

## Systematic Literature Review: Development of Scratch Media on Statistics Material to Train Computational Thinking

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### ABSTRACT

Utilizing a Systematic Literature Review (SLR), this research explores the potential for creating Scratch-based statistical learning tools integrated with the cultural heritage of Songket Palembang. This review analyzes empirical studies published between 2020 and 2025 that focus on Scratch, computational thinking, statistics education. Research results suggest that learning tools built on Scratch are broadly accepted as valid and efficient means of improving students' computational logic, thematic comprehension, and analytical problem-solving abilities (Citation). However, most existing studies emphasize algebra or general mathematics topics, while research specifically addressing statistics is limited. Furthermore, no previous study has simultaneously integrated Scratch, statistical concepts (particularly measures of central tendency), computational thinking within a single instructional framework. Therefore, this study highlights a clear research gap and identifies significant opportunities for innovative development. Theoretically, this review contributes by explicitly mapping the intersections between computational thinking, statistics learning, and culturally grounded digital pedagogy. Practically, this provides a conceptual foundation and strategic direction for designing Scratch-based statistical media that uses Palembang Songket as authentic data to encourage meaningful learning and strengthen students' computational thinking skills in eleventh grade.

**Keywords:** computational thinking, learning media, scratch, songket palembang, statistics.

### ABSTRAK

Menggunakan Systematic Literature Review (SLR) atau Tinjauan Pustaka Sistematis, penelitian ini mengeksplorasi potensi pembuatan media pembelajaran statistika berbasis Scratch yang diintegrasikan dengan warisan budaya Songket Palembang. Tinjauan ini menganalisis studi empiris yang diterbitkan antara tahun 2020 dan 2025 dengan fokus pada Scratch, berpikir komputasional (computational thinking), serta pendidikan statistika. Hasil penelitian menunjukkan bahwa media pembelajaran yang dibangun dengan Scratch diterima secara luas sebagai sarana yang valid dan efisien untuk meningkatkan logika komputasi, pemahaman tematik, dan kemampuan pemecahan masalah analitis siswa (Sitasi). Namun, sebagian besar studi yang ada lebih menekankan pada topik aljabar atau matematika umum, sedangkan penelitian yang secara khusus membahas statistika masih terbatas. Selain itu, belum ada studi terdahulu yang secara simultan mengintegrasikan Scratch, konsep statistika (khususnya ukuran pemusatan data), dan berpikir komputasional dalam satu kerangka

instruksional yang sama. Oleh karena itu, penelitian ini menyoroti adanya kesenjangan penelitian (research gap) yang jelas dan mengidentifikasi peluang signifikan untuk pengembangan yang inovatif. Secara teoritis, tinjauan ini berkontribusi dalam memetakan secara eksplisit titik temu antara berpikir komputasional, pembelajaran statistika, dan pedagogi digital berbasis budaya. Secara praktis, penelitian ini memberikan landasan konseptual dan arahan strategis untuk merancang media statistika berbasis Scratch yang memanfaatkan Songket Palembang sebagai data autentik guna mendorong pembelajaran yang bermakna serta memperkuat keterampilan berpikir komputasional siswa di kelas sebelas.

**Kata Kunci:** berpikir komputasional, media pembelajaran, scratch, songket Palembang, statistika.

## INTRODUCTION

The integration of computational logic with mathematical instruction goes beyond theoretical mastery; it empowers learners to decode and resolve practical problems, fostering a more profound connection to their environment (Fagerlund et al., 2021). Computational thinking skills have four indicators, including (1) breaking down complex problems into simpler sub-problems (decomposition), (2) recognizing patterns (pattern recognition), (3) filtering important information (abstraction), and (4) applying logical and structured steps to solve problems (algorithmic thinking) (Lestari & Roesdiana, 2023). The characteristics align with these four components: students can decompose data into variables such as motif type, price, production quantity, and production time (decomposition); identify patterns such as more complex motifs have higher prices or seasonal production trends (pattern recognition); create statistical representations such as frequency distribution tables or graphs from concrete data (abstraction); and apply systematic steps to calculate the mean, median, and mode using Scratch (algorithmic thinking).

Statistics is a mathematical subject with a variety of formulas and solution procedures. This often leads to students' difficulties in understanding concepts and solving problems given by teachers. Previous research has shown that students still experience various obstacles and errors in applying the mean, median, and mode formulas. Therefore, strategies or learning media are needed that can facilitate clearer, more coherent, and engaging understanding (Gumilar & Effendi, 2022; Nurhayati et al., 2023). Supporting this perspective, Nursya'ban, (2024) found that conventional methods in statistics fail to sufficiently foster student creativity, suggesting a shift toward PBL models. Furthermore, the implementation of well-designed e-modules has been proven by Bernessa et al., (2024) to be a practical and effective strategy for improving educational outcomes. This indicates that innovation in learning models and media in statistics is essential to help students understand concepts more deeply and meaningfully.

According to research Retta et al., (2025) indicates that students often struggle with the abstract nature of statistical measures, prioritizing procedural steps over conceptual depth (Citation). Although RME and PjBL offer effective, context-driven solutions for improving critical thinking, systemic issues such as varying classroom conditions and inadequate institutional support continue to hinder their execution. Moreover, systematic studies mapping effective strategies for applying these

approaches to central tendency topics remain limited, indicating the need for more comprehensive and innovative research in statistics learning.

Research Garfield & Ben-Zvi, (2021) suggests that this difficulty is related to a lack of instruction that emphasizes data interpretation and statistical reasoning rather than simply mechanical skills. Furthermore, statistics learning in high school rarely integrates local cultural contexts as sources of learning data, making the material feel abstract and distant from students' experiences. However, researchers believe that using local cultural contexts such as community economic activities, regional traditions, or local cultural products can increase student engagement and help them develop a more meaningful and contextual understanding of statistics (Maulida & Ghufro, 2025). A contextual approach that connects statistics to local culture can improve student learning outcomes (Misqa et al., 2024). A prevalent educational resource employed is Scratch Media.

Scratch functions as a visual programming tool that facilitates the creation of multimedia projects and simple applications through a block-based interface. This environment, originating from the MIT Media Lab, allows for sophisticated development while bypassing the need for conventional programming languages (Al Anshary et al., 2023). Scratch, as a programming language, has the advantage of a drag-and-drop concept that makes it easy for students to assemble code blocks like a puzzle, making it effective in training computational thinking (Zahid et al., 2021). Therefore, mathematics learning using Scratch, also allows them to practice computational thinking skills (Ansori, 2020); Satria et al., 2022).

Recent studies show growing interest in integrating cultural contexts into digital learning. However, research combining Scratch, statistics education, and cultural contexts is still limited. Although Scratch-based learning and culturally responsive pedagogy have been studied separately, few studies have integrated them into culturally grounded computational tools (Hidaytai & Perdana, 2026). Sembring et al., (2022) conducted a study on local wisdom-based Scratch media learning. Validation results from experts included a feasibility score of 86% from material experts, 85% from media experts, and 89% from mathematics learning experts.

Research Nopriyanti & Retta, (2020) on social arithmetic using financial literacy contexts revealed that real-world integration significantly enhanced students' decision-making abilities and conceptual understanding. Similarly, studies Pakpahan., et al (2023). Emphasized that problem-based and context-oriented strategies foster deeper engagement and interpretation of mathematical information. Although these studies addressed broader mathematical domains such as algebra and social arithmetic, their findings underscore the importance of meaningful contexts in promoting skills closely related to computational thinking and statistical reasoning.

Based on this background, this study was conducted using a Systematic Literature Review (SLR) to systematically map research trends, identify existing gaps, and explore opportunities to integrate Scratch-based learning, statistical concepts, computational thinking, and cultural contexts in mathematics education.

## **METHOD**

Following the SLR methodology, this study adopted a highly structured process to identify and scrutinize relevant evidence. This methodical evaluation, guided by specific eligibility standards, allowed for an exhaustive review of the advancements and trends within the existing body of research (Ansorullah et al., 2025; Wibowo &

Putri, 2021). SLR was chosen because it allows the identification of recent trends and strategies in implementing Scratch-based learning media in statistics education.

To ensure the credibility of the studies in this systematic literature review, a quality assessment and risk of bias evaluation were performed on each article using a checklist adapted from the guidelines of. To assess the quality of the selected literature, researchers examined the clarity of objectives, methodological appropriateness, and the consistency of data procedures. Each element was assigned a score ranging from 0 to 1, reflecting the degree to which the study met the criteria. Additionally, potential bias in selection and reporting was analyzed, leading to the exclusion of any high-risk studies to maintain a robust final analysis.

**Table 1.** Methodological assessment

Article	Q1	Q2	Q3	Q4	Q5	Score	Risk of Bias
(Ulhasanah et al., 2021)	1	1	0.5	1	1	4.5	Low
(Mylida et al., 2022)	1	1	1	0.5	1	4.5	Low
(Nurhalizah & Jayanti, 2023)	1	1	1	1	1	5	Low
(Iskandar et al., 2023)	1	1	0.5	1	1	4.5	Low
(Handayani et al., 2023)	1	1	1	1	1	5	Low
(Berlian et al., 2024)	1	1	1	0.5	1	4.5	Low
(Alhasir & Mariatun, 2024)	1	1	1	1	0.5	4.5	Low
(Sekarsari & Karimah, 2025)	1	1	1	1	1	5	Low

Assessment Criteria:

Q1=The research objective is clearly explained

Q2=The research design is in accordance with the objective

Q3=The data collection procedure is explained

Q4=The data analysis is clearly explained

Q5=The validation/effectiveness of the results is reported

Several articles received a score of 0.5 because the methodology or research results were not fully explained in the summary. Ulhasanah & Dewi (2021) only mentioned the quasi-experimental method without a detailed explanation of the data collection procedure, resulting in Q3 = 0.5. Iskandar et al. (2023) used a 4D development model, but the procedure was not explained in detail in the summary, resulting in Q3 = 0.5. Berlian et al. (2024) presented a more descriptive analysis, resulting in Q4 = 0.5, while Alhasir & Mariatun (2024) did not explain the effectiveness report in detail, resulting in Q5 = 0.5.

The methodological quality assessment shows that most studies have good research quality, with scores ranging from 4.5 to 5.0. All selected studies clearly state their research objectives and use appropriate research designs, such as experimental or research and development approaches. However, several studies provide limited explanations regarding data collection procedures or detailed data analysis techniques. Overall, the risk of bias in the selected studies is categorized as low, indicating that the findings synthesized in this review are considered reliable.

The review process began with a systematic search of articles in Google Scholar, GARUDA, Watase, and Scopus using keywords such as computational thinking,

learning media, Scratch, and statistics. Inclusion criteria included empirical studies related to mathematics or statistics learning that focused on computational thinking and/or Scratch, while articles with irrelevant or no empirical data were excluded. The complete criteria are presented in Table 2.

**Table 2.** Inclusion and exclusion criteria

Criteria Name	Inclusion Criteria	Exclusion Criteria
Research Topics	A study that integrates the development of Scratch based learning media	A scholarly investigation that deviates from the central research inquiry.
Types of Literature	A study includes Journals (research based)	A study that is not relevant to the research topic
Indexing	Indexed by Google Scholar, Sinta	A study excludes theses, books, meta-analyses and literature reviews.
Publication Year	Published between 2020-2025	Not indexed by Google Scholar and Sinta
Language	Full text/English	Not full text/English

The initial search identified 1,825 potentially relevant articles. After screening the titles and abstracts, studies that did not meet the inclusion criteria such as those unrelated to the main topic, literature reviews, meta-analyses, bibliometric studies, and books were excluded. This stage reduced the number of eligible articles to 517 for further examination. The screening process was guided by two primary criteria: (1) relevance to Scratch-based learning media and (2) a focus on computational thinking skills. Next, these 517 articles were further screened based on publication year (2020–2025), indexing in Google Scholar and Sinta, and availability of full-text versions in English. This step narrowed the selection to 62 articles deemed potentially suitable.

A more rigorous eligibility assessment was then conducted through full-text review to ensure methodological quality and substantive alignment with the integration of Scratch learning media in fostering computational thinking. During this final evaluation stage, only 8 articles met all inclusion criteria and were deemed to provide strong empirical evidence and direct relevance to the research objectives. In the data collection phase, the selected articles were analyzed to explore how Scratch based learning media support students' computational thinking skills. The analysis examined instructional strategies, research findings, and the challenges or limitations reported in implementing Scratch in educational settings.

For data analysis, the researchers applied qualitative and/or quantitative synthesis techniques through an in-depth review of each selected study. To highlight current research trajectories, the data were categorized based on how each study supported the creation of Scratch learning media for advancing student computational logic (Citation). The systematic selection stages are visually represented in the accompanying PRISMA flow chart (Figure 1).

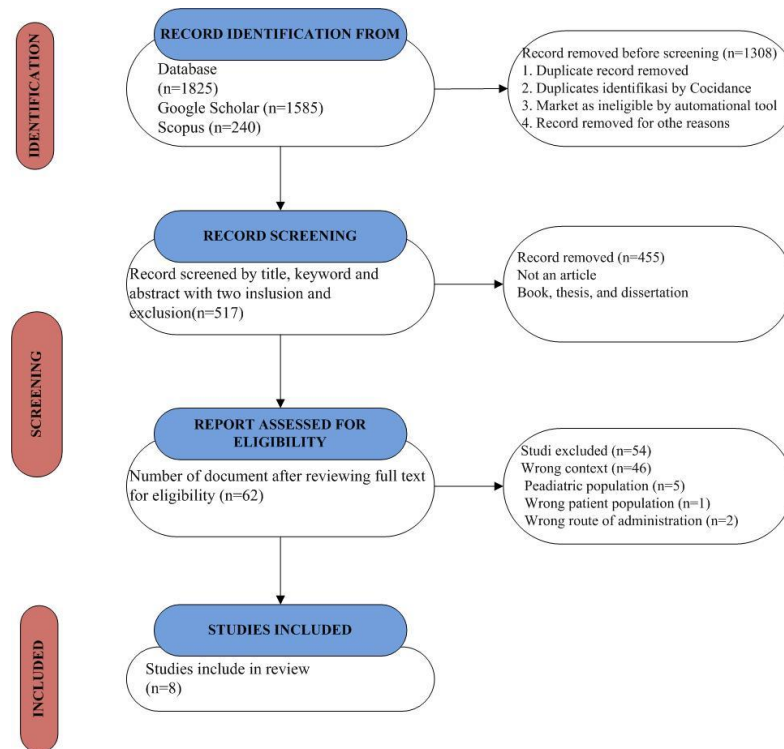


Figure 1. PRISMA

## RESULT

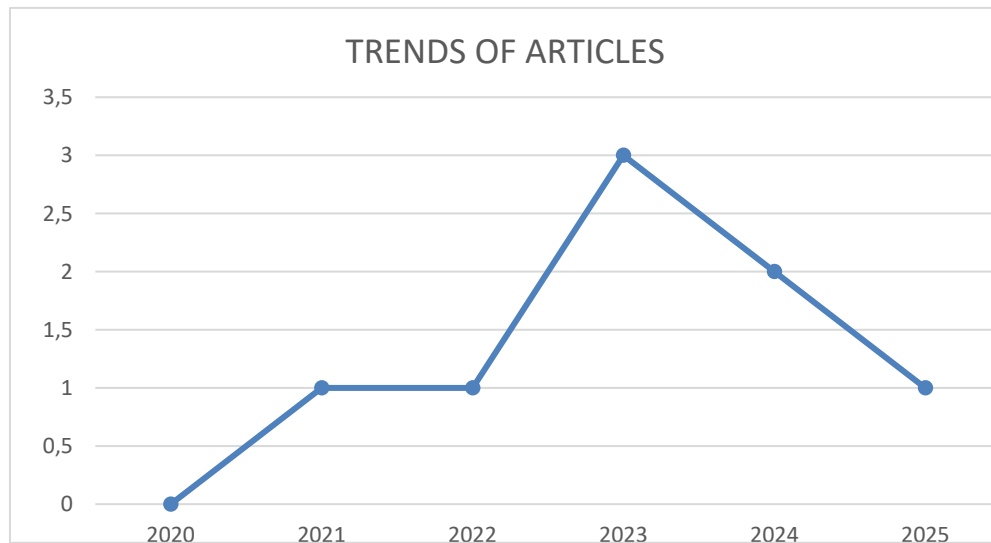
Data obtained from this study were systematically collected, analyzed, and supplemented with summaries of relevant articles related to the development of scratch media. A literature search using predetermined inclusion criteria resulted in eight articles deemed appropriate to the research focus. These articles were then analyzed and categorized based on two main characteristics: publication year and journal index. The following description presents a description of the analysis of the articles that met the inclusion criteria.

Table 3. Result data analysis

Characteristics	Criteria	Frequency
Year of Publication	2020	0
	2021	1
	2022	1
	2023	3
	2024	2
	2025	1

### Journal publication year

In this study, articles were selected based on publications published between 2020 and 2025 that met the established inclusion criteria. The collected data were then analyzed to identify publication distribution patterns. The following graphical representation illustrates the development of the number of relevant articles from 2020 to 2025.



**Figure 1.** Trends of article

Data were collected from relevant articles and journals on the development of Scratch-based media for statistical learning to enhance computational thinking. A systematic analysis identified empirical evidence supporting the effectiveness of interactive learning. Findings indicate that Scratch media improves student engagement and contextual relevance, as well as computational thinking skills and understanding of statistical concepts. Table 3 provides a summary of the eight selected studies, including their methods and main conclusions.

**Table 4.** Synthesis of research

Title and author	Journal identity / indexed	Method	Research results
The effect of mathematics learning with a computational thinking approach assisted by scratch on the mathematical problemsolving ability of grade x phase e students of sma n 8 tanjung jabung timur (ulkhasanah et al., 2021)	Phi: journal of mathematics education Sinta 5	Adopting a quantitative methodology, this research follows a quasi-experimental approach based on the non-equivalent control group model to analyze the data.	Analysis of pretest and posttest scores reveals that students in the experimental group achieved superior mathematical problem-solving outcomes compared to the control group. This improvement is attributed to the integration of a computational thinking framework utilizing scratch, whereas the control group followed a standard scientific approach.
Development of scratch-based interactive learning media for two-variable	Edu-mat journal of mathematics education Sinta 3	This study follows a research and development (r&d) framework,	Evaluation data suggests that the scratch-based interactive media is highly suitable for classroom use;

Title and author	Journal identity / indexed	Method	Research results
linear equation systems for class x (mylida et al., 2022)		specifically utilizing the addie model to guide the design and development process.	it was deemed valid by experts and received strong practicality ratings from both educators and learners. Its effectiveness was further validated by a statistically significant increase in student performance following the intervention.
The development of scratch software-based interactive learning media on regulatory system material (nurhalizah & jayanti, 2023)	Journal of nuclear biology and learning Sinta 3	Adopting a research and development (r&d) methodology, this investigation follows the systematic stages of the addie instructional design model.	Evaluation data suggests the scratch-based media is highly suitable for classroom use, achieving validity scores above 87% from both media and material specialists. Its practicality was validated by teachers and students alike, with scores ranging from 84.30% to 97.50%. With an n-gain result of 84%, the study identifies the media as a valid and effective educational resource.
Development of mathematics interactive multimedia with scratch to enhance student's mathematics understanding ability (iskandar et al., 2023)	Prima: journal of mathematics education Sinta 3	Following a systematic 4d (four-d) approach, this research is organized into the sequential phases of define, design, develop, and disseminate.	The findings revealed that the effectiveness test indicated an improvement in students' conceptual understanding of mathematics after the implementation of scratch-based learning media compared to their performance prior to the intervention. Moreover, students demonstrated greater participation, higher motivation, and improved ability to grasp concepts through visual and interactive representations.
Development of e-module based on problem based learning assisted with scratch applications to improve	Journal of education: a journal of research results and literature reviews in the fields of	Adopting a research and development (r&d) methodology, this study follows the	The study results demonstrated that the product met very valid criteria across several aspects: lesson plans (94.44%), material experts

Title and author	Journal identity / indexed	Method	Research results
students computational thinking skills (handayani et al., 2023)	education, teaching, and learning Sinta 2	systematic stages of the addie instructional design model.	(90.48%), linguists (92.86%), and media experts (89.6%). Practicality was also rated highly, with student responses at 90.42% and teacher responses at 93.52%, both classified as very practical.
Development of scratch learning media to improve scientific literacy and computational thinking in primary education in the society 5.0 era (berlian et al., 2024)	Journal of natural science and integration Sinta 2	Following a research and development (r&d) approach, this investigation is structured around the five systematic phases of the addie model.	The development of the scratch-based e-module successfully met established standards, with a validity score of 77%. Practicality assessments were similarly robust, yielding scores of 88.10% for teachers and a range of 85.53% to 88.18% for students. Furthermore, the study assessed teacher computational thinking skills, which were rated as "good" based on a majority positive consensus (86% total agreement) among participants.
Development of scratch educational game-based learning media to improve students' problem-solving ability (alhasir & mariatun, 2024)	Asatiza: journal of education Sinta 4	Adopting a research and development (r&d) methodology, this investigation is structured around the five systematic stages of the addie model: analysis, design, development, implementation, and evaluation.	The study's results highlight strong feasibility, with material experts and teachers both categorizing the tool as "very feasible" with scores of 4.5 and 4.6, respectively. Although media experts provided a slightly lower rating of 3.8, the tool remained within the "feasible" range. Notably, student ratings saw a marked increase, moving from 3.9 to 4.6 after engaging with the media.
Development of scratch-based interactive quiz learning media on	Hots research journal of mathematics education	Adopting an r&d methodology, this study is grounded in the addie	The study's results highlight strong foundational metrics, with expert validation and

Title and author	Journal identity / indexed	Method	Research results
statistics to enhance students' learning outcomes (sekarsari & karimah, 2025)	Sinta 4	instructional design model. This framework facilitates a comprehensive development process, beginning with initial analysis and concluding with a final evaluation phase.	student practicality reaching 80% and 78%, respectively. The instructional impact was further evidenced by a comparison of mean scores, where the experimental cohort achieved a notably higher average of 88.29 compared to the 82.77 recorded by the control group.

The findings of this systematic literature review show that Scratch-based learning media positively support mathematics and statistics education, particularly in enhancing computational thinking, conceptual understanding, and learning outcomes. From the eight selected studies, three main themes emerged: (1) the validity and feasibility of Scratch-based media, (2) their effectiveness in improving cognitive and problem-solving skills, and (3) the potential integration of cultural contexts into digital learning.

Most studies reported that Scratch-based media received valid to highly valid ratings from experts. For instance, Nurhalizah & Jayanti, (2023) found high validity scores, and Mylida et al.,(2022) confirmed that their product met validity, practicality, and effectiveness criteria under the ADDIE model. These findings indicate that Scratch is a feasible platform for developing interactive educational media. In terms of effectiveness, most studies reported significant improvements in computational thinking, conceptual understanding, and problem-solving skills. Ulkhasanah et al., (2021) and Iskandar et al., (2023) found higher post-test scores and increased student motivation after using Scratch-based media. Other studies also showed its contribution to strengthening computational thinking, scientific literacy, and 21st-century skills such as creativity and digital literacy.

However, the integration of Scratch in statistics education remains limited. Only a few studies, such as Sekarsari & Karimah, (2025), specifically addressed statistics and showed positive impacts on learning outcomes. This indicates opportunities for further development, as statistics aligns naturally with computational thinking skills. The review also highlights the potential of integrating cultural contexts into Scratch based media to strengthen computational thinking. Overall, Scratch-based media are feasible and effective in improving computational thinking and learning outcomes, but research on statistics learning and culturally integrated digital media is still limited, providing opportunities for future innovation.

## CONCLUSION

Findings from this Systematic Literature Review verify that Scratch-integrated instructional tools are reliably valid, practical, and effective. The synthesized data provides robust empirical evidence that these media significantly enhance conceptual

clarity, problem-solving proficiency, and computational thinking within mathematical contexts.

However, the synthesis also reveals two critical research gaps. First, most studies focus on algebra, science topics, or general mathematical concepts, while the application of Scratch in statistics particularly on measures of central tendency remains very limited. Second, although cultural-based digital learning has gained attention, no previous study has simultaneously integrated Scratch, statistical concepts, computational thinking, and a specific local cultural context such as Songket Palembang within a single instructional framework.

Therefore, the novelty of this study lies in proposing the integration of four interconnected components: Scratch as a visual programming medium, measures of central tendency as statistical content, computational thinking as a core 21st-century competency, and Songket Palembang as an authentic cultural data context. This integrative framework not only addresses the identified research gaps but also offers a theoretically grounded and culturally meaningful direction for developing innovative statistics learning media.

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