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Article

Teaching Materials in Creative Thinking Skills-Based Learning: A Systematic Literature Review

Muhamad Khoirul Anwar[1*], Suratno[2], Hikmah Buroidah[3], M. Ubaidillah Hasan[4]

[1,2,3,4] Universitas Jember, Indonesia

**Corresponding Address: khoirul.anwar@unej.ac.id*

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ABSTRACT

Teaching materials designed for creative thinking skills are very important because they guide students to develop innovative problem-solving skills and think outside the box. The purpose of this study is to analyze the characteristics of effective teaching materials in supporting creative thinking skills-based learning, and to identify the essential components that must be present in teaching materials to develop these skills. This study is a systematic literature review that describes teaching materials in creative thinking skills-based learning in the field of biology education. This study synthesizes 11 of 42 articles published between 2021–2024 in Sinta 2–4 journals obtained based on the formulation of the problem. The study results consistently demonstrate the dominance and crucial role of digital-based teaching materials in significantly enhancing students' creative thinking skills. These digital resources are uniquely designed with embedded features like multimedia integration, Problem-Based Learning (PBL) scenarios, and open-ended questions, thereby creating a highly interactive, flexible, and relevant learning environment aligned with 21st-century demands. The efficacy of these digital tools is strongly reinforced through their integration with active learning strategies such as PBL and Inquiry-Based Learning, This finding offers significant novelty by providing empirical evidence that locally-adapted digital products are a primary catalyst for pedagogical transformation. The practical implication is that educators must shift their focus from mere information delivery to designing rich learning experiences that explicitly demand students to generate, test, and validate their own creative ideas, preparing them for future complexity.

INTRODUCTION

21st century education requires students to not only master knowledge, but also develop high-level thinking skills, one of which is creative thinking skills. These skills are considered key to facing complex global challenges, solving problems innovatively, and creating sustainable solutions (Runco, 2020). Learning based on creative thinking skills is becoming an increasingly important approach to encourage students to think outside the box, generate original ideas, and apply knowledge contextually (Beghetto & Kaufman, 2014). However, this implementation approach requires the support of teaching materials specifically designed to stimulate and develop creative thinking skills.

Creative thinking skills are essential for navigating the challenges of the 21st century, enabling individuals to generate novel ideas, solve problems innovatively, and adapt to rapidly changing environments. Research highlights that these skills can be developed and enhanced through targeted educational strategies and supportive learning environments. Creative thinking is typically defined by several interrelated abilities: (1) fluency: Generating many ideas or solutions, (2) flexibility: approaching problems from multiple perspectives, (3) originality: producing unique or novel ideas, (4) elaboration: Expanding on ideas with detail and depth (Tam, et al., 2023).

Teaching materials are a crucial component in the learning process, acting as a connecting medium between the curriculum, teachers, and students (Tomlinson, 2012). Unfortunately, many teaching materials currently available are still conventional and do not encourage students to think creatively (Saputri et al., 2021). Therefore, an in-depth study is needed regarding the characteristics of teaching materials that are effective in supporting learning based on creative thinking skills. Although the importance of creative thinking skills has been widely recognized, there is still a gap between expectations and the reality of their implementation in the world of education. Some of the problems that are often faced include: (1) the lack of teaching materials specifically designed to develop creative thinking skills (Henriksen et al., 2020), (2) the mismatch between teaching materials and students' needs in honing creative thinking skills (Naziah & Maimunah, 2024), and (3) the lack of guidance for educators in selecting or developing teaching materials that support this learning approach (Azmi et al., 2024). The learning that is carried out also does not use media or teaching materials that can be used by students who have various learning styles. This makes it difficult for students to understand the material because they only follow instructions and do not have a book that can be used as a study guide

The purpose of this study is to perform a systematic and focused literature review to analyze the characteristics of teaching materials that effectively support creative thinking skills in Biology learning. This review is essential because it moves beyond general discussions of pedagogy to specifically identify and map the critical design components that must be present in digital and innovative teaching materials to develop these skills. The novelty of this study lies in its focused attention on synthesizing fragmented findings (many sourced from Sinta-indexed literature) to provide a comprehensive, practical framework on how teaching materials—rather than just methods—can be engineered to stimulate creative thinking, such as generating original ideas and solving innovative problems. Ultimately, this study aims to offer evidence-based, practical recommendations for Biology educators and curriculum developers, serving as a vital reference for improving the quality of learning through the development of innovative, skill-oriented teaching materials for the 21st century.

This study aims to systematically review empirical studies published between 2021–2024 on the use of teaching materials in biology education to foster students' creative thinking, focusing on the types of materials, instructional strategies applied, and their reported effectiveness. In addition, this study will identify the characteristics of teaching materials that can encourage active student involvement in the learning process, such as interactivity, communication, and relevance to real life. By understanding the key elements in the preparation of teaching materials, it is hoped that educators can design materials that are not only educational but also able to stimulate students' imagination and exploration. This study will examine various approaches based on technology and digital media that can support the development of creative thinking skills in the digital era. The results of this study are expected to provide a significant contribution to improving the effectiveness of learning and creating a more inspiring and innovative learning environment.

Previous studies have extensively highlighted the importance of creative thinking skills in learning; however, research focusing on the systematic design and comprehensive impact of dedicated teaching materials as the primary development medium remains fragmented and

limited. While existing literature often demonstrates the effectiveness of certain teaching methods (e.g., Problem-Based Learning), it tends to be partial by failing to provide a comprehensive, integrated framework detailing *how* teaching materials themselves should be specifically engineered to maximize creative thinking outcomes (Henriksen et al., 2020). Crucially, there is a lack of systematic literature review that integrates these disparate findings to offer practical, evidence-based guidelines for educators on designing and implementing creative thinking-oriented teaching materials (Suryani et al., 2020).This study offers novelty by conducting an in-depth analysis of various literature related to teaching materials and creative thinking skills, as well as compiling a conceptual framework that can be used as a reference in developing teaching materials. In addition, this study also identifies current trends and challenges in the development of teaching materials based on creative thinking skills, which have not been widely discussed in previous studies (Rahman & Latif, 2020). This research is important to conduct because it can make a significant contribution to the world of education, especially in improving the quality of learning through the development of innovative teaching materials. The results of this study are expected to be a reference for educators, curriculum developers, and researchers in designing and implementing effective teaching materials to develop students' creative thinking skills. Thus, this study not only has academic value, but also high practical relevance (Hidayati & Asy'ari, 2020).

METHODS

2.1. Research Design

This study aims to describe the teaching materials used in creative thinking skills-based learning. This study uses a qualitative research approach with a systematic literature review design to answer the research objectives. The systematic literature review research design of this study uses various primary literature sources from academic journals with the keywords creative thinking, creative thinking skills teaching materials.

2.2 Participants

This study uses articles with the keywords creative thinking, creative thinking skills teaching materials in 2021-2024 from Sinta databased. The results obtained 42 articles collected as the basis for describing teaching materials in creative thinking skills-based learning in the field of biology education.

We selected and identified articles from a total of 42 articles according to the criteria according to the formulation of the research problem. After reading and identifying the contents of the article as a whole, we found 11 articles that were in accordance with the formulation of the research problem. Furthermore, in general, the in-depth article review process was carried out on Sinta journals ranked 2 to 4 is described PRISMA flow diagram in Figure 1.

The provided PRISMA flow diagram clearly illustrates the systematic process of literature selection, beginning with the Identification stage where a total of 64 records were found from databases and registers. After removing 10 duplicates and irrelevant records, 42 records proceeded to the Screening stage, where an initial review of titles and abstracts led to the exclusion of 2 reports. The Full-Text Assessment stage began with 40 reports sought for retrieval, all of which were successfully accessed. During the final assessment for eligibility, a significant number of 29 reports were excluded because they did not align with the specific problem formulation of the study. Consequently, the meticulous filtering process concluded with 11 final studies deemed eligible and included for detailed analysis in the systematic review.

2.3 Data Collection Tool

The data collection tool uses a search engine that can identify articles from reputable national journals related to the problem formulation. The search keywords for articles are creative thinking, creative thinking skills teaching materials. The search engine that identifies articles in the national database in this study is Sinta.

This study also uses inclusive and exclusive criteria to select articles. The inclusive criteria to answer the problem formulation are focused on the theoretical framework of creative thinking skills, teaching materials in learning creative thinking skills, and the use of these teaching materials in learning. The suitability of the inclusive criteria by reading and understanding the entire article. Articles that do not meet the inclusion criteria and do not match the problem formulation are included in the exclusive criteria category.

2.5. Data analysis

This study uses data extraction to analyze data. This data analysis involves synthesizing the results of the interpretation of each article that falls into the inclusion criteria category. The analysis of the interpretation of the research results brings up new findings that describe open materials and their application in creative thinking skills. Data were taken from 11 articles to answer the problem formulation. This extraction activity accommodates the findings and conclusions of the study. We identified twelve articles by creating a table of article characteristics that contains several components, namely article sources, research design, number of samples, result and comparing conclusion.

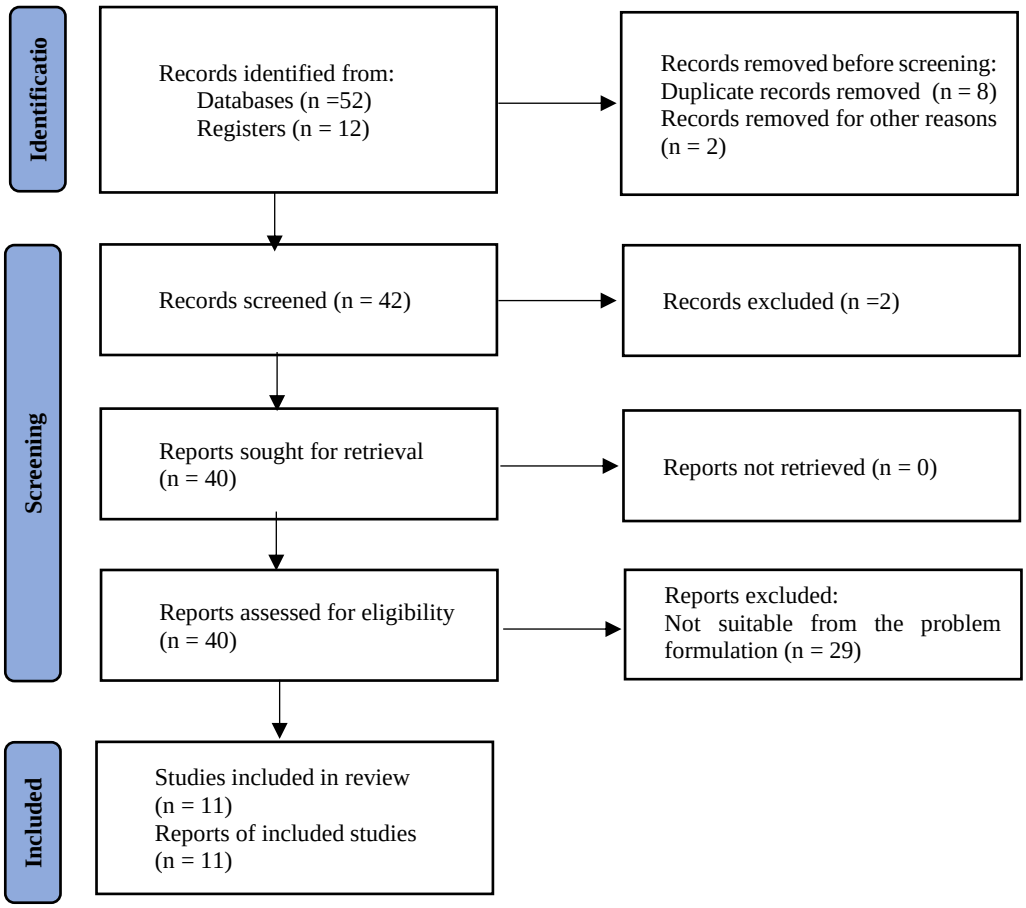

Figure 1. PRISMA Flow Diagram

RESULTS AND DISCUSSION

Identifying articles that meet inclusive criteria to answer the results of the problem formulation as many as 11 articles. These articles formulate new research results to describe teaching materials in creative thinking skills. Table 1 presents a summary of article characteristics based on article sources, design, sample, teaching material, and results. These five things are the basis for describing teaching materials in creative thinking skills and their application. Based on table 1, it can be seen that there are various kinds of teaching materials used in learning creative thinking skills. As part of the learning tools, teaching materials

become an important part of the learning process. In these studies, teaching materials play an important role in improving creative thinking skills. The teaching materials used are applied using certain learning models as instructions in delivering teaching materials to students.

Tabel 1. Analysis of Article Characteristics

No.	Author	Design	Sample	Result	Comparing conclution
1	Wikanta, et al	RnD	37	Mobile AR Model significantly increased students' average score on creative thinking skills.	Confirms that integrating Augmented Reality (AR) in lab work is effective for developing higher-order thinking skills and supports the mobile learning trend..
2	Ardiansah & Zulfiani	RnD	38	E-LKPD product developed was proven effective in training students' creative thinking skills.	Provides a valid and contextualized e-LKPD product. Effective because it engages students in constructing understanding from real-world problems.
3	Aini, et al,	ES	34	Significant difference in the increase of creative thinking skills in the experimental group (using Linktree).	Reinforces that the use of Linktree media within the *Discovery Learning* model is highly effective and offers a user-friendly digital alternative
4	Cahyanti, et al	ES	N/A	E-Biotechnology Module successfully improved students' creative thinking skills.	Establishes that using an E-Biotechnology Module based on local potential is a practical and effective teaching material for enhancing thinking skills
5	Cahyanti, et al	RnD	15	Insect Encyclopedia E-Book developed and declared highly valid and practical for creative thinking training.	Contributes a high-quality digital product (e-book) that is practical for training creative thinking skills in high school students
6	Kautsaranny	RnD	20	Interactive Biodiversity E-Book was declared very practical and suitable for training creative thinking.	Supports the literature that interactive media (not passive reading) is highly efficient and recommended for use in Biology learning.
7	Sundari et al	ES	22	Pop Up Book media resulted in a "Very Good" average student score (80) on creative thinking ability.	Demonstrates that physical, 3D media (*Pop Up Books*) remains highly effective and relevant in fostering creative thinking at the junior/senior high school level.
8	Ginting	RnD	20	E-LKPD based on PBL showed 88.5% effectiveness in strengthening creative thinking skills.	Provides strong, evidence-based data that combining e-LKPD with *Project Based Learning* is a robust and successful method.

No.	Author	Design	Sample	Result	Comparing conclution
9	Aprillia et al	RnD	33	Web-based learning media (Glideapps) was deemed feasible and effective in improving creative thinking skills.	Confirms the potential of using easily accessible web-based media (*Glideapps*) as an innovative tool to foster creative thinking in the digital age.
10	Arsena	RnD	N/A	LKPD *Microgreen* based on PJBL was developed and declared valid.	Contributes a validated LKPD product that is ready for implementation, focusing on *Project Based Learning* in the context of plant growth.
11	Triandro	RnD	N/A	E-Book based on *Project Based Learning* was declared valid and highly feasible for use.	Contributes a high-quality E-book product, indicating that the integration of the PJBL model is strongly recommended for curriculum design.

The table shows that research using certain teaching materials can improve creative thinking skills. This is supported by the findings of Afianti & Ibrahim (2021) showing that the use of open-ended problem-based teaching materials significantly improves students' ability to generate original ideas and innovative solutions. In addition, Fatimah (2018) also confirmed that teaching materials designed with an inquiry-based project approach are able to stimulate students' creative thinking skills through complex exploration and problem-solving processes. Furthermore, research conducted by Putri et al. (2019) states that teaching materials that integrate creative activities, such as brainstorming and project design, can improve students' different thinking skills. Thus, it can be concluded that the use of teaching materials that are designed innovatively and contextually has an important role in developing students' creative thinking skills.

The teaching materials in the research found were digital-based. The development of digital teaching materials has brought significant changes in the world of education, enabling a more interactive, flexible, and student-oriented learning process (Suryani & Setiawan, 2020). Digital teaching materials not only make it easier for teachers to deliver material, but also increase student learning motivation through the use of multimedia such as videos, animations, and interactive simulations (Efendi & Wahidy, 2019). This development is supported by technological advances such as artificial intelligence and cloud computing, which allow learning to be accessed anytime and anywhere (Picauly, 2024). In addition, well-designed digital teaching materials can improve students' understanding of concepts through clearer visualizations and examples that are relevant to everyday life. The use of digital teaching materials also requires teachers to be more creative in designing learning so that it remains interesting and in accordance with the needs of students in the digital era. However, challenges such as limited access to technology and the digital divide are still obstacles that need to be overcome so that the benefits of digital open materials can be felt evenly.

Effective teaching materials in supporting creative thinking skills should be designed interactively and challengingly, by integrating approaches such as Creative Problem Solving (CPS) and Challenge-Based Learning (CBL). The CPS approach has been shown to improve students' creative thinking skills in solving real problems (Rachmahniah, 2022). In addition, the use of the CBL model that combines project-based, problem-based, and real-world learning can stimulate students' creative learning (Rahmatillah & Ardiansyah, 2023). The development of e-modules using the Book Creator application that is tailored to the needs of students and teachers, and packaged with a scientific approach, can also improve creative thinking skills (Qomara et al., 2024). Thus, the integration of technology and appropriate learning approaches in electronic open materials can significantly improve students' creative thinking skills.

Effective teaching materials should not only present information but also actively engage students in a way that challenges their thinking and problem-solving abilities. If learning materials remain static and unengaging, students may struggle to develop the creative flexibility needed to tackle complex, real-world problems.

The findings clearly establish that innovative, digital-based teaching materials—specifically those integrating multimedia, open-ended problems, and Problem-Based Learning (PBL) elements—are the cornerstone for enhancing students' creative thinking skills. The practical implication for educators and curriculum developers is immediate and clear: efforts must shift from revising content to re-engineering the instructional medium itself, prioritizing the design of materials that function as scaffolds for autonomous exploration and complex problem-solving. These materials, implemented alongside active strategies like Inquiry-Based Learning, directly foster essential 21st-century skills. For future research, this review highlights two critical next steps: there is an urgent need to validate the efficacy of these novel digital instructional materials through rigorous quasi-experimental research designs to confirm their causal impact on creative thinking metrics, and future studies should explore the integration of these materials with Artificial Intelligence (AI) tools to personalize learning pathways and refine the automated assessment of creative output.

In terms of improving creative thinking skills, teaching materials require specific characteristics. These characteristics include: Teaching materials designed to improve creative thinking skills should include open-ended questions, problem-solving scenarios, and opportunities for students to analyze, evaluate, and synthesize information (Facione, 2015). In addition, teaching materials should encourage active learning, where students engage in discussions, debates, and collaborative activities to explore multiple perspectives (Ennis, 2018). The use of real-world problems and case studies is also important, as it allows students to apply theoretical knowledge to practical situations (Halpern, 2014). Teaching materials also need to provide guidance for reflection and self-assessment, so that students can evaluate their own thinking processes and learning outcomes (Paul & Elder, 2019). Finally, teaching materials should be designed to challenge students' assumptions, encourage curiosity, and promote intellectual humility by introducing multiple viewpoints (Brookfield, 2017). In addition, the use of open-ended questions and problem-solving scenarios not only helps students develop creative thinking skills, but also trains them to deal with uncertainty and complexity in decision-making. Thus, well-designed teaching materials should not only focus on providing information, but also on creating a learning environment that stimulates discussion and in-depth exploration of ideas.

Several studies reviewed show that the teaching materials created are often implemented using certain learning models to maximize their effectiveness. For example, the problem-based learning model (PBL) has been shown to be effective in improving students' creative thinking skills when the teaching materials are designed to facilitate investigation and problem solving (Hmelo-Silver, 2004). In addition, the Inquiry-Based Learning model is also often used, where teaching materials are designed to guide students through a process of independent discovery and exploration (Lazonder & Harmsen, 2016). The Cooperative Learning model is also widely applied, with teaching materials that encourage collaboration between students to achieve common learning goals (Johnson & Johnson, 2018). The implementation of teaching materials through these learning models not only improves conceptual understanding but also develops students' social and metacognitive skills (Prince & Felder, 2006). Penggunaan model pembelajaran yang tepat dalam implementasi bahan ajar menjadi faktor kunci dalam meningkatkan kualitas pembelajaran, karena setiap model menawarkan pendekatan unik yang dapat disesuaikan dengan kebutuhan siswa. Namun, penting untuk mempertimbangkan bahwa efektivitas suatu model pembelajaran juga bergantung pada kesiapan guru dan siswa dalam mengadaptasi metode tersebut ke dalam konteks pembelajaran yang beragam.

CONCLUSION

The findings clearly establish that innovative, digital-based teaching materials—specifically those integrating multimedia, open-ended problems, and Problem-Based Learning (PBL) elements—are the cornerstone for enhancing students' creative thinking skills. This study provides novelty by demonstrating that the trend of digital instructional materials consistently supports thinking skills in Biology learning, a relationship that has not been systematically mapped and synthesized within the existing Sinta literature. The practical implication for educators and curriculum developers is immediate and clear: efforts must shift from revising content to re-engineering the instructional medium itself, prioritizing the design of materials that function as scaffolds for autonomous exploration and complex problem-solving. Teachers can prioritize the development of PBL/Inquiry-Based digital teaching materials to effectively encourage the acquisition of creative and critical thinking skills. These materials, implemented alongside active strategies like Inquiry-Based Learning, directly foster essential 21st-century skills. For future research, this review highlights two critical next steps: there is an urgent need to validate the efficacy of these novel digital instructional materials through rigorous quasi-experimental research designs to confirm their causal impact on creative thinking metrics, and future studies should explore the integration of these materials with Artificial Intelligence (AI) tools to personalize learning pathways and refine the automated assessment of creative output.

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