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Trends and effectiveness of web-based mathematics learning media in fostering creative thinking in primary education: A systematic review

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Abstract:
This study evaluates the trends and effectiveness of web-based learning media in fostering creative thinking in elementary mathematics education through a Systematic Literature Review (SLR). Data were collected from Scopus and screened using clearly defined inclusion and exclusion criteria based on population, intervention type, study design, and creativity-related outcomes. Of the 36 identified documents, 7 met all criteria and were analyzed. The findings indicate a substantial increase in the use of web-based mathematics media over the last five years, driven by digital transformation and the demand for interactive learning environments. Web-based media were shown to enhance creative thinking through simulations, dynamic visualisations, and contextual problem-solving tasks. However, effectiveness depends on media design, pedagogical strategies, digital infrastructure, and teacher readiness. This review highlights the need for developing creativity-oriented web-based mathematics media that directly support higher-order thinking.

Keywords: Creative Thinking; Elementary School; Mathematics Learning; Systematic Literature Review; Web-Based Learning Media.

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Introduction

Creative thinking is a crucial competency in 21st-century mathematics education, especially at the primary level (Schoevers et al., 2019; Yayuk & As'ari, 2020).

Mathematics learning that emphasizes creative thinking enables students to explore ideas, understand concepts meaningfully, and develop innovative solutions to problems (Khalid et al., 2020; Umam et al., 2025). In a rapidly changing world, these skills are increasingly important for helping students navigate academic and real-life challenges (Rusmin et al., 2024; Thornhill-Miller et al., 2023).

The use of web-based learning media has become one of the most promising approaches for supporting creative thinking development (Pertiwi et al., 2024; Simanjuntak et al., 2021). Its interactive features, accessibility, flexible learning pathways, and multimodal content make it suitable for enhancing engagement in mathematics learning (Haleem et al., 2022; Halimatusyadiah & Disman, 2023). Given that today's learners are familiar with digital technologies, integrating web-based media into the mathematics classroom has become increasingly relevant.

Web-based learning media brings an innovative approach in improving the teaching and learning process (Ahmar et al., 2024; Novi Prayekti, 2020). These technologies not only modernize teaching methods but also foster the development of critical skills, including creative thinking and problem-solving abilities (Hrybiuk, 2019). One of the main advantages of web-based media is the high level of interactivity (Moch. Sukardjo & Sugiyanta, 2018). Students can engage directly through various interactive features, such as simulations and educational games, which make learning more interesting and fun. In addition, the accessibility and flexibility offered by this media allows students to learn anytime and anywhere, giving them the freedom to adjust to the pace and time that is most convenient for them (Huang et al., 2020).

Although the use of web-based learning media in basic education continues to grow, its effectiveness in fostering students' creative thinking skills still requires further research (Astuti et al., 2020; Pertiwi et al., 2024). Significant changes in the way students learn and interact with mathematics subject matter have occurred, but the extent to which these media can actually improve students' creative thinking skills is still a question that requires stronger evidence. In today's digital era, where students are increasingly accustomed to technology, it is crucial to evaluate the extent to which web-based media can fulfill educational objectives, particularly in the development of students' creative thinking skills.

This research aims to explore the trend of using web-based learning media in basic education and analyze its effectiveness in fostering students' creative thinking skills. By reviewing relevant studies and literature, this research is expected to provide deeper insights into the potentials and challenges faced in implementing this medium. It is also hoped that the results of this research can contribute to the development of more innovative learning strategies that can motivate students to be more active, creative and engaged in the mathematics learning process.

In addition, although much research has been conducted on the use of web-based media in education, there is still a gap in the understanding of how effective these media are in fostering students' creative thinking skills. Therefore, this study aims to evaluate the methods and strategies used in web-based mathematics learning, to ensure that students are not only passively receiving information, but also actively and creatively engaged in the learning process. Through this systematic review, it is expected to find existing trends and patterns, as well as various factors that influence the success of the application of web-based learning media in developing students' creative thinking skills. The results of this study are expected to contribute to the development of a more effective and innovative curriculum in mathematics learning at the primary level, which

not only prioritizes concept understanding but also inspires students to think creatively and innovatively. None of the existing studies specifically develops or evaluates web-based mathematics media designed to enhance creative thinking at the primary level, indicating a critical research gap addressed in this review.

Although numerous studies have explored digital, STEM-based, or multimedia-supported mathematics learning, the literature still lacks (1) web-based mathematics media specifically designed to foster *creative thinking* at the primary school level; (2) empirical studies that evaluate creativity-focused learning mechanisms within website platforms; and (3) comparative evidence explaining which media design features directly contribute to creative thinking outcomes. These gaps indicate the need for a systematic synthesis that maps existing trends, identifies effective web-based features, and outlines future directions for creativity-oriented web-based mathematics learning tools.

Research Methods

This research uses the Systematic Literature Review (SLR) method to examine the trends and effectiveness of web-based mathematics learning media in fostering students' creative thinking skills at the elementary education level. To formulate the research questions, the PICOS (Population, Intervention, Comparison, Outcome, Study type) approach was used (Eriksen & Frandsen, 2018), namely: population in elementary school students, intervention in the form of website-based mathematics learning media, comparison with learning without website-based media, outcome in the form of creative thinking skills, and the types of studies examined are quantitative, qualitative, and mixed studies.

Table 1. Inclusion and Exclusion Criteria

Criteria	Inclusion	Exclusion
Population	Primary/elementary school students	Secondary, tertiary, and early childhood
Intervention	Web-based/website-based/online/digital learning media for mathematics	Non-digital or offline media
Study Design	Empirical studies (quantitative, qualitative, mixed)	Reviews, theoretical papers, book chapters
Outcome	Creative thinking/creativity indicators	Non-creativity outcomes only
Source Type	Scopus-indexed journals	Non-journal sources
Language	English	Non-English
Publication Year	2004-2024	Before 2004
Access Type	Any	-

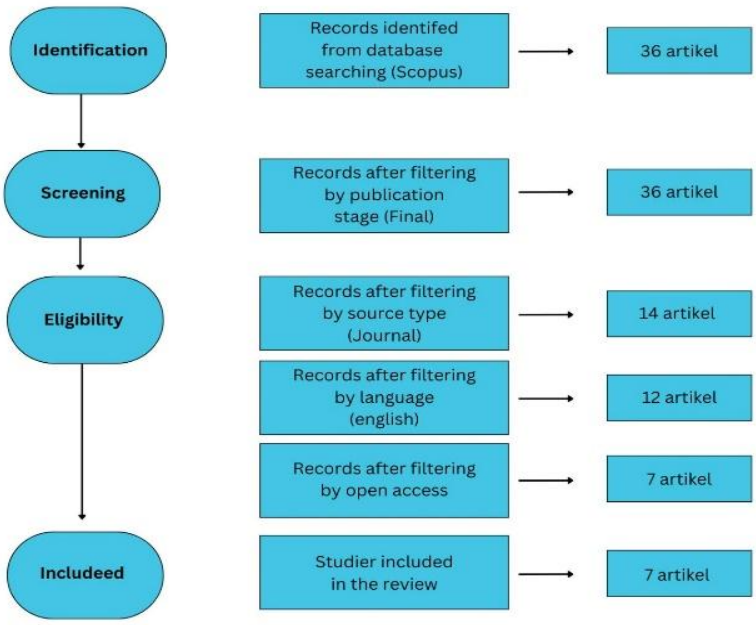
Based on this approach, the main research question was formulated: What are the design characteristics and pedagogical strategies of web-based mathematics learning tools that effectively foster creative thinking in elementary school students? Based on the Research Query, the keywords used were (“web-based” OR “website-based” OR

"online" OR "digital") AND ("mathematics" OR "math") AND ("primary school" OR "elementary school") AND ("creativity" OR "creative thinking").

The Systematic Literature Review method is carried out through five main stages, namely: (1) systematically formulating research questions, (2) identifying and searching for articles relevant to the research focus, (3) conducting a selection process by setting inclusion and exclusion criteria for the articles that have been collected, (4) analyzing and presenting the data obtained, and (5) interpreting the findings of the selected articles to finally conclude from the review results (Bettany-Saltikov & McSherry, 2024; Sauer & Seuring, 2023).

Articles were collected from the Scopus database spanning the years 2004 to 2024 using the keywords TITLE-ABS-KEY (("web-based" OR "website-based" OR "online" OR "digital") AND ("mathematics" OR "math") AND ("primary school" OR "elementary school") AND ("creativity" OR "creative thinking")) AND PUBYEAR > 2003 AND PUBYEAR < 2025 AND (LIMIT-TO (PUBSTAGE, "final")) AND (LIMIT-TO (SRCTYPE, 'j')) AND (LIMIT-TO (LANGUAGE, 'English')) AND (LIMIT-TO (OA, 'all')). The search was conducted using an official subscription account belonging to Universitas Muhammadiyah Malang. Data simulation uses the "Analyze search results" available on the Scopus system. To enrich the data and analysis, the data was exported to *CSV (to visualize the data process with VOSviewer and RStudio) and *RIS (to synchronize with Mendeley) formats.

In the literature review process, this study followed the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) procedure to ensure the quality of article selection and analysis (Parums, 2021). The selection process starts from the identification stage (36 articles), initial screening selects the final publication stage (remaining 36 articles), source type select journal (leaving 14 articles), language selects English (remaining 12 articles), Open access selects all open access until finally seven articles are obtained that meet all inclusion criteria. This selection process is visualized in the following PRISMA chart.



Picture 1. Flowchart of the Prism

Results and Discussions

Analysis of the Most Cited Articles Globally

An overview of the articles that have attracted the most attention from researchers in the form of the most cited articles is presented in Table 1 below.

Table 2. Most Globally Cited Documents

No	Document title	Authors	Source	Citations	Research Design	Sample	Key Variables	Main Findings	Limitations
1	Developing mathematical thinking in the primary classroom: liberating students and teachers as learners of mathematics	Hudson B.; Henderson S.; Hudson A.	Journal of Curriculum Studies, 47 (3), 374-398, 2015	33	Design-Based Research	24 teachers	Mathematical thinking	Blended learning improved creative & reflective math thinking	Not specific to web-based media
2	Makerspaces Fostering Creativity: A Systematic Literature Review	Soomro S.A.; Casakin H.; Nanjappan V.; Georgiev G.V.	Journal of Science Education and Technology, 32 (4), 530-548, 2023	29	SLR	34 studies	Creativity, makerspace	Makerspaces enhance the creative process & product	Not specific to mathematics
3	Quantum physics literacy aimed at K-12 and the general public	Foti C.; Anttila D.; Maniscalco S.; Chiofalo M.L.	Universe, 7 (4), 2021	26	Platform evaluation	K-12 students	Gamification, digital literacy	Gamified web platform improves conceptual understanding	Focus on physics, not math
4	The Influence of STEM-Based Digital Learning on 6C Skills of Elementary School Students	Zainil M.; Kenedi A.K.; Rahmatina; Indrawati T.; Handrianto C.	Open Education Studies, 6 (1), 2024	6	Quasi-experiment	200 students	STEM digital learning, 6Cs	Digital STEM boosts creativity significantly	Not math-specific media
5	Developing a handbook on multimedia integration in mathematics teaching for Indonesian primary school students	Susanto H.A.; Hobri; Nugrahaningsih T.K.	International Journal of Education in Mathematics, Science and Technology, 9 (2), 236-251, 2021	6	R&D	Primary students	Multimedia integration	Digital multimedia enhances engagement & understanding	Not fully web-based
6	Enhancing Mathematics Quality of Instruction (MQI)	Firdaus F.M.; Yuliana L.; Prasojo L.D.; Akalili A.;	International Journal of Information and Education	1	Quasi-experiment	Pre-service teachers	Digital flipbook, MQI	Digital media increases instructional quality &	Target is teachers, not students

No	Document title	Authors	Source	Citations	Research Design	Sample	Key Variables	Main Findings	Limitations
	Competency in Pre-Service Teachers through Digital Flipbooks: Digital Didactics Design	Wibowo S.; Maulyda M.A.	Technology, 14 (12), 1770-1778, 2024					creativity	
7	Perspectives on STEAM Education during the COVID-19 Pandemic at an Underprivileged Elementary School in Thailand	Phonnong I.; Keeraticha mroen W.	International Journal of Science, Mathematics and Technology Learning, 30 (2), 15-32, 2023	1	Case study	1 elementary school	STEAM digital activities	STEAM increases creativity & confidence	Infrastructure limitations

The article "Developing Mathematical Thinking in the Primary Classroom: Liberating Students and Teachers as Learners of Mathematics" by Hudson et al. (2015) examined the effect of a blended learning-based professional development program on improving mathematical thinking skills and changing pedagogical attitudes of primary school teachers. Through a design-based research approach, the study involved 24 teachers in Scotland who attended a postgraduate course entitled Developing Mathematical Thinking in the Primary Classroom and revealed an epistemological transformation from a fundamentalist mathematical view (rigid, procedural, and oriented towards right-wrong answers) to a fallibilist approach that is more open to exploration, creative thinking, and learning from mistakes. The course facilitated online reflective discussions, classroom action research projects and the integration of critical literature that challenged long-held beliefs about mathematics, so that teachers experienced increased confidence, pedagogical skills and awareness of the importance of providing space for students to question, err and construct understanding independently. The findings confirm that creative and meaningful mathematics learning can be facilitated through curriculum design that gives teachers autonomy and creates learning environments that encourage exploration and reflection. While not directly evaluating web-based media, this study provides a conceptual foundation that effective mathematics learning media should be of high epistemic quality, free teachers and students from procedural pressures, and facilitate reflective interactions - all of which are relevant in assessing the effectiveness of web-based media in fostering creative thinking in primary education contexts.

The article "Makerspaces Fostering Creativity: A Systematic Literature Review" by Soomro et al. (2023) makes an important contribution in explaining how makerspaces, creative learning spaces that integrate digital fabrication technologies, play a role in fostering creativity in STEM education, including at the primary education level. In a review of 34 articles, the authors identified four main aspects of creativity facilitated by makerspaces: person (individual and collaborative creative competence), environment (social and physical factors), process (creation process), and product (creative outcome or prototype). This study shows that web-based learning media that adopt makerspace principles, such as the use of digital design tools and 3D printing, are able to build an

environment that supports the exploration of ideas, cross-disciplinary collaboration, and active student engagement, all aspects that are instrumental in fostering creative thinking. Although most studies are still centred in higher education, this study found that the use of makerspaces at the elementary level (although only 12% of the total studies) also shows great potential in improving students' creative thinking skills, especially through project-based and experiential learning approaches. The study also highlighted that subjective methods still dominate creativity evaluation. It recommended the use of more objective creativity assessment tools such as the Torrance Test for Creative Thinking (TTCT) or the Creative Solution Diagnosis Scale (CSDS).

The article "Quantum Physics Literacy Aimed at K12 and the General Public" (Foti et al., 2021) offers important insights into the discussion on the effectiveness of web-based learning media in fostering creative thinking, particularly through gamification and experiential learning approaches. This article introduces the QPlayLearn online platform, designed to democratize access to quantum physics literacy through three learning approaches: Play, Discover, and Learn. The platform leverages Howard Gardner's theory of multiple intelligences to provide a multimodal learning path, with content that includes educational games, animated videos, virtual experiments, and formal math materials. One of the main contributions of this article is the application of gamification that not only enhances learners' cognitive and emotional engagement, but also builds scientific intuition that is essential in understanding abstract concepts - something that is highly relevant for fostering creative thinking in elementary school students. In the context of mathematics education, platforms like QPlayLearn show how web-based media can structure interactive, flexible and exploratory learning experiences that encourage students to actively engage, explore multiple representations and shape conceptual understanding through play and visualisation. The results of the platform implementation in the "Fun in Theory" event also showed positive responses from participants, who stated that games such as Psi & Delta and Quantum Playground helped them understand the basic concepts of quantum physics in a fun and intuitive way. Although the focus is on physics, the pedagogical approach used is very applicable in the context of web-based math learning, especially in building a creative, inclusive and meaningful learning environment that is in line with the objectives of this SLR.

The article "The Influence of STEM-Based Digital Learning on 6C Skills of Elementary School Students" by Zainil et al. (2024), although it only has six citations, makes a very relevant contribution to the analysis of the effectiveness of web-based digital learning media, especially in shaping 21st-century skills in elementary school students. This study used a quasi-experimental approach with 200 grade 5 students and compared two learning models: conventional STEM and digital-based STEM. The results showed significant improvement in all aspects of the 6Cs (Character, Citizenship, Critical thinking, Creative thinking, Collaboration, and Communication) in the group that used STEM-based digital learning. The most relevant finding for this SLR is that students' creative thinking improved markedly when they engaged in project-based activities supported by interactive digital media, simulations, online collaborative discussions, and concept exploration through multimedia tools. Students' creativity flourished because they were exposed to real-world problem solving, encouraged to design innovative solutions and had the opportunity to create original work using technological

approaches. The study also underscores the importance of digitizing STEM-based learning in the context of primary education as a means of encouraging divergent thinking, intellectual risk-taking, and strengthening reflective and collaborative learning. Therefore, this article supports the argument that web-based mathematics learning media designed in an integrative and contextual way are very effective in fostering creative thinking of primary school students, and become important empirical evidence in the trend map of digital learning innovations in the realm of primary education.

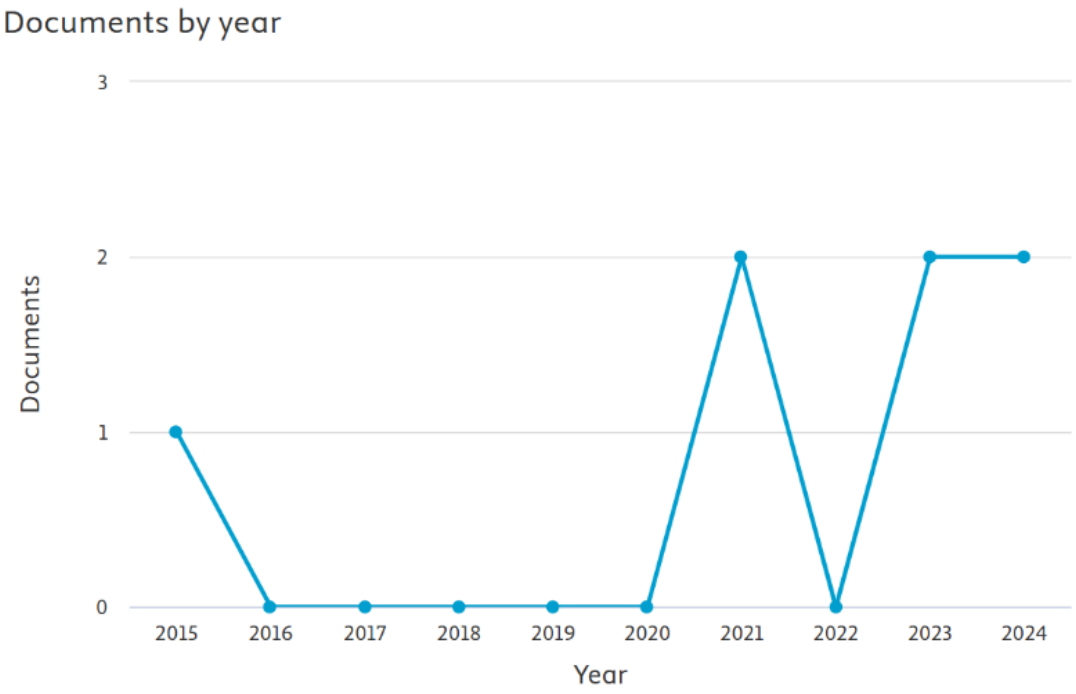
The article "Developing a Handbook on Multimedia Integration in Mathematics Teaching for Indonesian Primary School Students" by Susanto & Nugrahaningsih (2021) highlights the importance of developing digitally accessible multimedia-based learning media to improve the quality of mathematics learning in primary schools. Using a Research and Development (R&D) approach, this article was designed and test the effectiveness of a STEM-based guidebook that integrates multimedia technology into the math teaching and learning process. Findings from the experiment showed that students who used the guide experienced significant improvements in understanding and engagement in learning mathematics compared to the control group who used a conventional book. Expert validation showed that the guide was of high quality in terms of technical aspects, navigation, curriculum suitability and depth of content. The study also showed that teachers have a positive perception of the application of technology in learning, although there are still constraints in technical skills and access to facilities. In the context of SLR with a focus on web-based learning media to foster creative thinking, this article provides empirical evidence that interactive digital media designed with constructivist and contextual principles not only improve learning outcomes, but also encourage students' motivation, collaboration and explorative activities, all important elements in the development of creative thinking skills in mathematics learning at the primary level.

The article "Enhancing Mathematics Quality of Instruction (MQI) Competency in Pre-Service Teachers through Digital Flipbooks: Digital Didactics Design" by Firdaus et al. (2024) makes an important contribution to the discourse on the effectiveness of digital-based learning media, especially numeracy flipbooks, in improving the pedagogical competence of future elementary school mathematics teachers. Through a quasi-experimental approach with a pretest-posttest control group design, this study showed that the use of digital flipbooks not only resulted in a significant increase in Mathematics Quality of Instruction (MQI) scores but also exhibited a large effect (Cohen's d = 4.95), signifying a very strong positive impact on the quality of mathematics learning. Furthermore, the digital flipbook was shown to stimulate student engagement, clarify mathematical concepts through dynamic visualisation, and encourage creativity and mastery of technology by prospective teachers. These results reinforce the urgency of integrating interactive and adaptive web-based media in the context of basic education, and demonstrate the potential of such media in fostering students' creative thinking skills, which is one of the important indicators in 21st-century mathematics learning. This finding directly supports the relevance of SLR's research on the trends and effectiveness of web-based mathematics learning media, especially in the context of developing creative thinking at the primary school level.

The article "Perspectives on STEAM Education during the COVID-19 Pandemic at an Underprivileged Elementary School in Thailand" by Phonnong and Keeratichamroen (2023) provides in-depth insights into the implementation of STEAM curriculum through distance learning in the context of an underprivileged elementary school during

the pandemic, which is relevant to support the trend analysis of web-based mathematics learning media in fostering creative thinking. This study confirms that thematically designed and interactive STEAM activities significantly facilitate the development of students' creativity, encourage self-esteem, and enhance understanding of mathematical concepts and their real-life applications. However, major challenges arise from low literacy and limited access to adequate digital tools, which impact the effectiveness of online learning. This research shows that while digital platforms can be a powerful medium for creative transdisciplinary learning, their effectiveness is highly dependent on infrastructure readiness and students' basic competencies. Thus, this article strongly affirms the importance of web-based mathematics learning media design that is not only interactive, but also inclusive, contextual and adaptive to students' socio-economic conditions, making it an important reference in the framework of SLR's study on the effectiveness of web-based media in fostering creative thinking at the primary education level.

Analysis of Temporal Distribution by Year

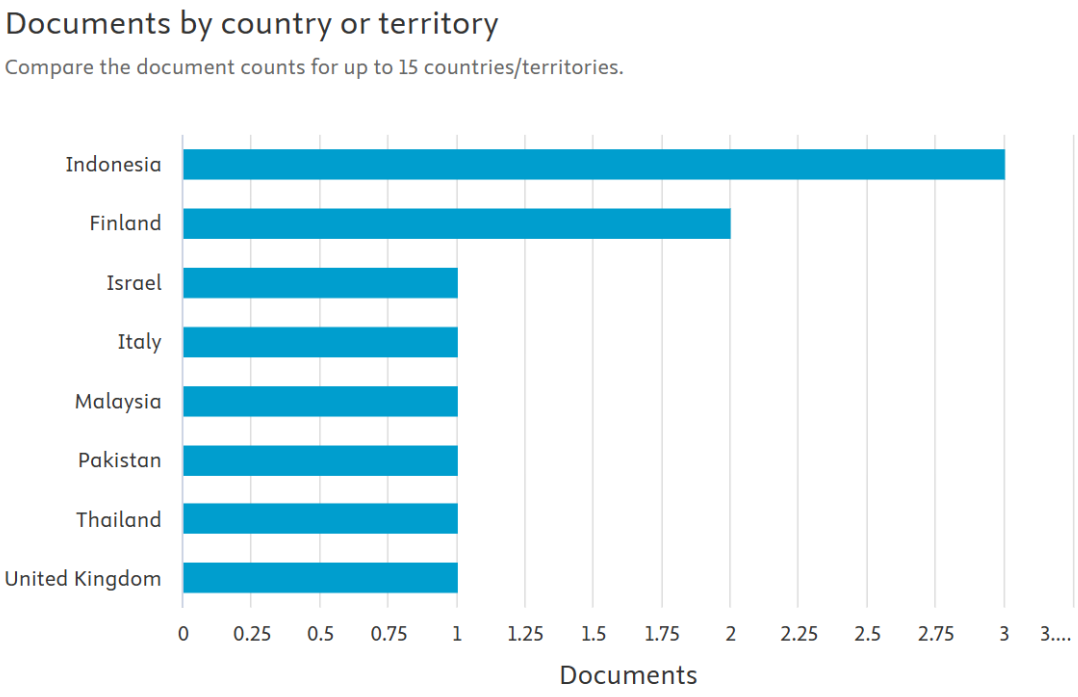


Picture 2. Documents by Year

Based on the year of publication distribution of the seven documents used in this SLR review, there is an increasing trend in the number of relevant publications from year to year, reflecting the growing attention to digital-based mathematics learning media and the development of creative thinking at the primary school level. The year 2015 produced only one document, namely "Developing Mathematical Thinking in the Primary Classroom: Liberating Students and Teachers as Learners of Mathematics", which showed that attention to developing mathematical thinking through reflective and humanistic approaches had emerged earlier but had not been explored much in a digital context. Then in 2021 there was an increase to two documents, namely

"Developing a Handbook on Multimedia Integration in Mathematics Teaching for Indonesian Primary School Students" and "Quantum Physics Literacy Aimed at K12 and the General Public", which marked a shift in the direction of research attention to the integration of multimedia technology and the development of digital-based science literacy since the COVID-19 pandemic began to affect global education. The trend continued and intensified in 2023 and 2024, with two documents each, including "Makerspaces Fostering Creativity" and "Perspectives on STEAM Education during the COVID-19 Pandemic" (2023), as well as "The Influence of STEM-Based Digital Learning on 6C Skills of Elementary School Students" and "Enhancing Mathematics Quality of Instruction through Digital Flipbooks" (2024). The surge in publications in these years indicates that the issue of utilizing web-based learning media and digital learning tools to foster creative thinking skills has become a highly relevant topic and is growing rapidly, along with the increasing adoption of digital technology in elementary classrooms. This increase in the quantity of documents reinforces the urgency and validity of the SLR study conducted, as well as providing a strong foundation for performing an in-depth analysis of the effectiveness and direction of development of web-based media in elementary mathematics education.

Country Analysis of the Authors

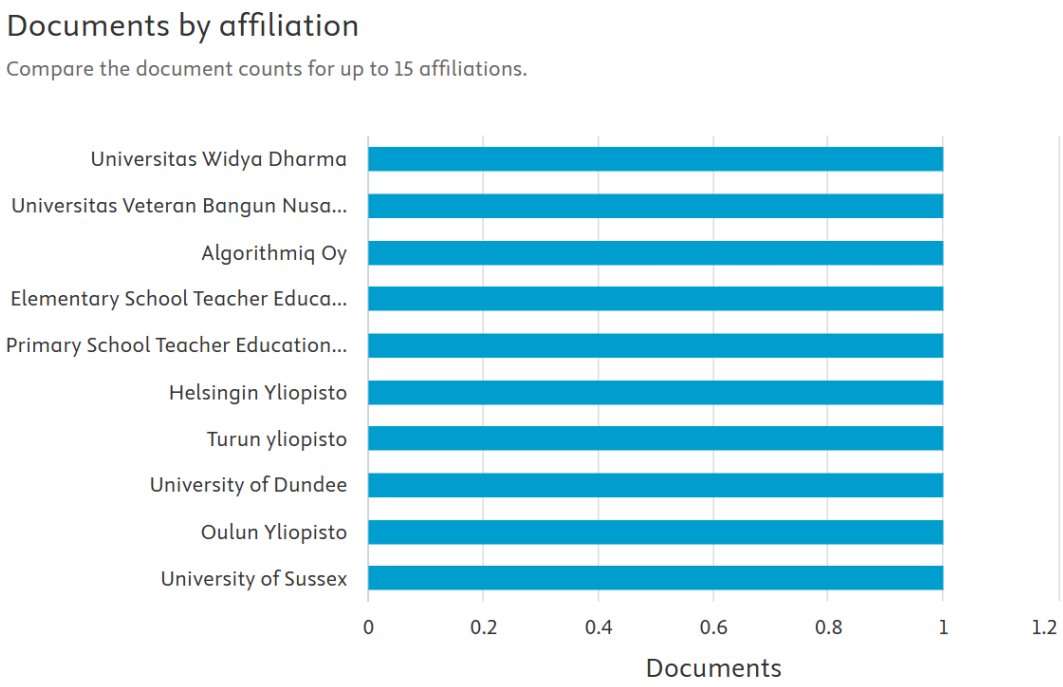


Picture 3. Country or Region of the Author

Based on the "Document by Country" diagram obtained from Scopus data analysis, it can be seen that countries such as Indonesia, Thailand, and Malaysia dominate the number of publications related to web-based mathematics learning media in the context of basic education. This dominance shows the great attention of developing countries in the Southeast Asian region to the development of learning innovations aimed at fostering creative thinking in elementary school students. The increase in the number of

publications from these countries also reflects a response to global challenges such as the COVID-19 pandemic, where the use of digital technology is the main solution in the learning process. Meanwhile, countries with more advanced educational technology infrastructure, such as the United States, the United Kingdom and China, also contribute to the development of theoretical frameworks, learning system designs and innovative methodologies that underpin the integration of digital media in mathematics learning. The involvement of countries from various regions shows that the issue of the effectiveness of web-based learning media and strengthening creative thinking skills has become a global concern. In general, the distribution of authors' home countries shows that although digital approaches in mathematics education have been widely adopted, their effectiveness and implementation are still influenced by the local context, both in terms of social, cultural, economic, and educational policies that apply in each country. This finding illustrates the importance for researchers to consider contextual relevance in assessing the trends and effectiveness of digital learning media globally.

Originating Institution Analysis



Picture 4. Author's Home Institution

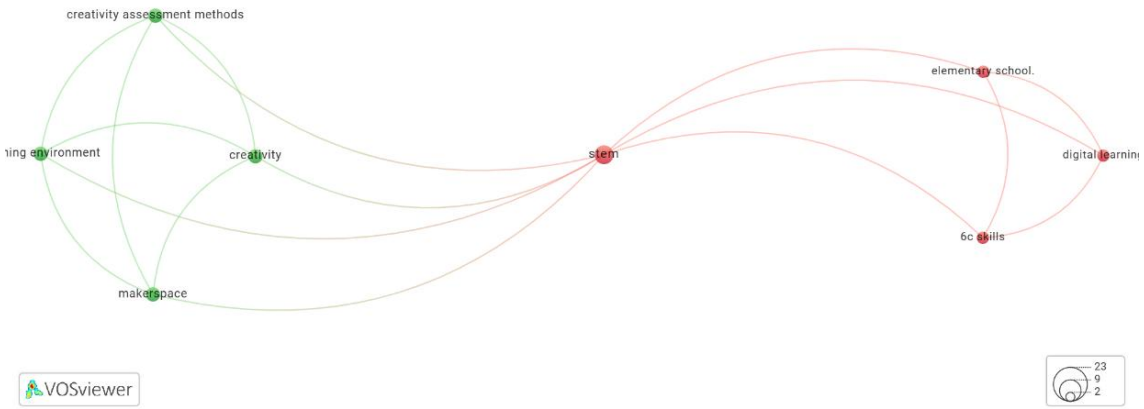
Based on the “Document by affiliation” diagram analyzed from the Scopus database in this Systematic Literature Review (SLR) study, it can be seen that the dominance of the author's institution of origin shows a tendency for the contribution of institutions from developed countries, as well as several institutions in Southeast Asia, including Indonesia and Thailand. Institutions such as Universitas Pendidikan Indonesia, Nakhon Ratchasima Rajabhat University (Thailand), as well as universities in Europe and North America, occupy a significant position in publications related to this topic. It indicates that research on web-based mathematics learning media for creative thinking

development at the primary school level is a major concern in many countries, both in the context of developing and developed countries.

Institutions such as Universitas Pendidikan Indonesia and Rajabhat University show serious efforts from developing countries in adopting and evaluating the use of digital media to encourage students' creative thinking skills, which is reflected in various studies. For example, in an article written by Isara Phonnong and Wasana Keeratichamroen from Nakhon Ratchasima Rajabhat University, it is outlined that STEAM learning during the COVID-19 pandemic opened new insights into technology integration and the importance of creativity development among disadvantaged primary school students. Meanwhile, contributions from institutions in developed countries reinforce the data-driven approach and advanced technology used in the development of web-based learning media. These institutions tend to emphasize pedagogical aspects that are innovative and based on empirical research, thus enriching the global perspective on the effectiveness of digital media in mathematics learning.

From a methodological perspective, the concentration of articles in certain institutions indicates the existence of centres of research excellence in this field, which also reflects the disparity in access to technology and educational research in some regions. Therefore, the distribution of author institutions in this diagram not only illustrates the map of scientific collaboration, but also reflects the inequality and potential for developing cross-country collaboration in promoting creative mathematics learning through web-based digital media in primary education.

Trend Analysis of Dominant Keywords



Picture 5. Keyword Trends

Based on the visualisation of the keyword network generated from the literature analysis using the Scopus database and visualized through VOSviewer, two dominant clusters represent the focus of research related to web-based mathematics learning media in the context of basic education, especially in encouraging creative thinking. The first cluster (marked in green) centres on the theme of “creativity” and its derivative keywords, such as creativity assessment methods, learning environment, and makerspace. It suggests that aspects of creativity and how to measure it, as well as

supportive learning environments (such as makerspaces), are important concerns in the context of technology-based mathematics learning. It is in line with the 21st-century education goals that emphasize the importance of developing students' creative thinking skills from basic education.

The second cluster (in red) centers on the keyword “STEM”, which is closely connected to the terms elementary school, 6C skills, and digital learning. This connection indicates that the STEM approach is not only a global trend in science and mathematics education, but is also increasingly integrated with the strengthening of digital literacy and the development of 6C competencies (Critical thinking, Creativity, Collaboration, Communication, Citizenship, and Character). The keyword digital learning, which has a strong relationship with STEM and 6C skills, also reflects the trend of using digital media, including websites, as a potential tool in facilitating innovative and interactive mathematics learning.

Interestingly, the keyword STEM is the central point that bridges the two clusters, showing that the development of student creativity in learning mathematics through digital media is framed within the STEM framework. The relationship between STEM, creativity and learning environment indicates a synergy between innovative pedagogical approaches and the use of digital technology in creating more meaningful learning experiences at the primary school level. Thus, the results of this analysis strengthen the relevance of the research topic “Trends and Effectiveness of Website-Based Mathematics Learning Media for Fostering Creative Thinking” as it empirically shows that creativity, STEM, and digital learning are the main axes in the current academic discourse in the field.

Conclusions and Suggestions

Based on the systematic review of 36 articles retrieved from Scopus, of which 7 met all inclusion criteria, the findings show a significant improvement trend. They are highly effective in fostering the creative thinking skills of elementary school students. This media offers an interactive and contextual learning experience through various features such as visualisation, animation, simulation, and educational games that can stimulate the exploration of ideas, divergent thinking, and problem-solving. The use of web-based media also encourages a more constructivist and student-centred approach to learning. However, its successful implementation is influenced by various factors, including the quality of media design, technology support, teacher training, and curriculum integration. Therefore, the development and use of web-based media must be strategically designed to align with pedagogical objectives and student needs, while also addressing aspects of accessibility and inclusiveness. Of the seven articles that have been selected for further analysis, none specifically discuss the development of website-based mathematics learning media designed to improve the creative thinking skills of elementary school students. Therefore, there are additional research opportunities that explore the development of web-based mathematics learning media that can specifically be used to improve students' creative thinking skills. This research would have a significant element of novelty by filling a gap that exists in the current literature. The focus of the study could be on how these media can be designed to maximize students' creative thinking potential, taking into account factors such as interactive design, challenging content and flexible learning approaches.

Teachers should integrate web-based media that support interactive simulations, multimodal representations, and creative problem-solving tasks. Schools must ensure adequate digital infrastructure and continuous training to enable teachers to design creativity-oriented digital activities. Curriculum developers should embed digital creativity components in mathematics learning standards. Future studies should (1) design dedicated web-based mathematics platforms that embed creativity indicators; (2) evaluate creativity using standardized creativity tests (e.g., TTCT, CSDS); (3) compare the effectiveness of multiple web-based features (e.g., gamification vs simulations) in fostering creative thinking; and (4) examine implementation in low-resource settings.

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