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Analysis of Research Trends in Creative Thinking Skills in Science Learning: A Systemic Literature Review

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Abstract: There are problems in science learning, such as decreased learning outcomes, a lack of student motivation, and difficult science material. This creative thinking skill is a solution to the problem. This study aims to provide information and alternative solutions using appropriate models or methods to improve creative thinking skills. The method employed is content analysis of articles from journals indexed by Sinta 1-2 from 2011 to 2023. The results of the study showed that the PBL and PJBL models were the right choice for implementing creative thinking skills by using science-based practicum material with the successful achievement of indicators of creative thinking skills, including indicators of flexibility and originality.

Keywords: Creative Thinking skill; Science Learning.

Introduction

The fourth industrial revolution necessitates numerous changes. The educational world, which is closely linked to the skills needs of the 21st century, is a factor influencing change. Critical thinking skills, creativity, communication, and collaboration are among the 21st century learning skills identified by Yulianti et al. (2022), one of the most important cognitive aspects to consider when learning science in the classroom is creative thinking skills. This competency is important as it is required from primary school to university.

The ability to think creatively can be measured from a variety of perspectives, including fluency, flexibility, originality, and clarity, all of which increase students' creativity and problem-solving abilities and improve learning outcomes. In science learning, the ability to think creatively can give birth to new perspectives to help students respond to various scientific problems. Students are able to learn independently, recognize lessons more easily, develop a positive attitude towards science, and develop their creativity through activities such as observation and experimentation. The softness of innovation, newness and imagination is the result of continuous creative processes (Mahmudi and Sumarmo, 2011).

Creative thinking skills begin with sensitivity to situations that identify problems to solve (Moma, 2017). Creative thinking can also refer to the process by which people come up with new ideas (Putri, et al., 2023). Analysis, experimentation, problem solving, communication, and scientific process skills are examples of high-order thinking skills (Pujawan et al., 2022).

Creativity among students and teachers is an important factor that can influence learning. However, it is well known that students are prone to experiencing learning difficulties during the science learning process. Several factors contribute to this, including low student motivation and interest in learning, failure to study the material obtained, failure to read textbooks as basic knowledge, a lack of learning experience, and a low level of learning. Furthermore, science material is still regarded as difficult because some of the existing material is still cumulative, which means that if students do not understand one concept, they will struggle to

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understand other concepts. Aside from that, some science materials investigate abstract objects. As a result, the ability to think creatively is required to support the science learning process in order to improve learning outcomes, particularly from a cognitive standpoint, and to solve existing problems. This is consistent with the findings of Afandi et al. (2019), who found that creative thinking skills must be developed in science learning through the use of models and media to foster students' abilities to think creatively, innovatively, and productively.

Researchers examined how models, strategies, approaches, subject matter, and indicators were used to implement creative thinking skills in science learning in this study. As a result, the goal of this study is to provide information and describe the selection of solutions for implementing creative thinking skills in science learning using appropriate models or methods.

Method

This is a qualitative study that examines the implementation of creative thinking skills in science learning using a content analysis approach and systematic literature review techniques. A systematic literature review is a study that combines findings from multiple primary studies to answer research questions (Newman & Gough, 2020). Sharif (2019) describes the stages of analysis or review used in this technique, which are as follows: 1) develop research questions, 2) establish inclusion criteria, 3) search for articles in various databases (SINTA and national and international journal websites) using the keywords "creative thinking" and "science learning", 4) article coding using the Paper Classification Form (PCF), 5) identify patterns across articles, 6) synthesize these patterns to answer research questions. Following the screening stage, the results obtained were 30 articles that met the inclusion criteria in Table 1. Table 2 shows the results of screening 30 articles.

Tabel 1. Inclusion Criteria

Category	Inclusion Criteria
Publication Type	Scientific articles published in journals
Journal Specifications	Sinta 1-2 and Scopus-accredited national and international journals (journal in https://sinta.kemdikbud.go.id/)
Publication Year	2011-2023
Research Setting	Indonesia
Nationality of Researcher	Indonesian, a mixture of Indonesian and foreign researchers
Free Variables	Research on creative thinking skills in science learning includes all types of integration patterns
Field	Science, Physics, Chemistry, and Biology
Type of Study	Empirical and theoretical
Research subject	Students and teachers at all levels (primary, secondary, high school, and college)

Tabel 2. Distribution of articles based on Journal Identity

Journal Type	Status	Journal Name	Article Source
National	Sinta 1, indexed by Scopus	Jurnal Pendidikan IPA Indonesia (JPII)	(Yustina et al., 2020) (Nuswowati et al., 2017) (Apriwanda & Hanri, 2022) (Ernawati et al., 2022) (Sumarni & Kadarwati, 2020) (Pujawan et al., 2022) (Afandi et al., 2019) (Sari et al., 2017) (Yulianti et al., 2022) (Fatmawati, 2016) (Rahmatan et al., 2012) (Wibowo & Suhandi, 2013) (Hartini et al., 2014) (Husamah, 2015) (Putra & Iqbal, 2016) (Farida et al., 2017) (Ahmad et al., 2021) (Asrizal et al., 2022)
		Cakrawala Pendidikan	(Mahmudi & Sumarmo, 2011) (Moma, 2017) (Suryandari et al., 2018) (Istiyono et al., 2018)

Journal Type	Status	Journal Name	Article Source
International	Scopus Q3	The International Journal of Evaluation and Research in Education (IJERE)	(Ramdani et al., 2021) (Habibi et al., 2020) (Saregar et al., 2021) (Jumadi et al., 2021) (Ernawati et al., 2019) (Ariyani et al., 2022) (Putri et al., 2023) (Botagariyev et al., 2023)
		Total	30

Result and Discussion

Research Topics

Based on a synthesis of 35 articles from three journals on sinta.kemendikbud.com, it was discovered that research on creative thinking skills in Indonesia was conducted on a variety of topics. Table 3 shows the most popular research topics on creative thinking skills over the last 13 years.

Table 3. Trends in Research Topics

Research Topics	Percentage
Learning model	50%
Learning strategies	34%
Instructional Media	10%
Learning Instruments	3%
Teaching materials	3%

Figure 1 depicts the distribution of articles on creative thinking skills from 2011 to 2023 (the last 13 years), indicating that interest in research on these skills began to rise in 2017, with the number of published articles peaking during the COVID-19 pandemic. Because of the pandemic, learning methods have shifted to online learning, while the skills required in this era must still be met. As a result, all levels of education must teach 4C skills (critical thinking, creativity, collaboration, and communication) (Fatmawati et al., 2016; Wibowo et al., 2013).

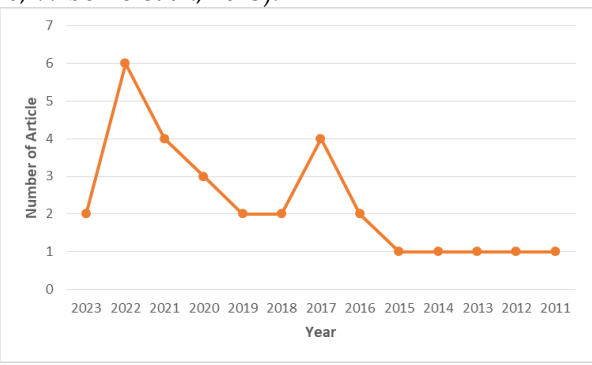

Figure 1. Distribution of articles on the topic of Creative Thinking Skills

Table 3 depicts the research trend for creative thinking skills, which is dominated by the use of appropriate learning models to improve this one skill, namely achieving a 50% percentage. This demonstrates that learning models are the best choice for researchers to use in order to improve creative thinking skills in each period, as evidenced by studies by Rahmatan et al. (2012), Wibowo & Suhandi (2013), Yustina et al. (2020), and Ramdani et al. (2021), which demonstrate various uses of models such as PjBL, PBl, inquiry, and so on.

Learning model

The trend of learning models used in improving creative thinking skills is shown in Table 4. According to table 4, the maximum generally used version to enhance innovative questioning competencies is a venture-primarily based totally version (PjBL) with a percent of 50% and a problem-primarily based totally version (PBL) with a percent of 27.7%. Creative questioning competencies used withinside the studying technique check with PBL steps and challenge depend that may be extraordinarily useful in accomplishing studying objectives. According to Chu et al. (2017), PjBL has the benefit of studying with the aid of using asking questions, debating an concept or ideas, designing plans, speaking with others, forming thrilling studying experiences, answering venture questions, supplying commands for venture completion, growing venture plans, amassing facts, organizing ideas, and assigning tasks. The advantages of this PjBL version encompass an answer and a place to enhance innovative questioning competencies, which might be manifested withinside the success of elements of innovative questioning competencies, together with fluency, flexibility, originality, and elaboration.

Table 4. Learning Model Trends

Model Type	Integrated Model	Percentage
Project Base Learning (PjBL)	- Blended-PjBl (2) - PjBL (3) - Quantitative Project-Based (1) - Project Brief(1)	50%

Model Type	Integrated Model	Percentage
Problem Base Learning (PBL)	- Pjcm-Gc (project collaboration model-Google Classroom) (1) - Model Scl (Science Creative Learning) (1) - PBL (2) - PBL-Green Vision (1) - PBL integrated Scaffolding (1) - PBL- EthnoStem (1)	27.7%
Inquiry	- Inquiry - Structured, guided, open inquiry	11.1%
CORE	- CORE (Connecting, Organizing, Reflecting, And Extending) (1)	5.6%
Model Learning Cycle 5E	- Model Learning Cycle 5E (1)	5.6%

In technology getting to know that makes use of a project-primarily based totally version, it's miles commonly associated with the implementation of a technology practicum. This project-primarily based totally version could make college students innovative, offer clean understanding, and higher have interaction college students due to the fact the getting to know sports are pupil-targeted and permit college students to hyperlink practicum with normal life. (Apriwanda & Hanri, 2022; Sari et al., 2017). Therefore, this version can cause innovative questioning skills.

While the software of the PBL version facilitates college students acquire signs of innovative questioning skills, it's miles accompanied through an boom in pupil getting to know results. The problem-primarily based totally getting to know version also can boom pupil motivation and getting to know strategies. Students` cognitive getting to know results boom because of motivation and suitable getting to know strategies (Yustina, Syafii, & Vebrianto, 2020). PBL permits college students to increase viable solutions through amassing and studying information to resolve problems. as a getting to know version that demanding situations college students to research and paintings collectively with their organizations to locate answers to actual problems (Nuswowati et al., 2017; Hartini et al., 2014).

Strategies, Media, Instruments, and Teaching Materials

Based at the studies subjects analyzed in phrases of strategies, methods, media, instruments, and coaching substances, diverse sorts have been received and implemented in studies on innovative wondering skills. Table five gives the styles of subject matter strategies, media, instruments, and coaching substances utilized in studies.

Table 5. Trends in Strategy, Media, Instruments, and Teaching Materials

Trending Topic	Type of Topic	Quantity
Strategy/Mode	- Bloom's Taxonomy Oriented (1) - Pedagogical Strategy (1) - STEM (1) - STEAM (2) - Mind Mapping (1) - Strategy Mathematical Habits Of Mind (MHM) - Scamper's Strategy (1)	9
Media	- Discussion (1) - Serious Game Based on Baluran National Park (1) - Interactive Multimedia (1) - Media Scratch (1)	3
Instrument	- Development of a Creative Thinking Skills Physics Test for High School Based on Modern Test Theory (1)	1
Teaching materials	- Thematic Science Teaching Materials (1)	1

Trends in mastering techniques used withinside the variables of innovative wondering abilties are pretty diverse, aleven though in phrases of amount they're categorised because the same. The mastering approach that sticks out on this magazine evaluate is using STEAM. Science, Technology, Engineering, Arts, and Mathematics (STEAM) gives cross-disciplinary mastering that explores students` distinctive methods of wondering and creativity. STEAM consists of factors of the humanities into STEAM mastering to beautify creativity, innovation, problem-fixing abilties, and lively scholar engagement. In addition, STEAM additionally will increase mastering motivation, encourages vital wondering abilties, and makes technological know-how mastering extra interesting (Putri et al., 2023). So using STEAM may be an opportunity option to enhancing students' innovative wondering abilties.

Research subject

Of the 30 articles synthesized, the fashion of studies topics became 66.7%; maximum of them had been undergraduate college students in numerous fields including physics, chemistry, and biology. observed with the aid of using junior excessive faculty college

students at 16.7%, excessive faculty college students at 13.3%, and the studies difficulty on the fundamental faculty stage at 3.3%. The purpose in the back of the dominance of student-stage studies topics for evaluation of innovative questioning capabilities is that those capabilities are blanketed in excessive-order questioning capabilities, so studies topics who've a excessive stage of questioning and are academically and emotionally mature are needed. The use of college-stage topics is predicted with a purpose to achieve credible and responsible results. The following developments in studies topics are supplied in Table 6.

Table 6. Trends in Research Subjects

Research subject	Number of articles	Precentage
Undergraduate Student	20	66.7%
High school student	4	13.3%
Middle school students	5	16.7%
Elementary students	1	3.3%

Science Learning Materials

Furthermore, in phrases of the herbal technological know-how substances utilized in those articles, maximum of them belong to physics, with a amount of 14, accompanied with the aid of using nine organic substances and seven chemical substances. Natural technological know-how substances which can be used to put into effect innovative questioning competencies are people who have a practicum or direct statement with the aid of using elevating troubles so that scholars can discover thoughts and answers to those troubles. In practicum, college students can exercise what they examine with the aid of using integrating idea and exercise. Furthermore, college students can broaden their innovative questioning competencies to clear up the troubles they encounter (Ernawati et al., 2019; Ahmad et al., 2021; Asrizal et al., 2022). Following are the traits withinside the herbal technological know-how substances utilized in those articles.

Tabel 7. Science Material Trends

Level of education	Materials		
	Physic	Chemical	Biology
College	Measurement	Katabolism	Plants and Animals
	Substance and Change	Proteins and Lipids	Environmental Pollution
	Waves	Amino Acid & Protein Metabolism	Environmental Sustainability
	Optical	Elements & Compounds	Fermentation
	Simple Machine	-	-
Senior High School	Parabolic motion	-	-
	Momentum and Impulse	-	-
	Collision	-	-
	Heat	Colloidal Substance Synthesis	-
	-	Chemical equilibrium	-
	-	Saponification Reaction	-
	Effort	-	Human Skeletal Muscles
Junior High School	Simple Plane Physics and Its Application in Everyday Life	-	Object Classification
	Light	-	Biotic & Abiotic Environment
	Sound waves	-	-
Primary School	-	-	Ecosystem
Total	14	7	9

Creative Thinking Skills Indicator

These articles also are analyzed primarily based totally on signs of innovative wondering talents, which encompass flexibility, fluency, originality, and elaboration (Saregar, Cahyanti, Misbah, Susilowati, Anugrah, & Muhammad, 2021). Based on desk 8, the achievement price of innovative wondering talents primarily based totally on relative signs is withinside the medium category. Indicators of innovative wondering talents which have skilled achievement are signs of pliability and originality (novelty), with respective probabilities of 81% and 80%. This is due to the fact college students are capable of generate thoughts which can be a bit uncommon or precise in answering the questions or issues given. Solutions or thoughts supplied with the aid of using college students have a tendency to be new and feature opportunity solutions. Originality is the cappotential to generate precise or unpredictable thoughts (Ernawati et al., 2019). Therefore, this indicator withinside the evaluation of articles has skilled numerous achievement. Meanwhile, the ability indicator additionally has a excessive achievement price. Flexibility is an cappotential associated with the quantity of thoughts or solutions

which can be generated. Not handiest ought to there be many solutions, however the solutions ought to additionally be varied. This is likewise associated with the manner college students clear up issues, wherein every now and then they could produce multiple answer (Ernawati et al., 2019).

Tabel 8. Percentage of Success Indicator of Creative Thinking

Creative thinking indicator	Success Percentage		
	High	Medium	Lower
Smoothness	14%	79%	7%
Flexibility	6%	81%	13%
Originality	10%	80%	10%
Elaboration	7%	73%	20%

The fulfillment of this indicator is extensively implemented the use of problem-primarily based totally fashions in order that the issues given require college students to locate solutions, thoughts and numerous solutions to remedy issues, as said with the aid of using Sumarni (2020) that giving demanding situations at every step of PBL can encourage college students to locate data /procedure in actual lifestyles that helps the data acquired from the school. Students have began out to reveal their flexibility and elaboration competencies with the aid of using questioning flexibly and widely in giving arguments. Even so, primarily based totally at the effects of the evaluation of the article, the fulfillment charge withinside the excessive class is pretty low for all signs or even withinside the low class, the elaboration indicator is pretty excessive, particularly 20%. Therefore, this may be a notice and data for similarly research.

Conclusion

This observe indicates that innovative wondering abilties in technology gaining knowledge of may be carried out the usage of diverse models, specially the PBL and PjBL models. Science cloth that may be carried out to innovative wondering abilties consists of substances that do sensible paintings or observation. As nicely as CTS signs which might be extensively used, those encompass fluency, flexibility, originality, and elaboration; the best success signs are originality and flexibility.

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Author Contributions
The authors in this article have their respective roles and contributions to the research conducted. First, the author collects article data in international and national journals with the keywords creative thinking skills. The author plays the role of sorting articles in accordance with the provisions of the method used. The author also plays a role in the analysis of articles in the form of models, methods, learning strategies, research subjects, teaching materials, research topics, research results and linkages of articles with the topic of creative thinking skills and the author also performs statistical data analysis and interprets data based on the results of the data obtained.

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Conflicts of Interest
Conflicts of interest in this research can occur between researchers and related educational institutions. For example, when researchers have academic graduation requirements to publish in a place that meets institutional requirements, this can affect the selection of research designs, research subjects, methods and interpretation of data to obtain the expected results. This conflict can endanger the integrity of the researcher as an academic.

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