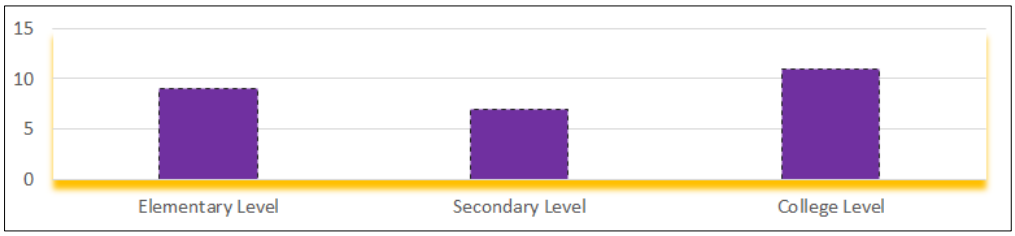
Design	Cross-sectional	Pre-test Post-test Non-Equivalant Control Group	Quasi-experimental and qualitative	Only Post Test Control Group	Pre-test Post-test Control and Treatment Group
N	17	3	2	1	4
Percentage (%)	63	11.1	7.4	3.7	14.8



The analysis of 27 studies on creative problem-solving among adolescents reveals that most (63%) use cross-sectional designs, offering a snapshot of creative problem-solving abilities at a single point in time. Pre-test and post-test designs (11.1%) assess intervention effectiveness, while quasi-experimental and qualitative designs (7.4% each) explore educational program impacts and personal experiences, respectively. One study (3.8%) uses a post-test only design. 14.8% comes under Pre-test Post-test Control and Treatment Group. The prevalence of cross-sectional studies indicates a focus on current trends, while the limited use of qualitative methods highlights a gap in understanding personal and contextual factors. A diverse mix of research designs could enrich insights into adolescent creativity.

Table 6 and Figure 5: Showing the education level used for selecting on creative problem-solving ability among school going adolescents.

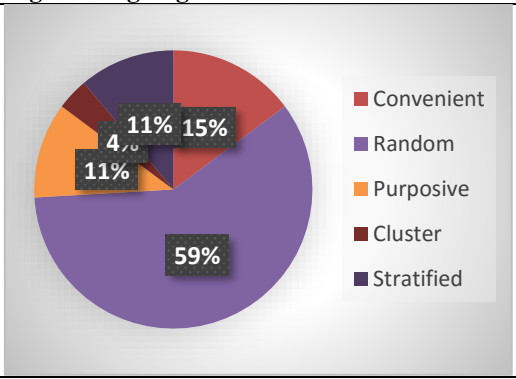
Education Level	Elementary	Secondary	College
N	9	7	11
Percentage (%)	33.3	25.9	40.7



The analysis of 27 studies on creative problem-solving among adolescents reveals that 33.3% focus on elementary students, highlighting the importance of early development of these skills. Secondary education participants make up 25.9%, reflecting a key phase where problem-solving abilities become more refined. The largest portion (40.7%) involves college students, emphasizing the role of creative problem-solving in higher education. This diverse representation underscores the value of fostering creativity across all educational levels. Future research should continue examining these skills at different stages to inform practices that effectively nurture creativity and prepare students for real-world challenges.

Table 7 and Figure 6: Showing sampling techniques have been used to assess the effectiveness on creative problem-solving ability among school going adolescents.

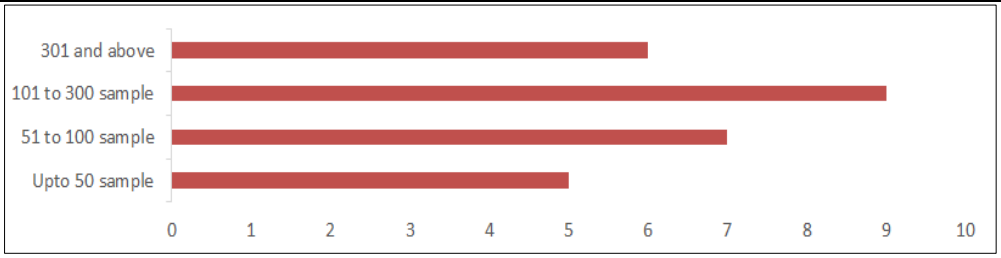
Type of Sampling	N	Percentage (%)
Convenient	4	14.8
Random	16	59.3
Purpose	3	11.1
Cluster	1	3.7
Stratified	3	11.1



The analysis of 27 studies on creative problem-solving among adolescents reveals that random sampling is the most common method (59.3%), ensuring representativeness and generalizability. Convenient sampling is used in 14.8% of studies, but its limited use reflects a focus on more rigorous approaches. Purposive and stratified sampling, each employed in 11.1% of studies, target specific subgroups, offering valuable insights, while cluster sampling is rare (3.7%). The predominance of random sampling highlights the importance of unbiased sampling in this research area, with opportunities for exploring diverse techniques to enhance the understanding of creative problem-solving ability.

Table 8 and Figure 7: Showing the sample size used for selecting on creative problem-solving ability among school going adolescents

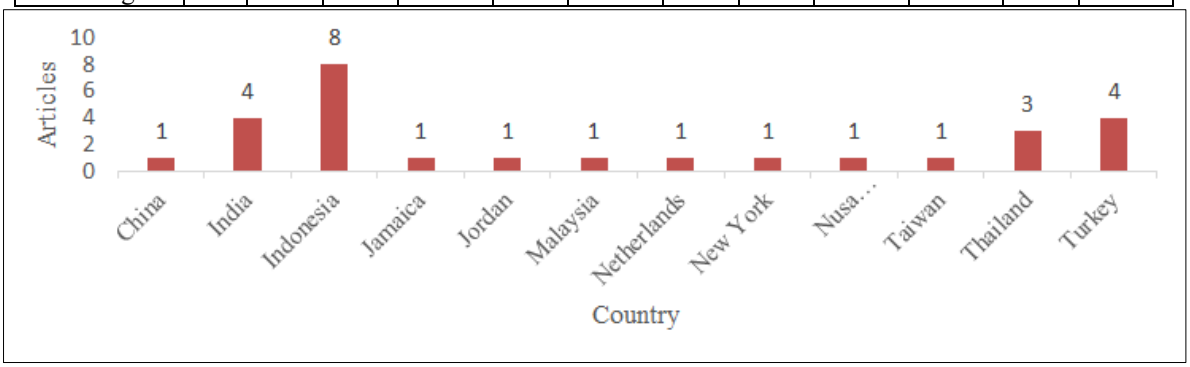
Sample size	Upto 50 sample	51-100 sample	101-300 sample	301 and above sample
N	5	7	9	6
Percentage (%)	18.5	25.9	33.3	22.2



The analysis of 27 studies on creative problem-solving among adolescents shows most studies on adolescent creative problem-solving abilities used moderate samples of 101–300 (33.3%), with notable portions at 51–100 (25.9%) and over 300 (22.2%). Studies under 50 (18.5%) were least frequent, highlighting researchers' preference for balanced sample sizes for reliable, feasible analysis. Future research could benefit from larger sample sizes to improve the generalizability and allow for more nuanced analyses of demographic factors influencing creative problem-solving abilities in educational settings.

Table 9 and Figure 8: Showing the countries that have conducted studies on creative problem-solving ability among school going adolescents

Country	China	India	Indonesia	Jamaica	Jordan	Malaysia	Netherlands	New York	Nusa Tenggara Barat.	Taiwan	Thailand	Turkey
N	1	4	8	1	1	1	1	1	1	1	3	4
Percentage	3.7	14.8	29.6	3.7	3.7	3.7	3.7	3.7	3.7	3.7	11.1	14.8



The analysis of 27 shows Indonesia leads with 8 studies (29.6%) on adolescent creative problem-solving, showing a strong research focus in this area. India and Turkey follow with 4 studies each (14.8%), and Thailand contributes 3 studies (11.1%). Other countries, including China, Jamaica, and Malaysia, each account for 1 study (3.7%). This distribution highlights Indonesia's prominent role, with significant contributions from India and Turkey, while other regions show limited but emerging interest in this research field. This data reflects a clear geographic concentration of research efforts in Asia, particularly in Indonesia, India, and Thailand, as they collectively represent over half of all studies.

DISCUSSION

This systematic review investigates trends in creative problem-solving ability among school-going adolescents from 2011 to 2024. The analysis reveals a significant shift in research focus, particularly between 2019 and 2021, when publications surged, reflecting an increasing recognition of the importance of creativity in education aligned with global educational goals (Amabile, 2019). This study on creative problem-solving (CPS) among school going adolescents underscores its centric role in fostering critical life skills crucial for academic success, personal development, and future career readiness. Adolescence is marked by significant cognitive and emotional maturation, a stage in which CPS ability can be developed to enable students to think independently, approach challenges creatively, and adapt to diverse situations (Blakemore & Choudhury, 2006). During this period, adolescents experience growth in areas like reasoning, planning, and complex problem-solving, making it a prime time to strengthen CPS through targeted educational practices.

One key finding is that collaborative educational models, including group discussions and project-based learning, have shown effectiveness in enhancing CPS abilities in adolescents. Studies, such as those by Nonthamand & Songkhla (2017) and Fiteriani *et al*., (2021), suggest that interactive learning environments that encourage teamwork and exploration are particularly impactful in fostering creativity and flexibility, two core components of CPS. These learning settings allow students to view problems from multiple perspectives, thereby promoting cognitive flexibility and originality, which are essential for innovative thinking.

Interestingly, the review reveals a strong preference for quantitative research methods in studying CPS (88.9%), with surveys and quasi-experimental methods dominating this area of research (Creswell & Poth, 2018). This focus on quantitative analysis has been valuable in providing generalizable insights into the factors influencing CPS. However, qualitative studies remain limited (11.1%), indicating an opportunity to enrich this field with deeper insights into the personal

and contextual factors shaping CPS in adolescents (Khamcharoen *et al*., 2021). Qualitative research could capture the nuanced ways students perceive and approach creative problem-solving, shedding light on influences that quantitative data may overlook, such as individual motivation, social interactions, and classroom dynamics. In terms of research design, a majority (63%) utilized cross-sectional designs, providing a snapshot of abilities at a specific time. However, the low utilization of pre-test/post-test designs indicates a gap in assessing intervention effectiveness (Gall *et al*., 2020). Such designs are crucial for evaluating the impact of educational programs and strategies on creative problem-solving abilities. The findings also reveal a diverse representation across educational levels, with 40.7% focusing on college students. This highlights the need to foster creative skills across all educational stages, from elementary to higher education, to ensure students are adequately prepared for real-world challenges (Kafai & Resnick, 2013). Additionally, random sampling emerged as the most common technique (59.3%), which enhances the validity of findings; however, the reliance on convenience sampling (14.8%) indicates a potential area for improvement in future studies. Geographically, Indonesia leads with 29.6% of studies, followed by India and Turkey, reflecting a concentration of research efforts in specific regions (Nusrat & Akter, 2022). This geographic focus suggests a need for further exploration in diverse cultural contexts to understand how creativity is cultivated among adolescents globally.

The review also highlights variations in CPS abilities across different demographics, including gender, socioeconomic background, and urban-rural divides. For example, Rakesh & Geetha (2016) found that male and urban students tend to outperform female and rural students in CPS, likely due to differences in access to resources and diverse educational settings. These findings suggest that demographic and contextual factors may play a role in CPS development, potentially impacting students' readiness for complex problem-solving tasks in both academic and social contexts.

Furthermore, while CPS has been positively correlated with academic performance in areas like STEM, some studies report challenges in applying CPS to certain subjects, such as environmental science (Fatmawati, 2020). This indicates that while general CPS skills are beneficial, specific subjects may require tailored instructional approaches to maximize the benefits of CPS. The review calls for future research to include diverse methodologies and interventions targeting flexibility, fluency, and originality. Such an approach could better address demographic gaps, enabling a more inclusive, supportive environment for developing CPS in students across varied educational settings, ultimately equipping them to meet real-world challenges effectively.

In conclusion, this review underscores the growing emphasis on creative problem-solving among adolescents but also highlights gaps in research methodologies and geographic diversity. Future studies should adopt a balanced approach that combines qualitative and quantitative methods, includes diverse educational levels, and expands to various cultural contexts to enhance the understanding and enhancement of creative problem-solving abilities in education. However, the decline observed in 2024 suggests a potential need for sustained research efforts to maintain this momentum.

CONCLUSION

In conclusion, this systematic review emphasizes the critical role of creative problem-solving (CPS) in fostering essential ability among school-going adolescents, particularly in the context of their cognitive and emotional development. The surge in publications from 2019 to 2021 reflects a growing recognition of CPS's importance in education; however, the decline in 2024 signals a pressing need for continued research to sustain this focus. The predominance of quantitative research methods offers valuable insights but also highlights the necessity for qualitative studies to explore the nuanced factors influencing CPS, such as individual motivation and social dynamics. Furthermore, variations in CPS abilities across demographics underscore the importance of tailored instructional approaches and interventions to ensure equity in educational outcomes. To effectively prepare students for real-world challenges, future research should adopt diverse methodologies, addressing the needs of all educational levels and cultural contexts. Ultimately, a comprehensive understanding of CPS development is vital for cultivating innovative, adaptable thinkers who can navigate complex problems in an increasingly dynamic world. The integration of targeted strategies in educational practices will be essential to foster these abilities sustainably across various settings.

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