Dikdas Bantara

LITERATUR REVIEW: IMPLEMENTATION OF FLIPPED LEARNING FOR ELEMENTARY SCHOOL MATHEMATICS LEARNING IN THE PERIOD 2019-2025

Abdiyati Ilmiyana[1], Ellianawati[2], Nuni Widiarti[3], and Arif Widiyatmoko[4]
[1]Department of Elementary Education S2, [2]Departement of Physical, [3]Department of Chemistry,
[4]Department of Natural Science Education, Semarang State University, Indonesia

E-mail: [1]abdiyatiilmiyana@students.unnes.ac.id* , [2] ellianawati@mail.unnes.ac.id ,
[3] nuniwidiarti@unnes.ac.id , [4] arif.widiyatmoko@mail.unnes.ac.id

ABSTRACT

Mathematics learning in elementary schools continues to face challenges related to low conceptual understanding, numeracy literacy, and student learning independence. In response to the demands of 21st-century education and the Merdeka Curriculum, student-centered and technology-based learning models are required. One such approach is Flipped Learning, which shifts content delivery outside the classroom and uses in-class time for active learning activities. This study aims to systematically review research trends and findings related to the implementation of Flipped Learning in elementary school mathematics learning during the 2019–2025 period. A Systematic Literature Review (SLR) was conducted on 12 national and international peer-reviewed articles identified through Google Scholar using the Publish or Perish application and analyzed thematically and bibliometrically with VOSviewer. The results indicate that Flipped Learning has a positive impact on students' learning outcomes, conceptual understanding, numeracy literacy, motivation, and learning independence. However, its effectiveness is influenced by teacher readiness, quality of digital learning media, technological infrastructure, and parental support. Overall, Flipped Learning shows strong potential to support innovative mathematics learning aligned with 21st-century skills and elementary education curriculum goals.

Keywords: *Literature Review, Flipped Learning, Ellementary School, Mathematics Learning*

INTRODUCTION

The transformation of 21st-century education emphasizes learner-centered approaches, critical thinking, collaboration, and digital literacy as essential competencies for students' future learning and everyday life (Partnership for 21st Century Skills, 2020; OECD, 2019). In primary education, these demands are particularly significant because elementary school represents a foundational stage in developing cognitive abilities, learning independence, and positive learning attitudes (OECD, 2021). Mathematics, as a core subject, plays a strategic role in fostering logical reasoning, problem-solving skills, and numeracy

competencies essential for students' academic success and daily life (National Council of Teachers of Mathematics [NCTM], 2020).

Mathematics learning in elementary schools is importance but continues to face significant challenges. Classroom practices remain largely teacher-centered and procedural, emphasizing memorization rather than conceptual understanding. This condition results in passive learning and limited development of higher-order thinking skills among students (Widya et al., 2022; Rohmatulloh et al., 2022). As a result, a gap persists between 21st-century educational goals and actual classroom practices.

Flipped Learning has emerged as an instructional approach that responds to these challenges by reversing conventional learning sequences. Instructional content is delivered outside the classroom through digital media, while face-to-face time is utilized for interactive discussions and problem-solving activities (Bergmann & Sams, 2012; Rahman & Kim, 2021). The model is grounded in constructivist and self-directed learning theories, positioning students as active participants in knowledge construction and teachers as facilitators (Cevikbas & Kaiser, 2023). Empirical studies published between 2019 and 2025 report that Flipped Learning positively impacts elementary mathematics learning, including improvements in conceptual understanding, learning outcomes, numeracy literacy, motivation, and self-efficacy (Widya et al., 2022; Shindika et al., 2023; Putri et al., 2025). International research further indicates that this model supports the development of 21st-century skills when implemented through well-designed digital instructional media (Al-Harbi, 2023; Sen, 2022).

A review of previous systematic reviews and meta-analyses shows that most studies examine Flipped Learning in secondary or higher education contexts and focus primarily on general learning outcomes (Rahman & Kim, 2021; Cevikbas & Kaiser, 2023). Limited attention has been given to synthesizing research specifically within elementary school mathematics education. In addition, prior reviews rarely integrate bibliometric mapping to identify research trends, dominant themes, and methodological patterns across studies. This situation reveals the need for a comprehensive synthesis that combines systematic review and bibliometric analysis within the specific context of elementary mathematics learning.

Based on this identified gap, the central research question of this study is: How has Flipped Learning been implemented and investigated in elementary school mathematics education during the 2019–2025 period, and what evidence exists regarding its effectiveness, research trends, and implementation challenges?

To answer this question, this study aims to: (1) analyze methodological trends and research characteristics; (2) examine the impact of Flipped Learning on learning outcomes, conceptual understanding, numeracy literacy, motivation, and learning independence; and (3) identify supporting factors and implementation constraints reported across studies. The findings are expected to contribute theoretically to the development of innovative, technology-based mathematics learning models and practically to support teachers and policymakers in designing instruction aligned with 21st-century educational demands.

METHODS

This study employed a Systematic Literature Review (SLR) to systematically identify, evaluate, and synthesize empirical research related to the implementation of Flipped Learning in elementary school mathematics instruction. The SLR approach was selected because it enables a structured, transparent, and replicable synthesis of research findings within a clearly defined scope and time frame (Latifah, 2023). To strengthen the analysis of research trends, this study also incorporated bibliometric analysis using VOSviewer to visualize keyword co-occurrence networks and thematic development patterns in the literature.

The review focused on national and international journal articles published between 2019 and 2025. This time frame was chosen to capture recent developments in technology-based and post-pandemic learning innovations in elementary education. The review was guided by four research questions: (1) What methodological characteristics and research trends characterize studies on Flipped Learning in elementary school mathematics during 2019–2025? (2) How is Flipped Learning implemented in elementary mathematics instruction? (3) What impacts does Flipped Learning have on learning outcomes, conceptual understanding, numeracy literacy, motivation, and learning independence? and (4) What supporting factors and implementation challenges are reported in the literature?

The literature search was conducted using the Google Scholar database with the assistance of the Publish or Perish application to ensure systematic retrieval and citation filtering. The Boolean search string applied was ("Flipped Learning" or "Flipped Classroom") and ("Mathematics Learning" or "Mathematics Education") and ("Elementary School" or "Primary School"), with publication years limited to 2019–2025. Only peer-reviewed journal articles available in full-text form were considered. The initial search identified a total of [isi jumlah awal] articles. After removing duplicate records and screening titles and abstracts for

relevance, [isi jumlah] articles were excluded. Full-text eligibility assessment was then conducted, resulting in the exclusion of [isi jumlah] articles due to mismatched educational level, non-mathematics focus, or incomplete empirical data. The final number of studies included in this review was [isi jumlah akhir] articles.

Article selection was guided by predefined inclusion and exclusion criteria to ensure analytical rigor. Studies were included if they examined the implementation of Flipped Learning or Flipped Classroom in elementary or primary school mathematics contexts, were empirical in nature, published between 2019 and 2025, and available in full-text peer-reviewed journal format. Studies conducted at secondary or higher education levels, conceptual papers, opinion articles, theses, conference proceedings, and studies not specifically focused on mathematics learning were excluded from the analysis.

Data from the selected studies were extracted using a structured classification table containing information on authorship, publication year, country of study, research objectives, research design, sample characteristics, learning media used, key findings, and reported implementation challenges. The extracted data were analyzed descriptively to summarize research characteristics and methodological trends and thematically to identify patterns of implementation, reported impacts, and recurring constraints. In addition, bibliometric mapping using VOSviewer was conducted to identify dominant keywords, thematic clusters, and the overall development of research trends related to Flipped Learning in elementary mathematics education.

The overall review process adhered to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework to ensure transparency and systematic reporting. The stages included identification, screening, eligibility assessment, and final inclusion of studies. The results of the screening process based on inclusion and exclusion criteria are summarized in Table 1.

Table 1. Article Inclusion and Exclusion Criteria

Aspect	Inclusion Criteria	Exclusion Criteria
Year of publication	Articles published in the period –2025	Articles published before 2019
Educational context	**elementary school** level (SD)	The research was conducted at the junior high, high school, or college level.
Field of study	Focus on **mathematics learning** with *Flipped Learning model*	Focus on other subjects (science, language, social studies, etc.)
Publication type	**Peer-reviewed** and full *text available* tific articles	Non-peer-reviewed articles, abstract only, proceedings, or otherwise inaccessible
Types of research	Empirical research, classroom action, stematic literature review related to *ed Learning*	Opinion articles, editorials, or non-empirical conceptual studies
Publication language	Written in Indonesian or English	Written in a language other than those two languages
Completeness of data	Presenting clear learning outcomes, ods, and context	Does not mention relevant methods or results

In addition to the systematic literature review process, bibliometric analysis was conducted to map research trends based on publication year, research focus, research subjects, and methodological characteristics. Bibliometric approaches are widely used to visualize research development and identify dominant themes in educational studies through network mapping and keyword co-occurrence analysis using tools such as VOSviewer (Hanifah et al., 2022; Iriyani et al., 2023). The integration of systematic review procedures and bibliometric mapping in this study aims to provide a more comprehensive understanding of research patterns and thematic evolution. The overall research flow is presented in Figure 1.

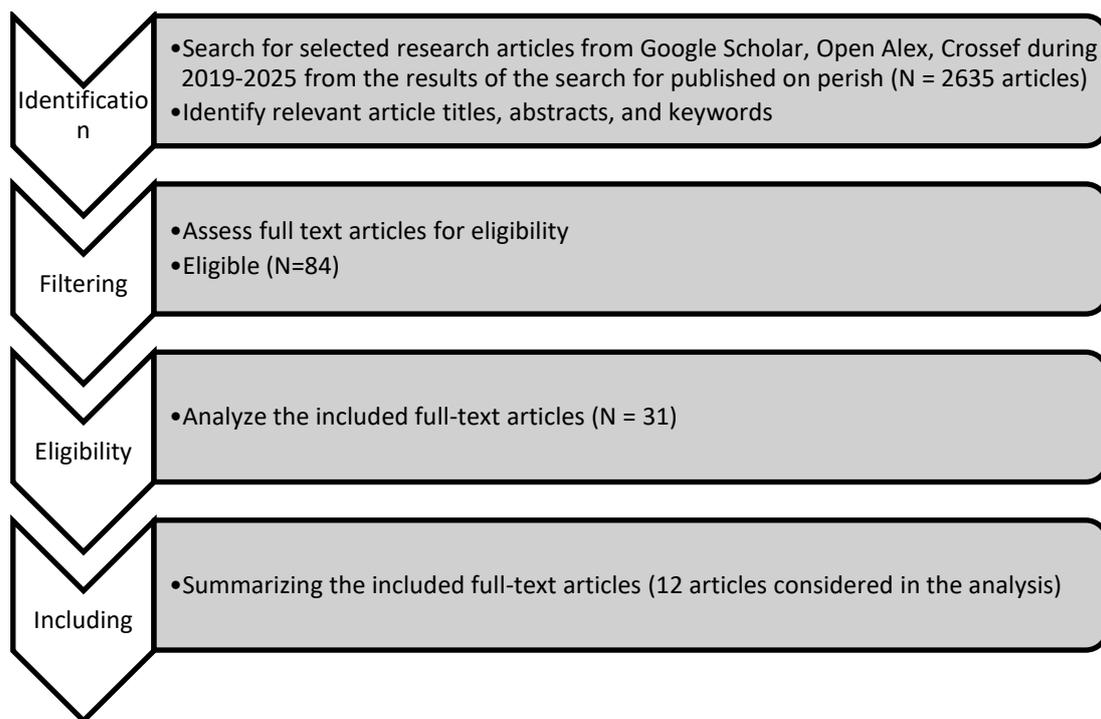| Identification | •Search for selected research articles from Google Scholar, Open Alex, Crossef during 2019-2025 from the results of the search for published on perish (N = 2635 articles)
•Identify relevant article titles, abstracts, and keywords |
Filtering	•Assess full text articles for eligibility •Eligible (N=84)
Eligibility	•Analyze the included full-text articles (N = 31)
Including	•Summarizing the included full-text articles (12 articles considered in the analysis)

Figure 1. Flowchart Prism Diagram

RESULTS AND DISCUSSION

RESULT

A bibliometric analysis was conducted using Publish or Perish (PoP) search results to categorize the selected studies based on publication year (2019–2025), research focus, methodological design, and key findings. Visualization of research trends was performed using VOSviewer to identify keyword co-occurrence networks and thematic clusters within Flipped Learning research in elementary mathematics education. The publication trend analysis indicates a consistent increase in the number of studies between 2019 and 2025, reflecting growing academic attention to technology-integrated and student-centered instructional models at the primary education level. This upward trend aligns with recent bibliometric studies reporting a shift toward interdisciplinary approaches and digital-based learning innovation in elementary education (Lismaya et al., 2025; Trenggono & Winarni, 2025)
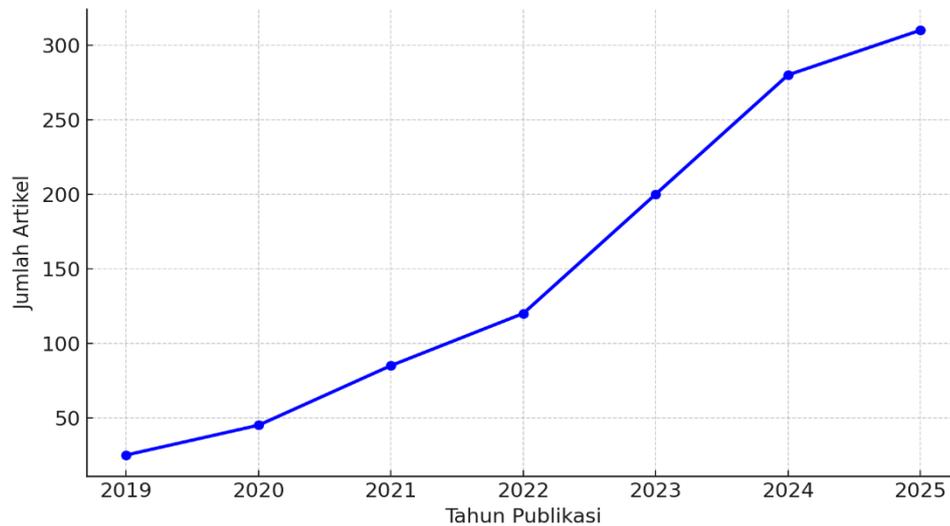
Figure 2. Flipped Learning Publication Trends in Elementary School Mathematics Learning (2019–2025)

Figure 2 presents the annual publication trend of Flipped Learning research in elementary school mathematics during the 2019–2025 period. To complement the annual publication trend analysis, a keyword co-occurrence network visualization was generated using VOSviewer to identify dominant research themes and their interrelationships within Flipped Learning studies in elementary mathematics education. This mapping provides a structural overview of thematic development and highlights how research focus has evolved across the 2019–2025 period. The visualizationof figure 3 helps identify central keywords, cluster formations, and emerging directions in the literature.
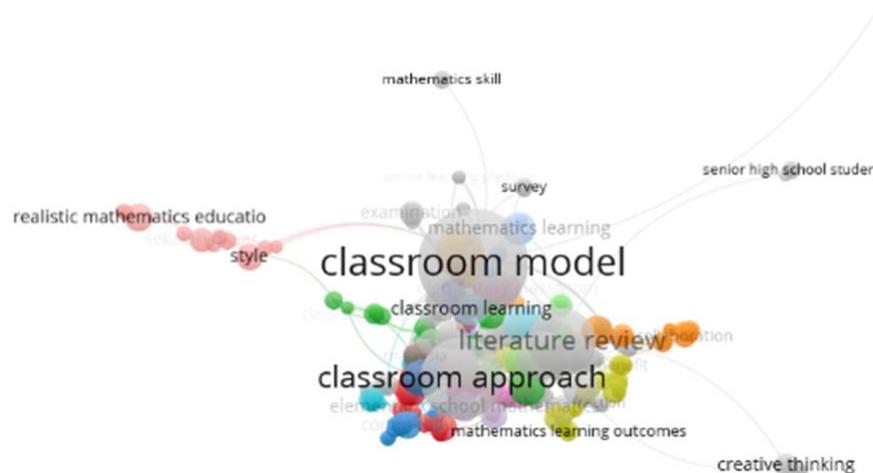

Figure 3 : Overview of the study

Figure 3 illustrates several interconnected thematic clusters. The dominant cluster centers on instructional models and classroom approaches, indicating that the primary focus of research remains the implementation of Flipped Learning

strategies. A second cluster relates to learning outcomes and cognitive dimensions, including conceptual understanding, creative thinking, and academic achievement. A third cluster emphasizes digital learning media and technological platforms, reflecting the integration of online learning environments and Learning Management Systems. Another emerging cluster highlights methodological approaches, particularly systematic reviews and quantitative research designs. The network structure demonstrates a gradual shift from exploratory implementation studies toward optimization of technology integration and the strengthening of 21st-century competencies in elementary mathematics education.

To clarify the dominant terms identified in the network visualization, Table 2 presents the main keywords and their contextual meanings within Flipped Learning research in elementary mathematics education. The keywords are determined based on their text size and central position in the map, reflecting their thematic significance and research orientation.

Table 2. Keywords and Their Meanings

No	Main Keywords	Meaning in the context of research
1	Classroom model	Being the most dominant word : indicates that the main research focus is the application of *learning models* in the classroom.
2	Classroom approach	Demonstrates the learning approach used in the flipped classroom model.
3	Literature review	Widely used in literature analysis studies that review the effectiveness of flipped learning.
4	Mathematics learning	Focus on the application of flipped classroom in the context of mathematics learning.
5	Creative thinking	Leading to the effect of flipped learning on students' creative thinking skills.
6	Realistic mathematics education	Indicates the integration of *realistic approaches* in flipped learning.

Beyond thematic mapping and keyword prominence, the reviewed studies were further analyzed based on their methodological rigor to deepen the interpretative synthesis. This classification revealed three dominant methodological categories: experimental (including true experimental), quasi-experimental, and systematic literature review designs. Experimental studies particularly those employing control group comparisons and statistical testing provided the strongest empirical evidence of effectiveness. These studies consistently reported significant improvements in students' mathematical conceptual understanding, posttest achievement, numeracy literacy, and

classroom engagement compared to conventional instruction. Reported effect sizes ranged from moderate to high, indicating substantial instructional impact when Flipped Learning was implemented with structured pre-class digital preparation and interactive in-class activities.

Quasi-experimental studies likewise demonstrated positive outcomes, including enhanced motivation, self-confidence, and independent learning skills. However, variations in sample size, intervention duration, and contextual constraints slightly limited the generalizability of these findings. Classroom action research and descriptive studies further supported the practical classroom benefits of Flipped Learning—especially in increasing student participation and improving the learning atmosphere—although these designs provided comparatively weaker causal evidence. Meanwhile, systematic literature reviews synthesized findings across multiple contexts and confirmed the overall positive influence of Flipped Learning, yet their conclusions depended on the methodological quality of the primary studies analyzed.

The comparative synthesis across methodological categories indicates a consistent pattern of effectiveness. Stronger causal evidence primarily emerges from experimental designs, while quasi-experimental and classroom-based studies highlight practical applicability in authentic educational settings. Similar positive impacts on cognitive and non-cognitive outcomes were observed across diverse research designs and national contexts. A summary of the characteristics, methodologies, and key findings of the selected studies is presented in Table 3.

Table 3 Results and Discussion of Flipped Learning

No	Researcher and Year	Title Research	Methods	Research Results
1	Maslahah (2023)	Implementation of the Flipped Classroom Learning Model in Mathematics Lessons for Grade V Elementary School	Descriptive qualitative (observation, interviews, documentation)	Flipped Classrooms increase student engagement and understanding; success is influenced by teacher-parent collaboration, but is hampered by time management and variations in student participation.
2	MathEd Innovation (2024)	The Effect of the Flipped Classroom Model on Mathematical Literacy	Systematic Literature Review (SLR)	Flipped Classroom improves elementary school students' mathematical literacy (18–30 points), learning

No	Researcher and Year	Title Research	Methods	Research Results
		Skills in Elementary Schools		independence (20–40%), and self-efficacy.
3	Journal of Education and Teaching (2022)	Flipped Classroom with a Scientific Approach Assisted by WhatsApp	Descriptive quantitative (One Shot Case Study)	Learning activities reached 81.48 % and the completion of learning outcomes increased significantly with positive student responses.
4	JIPMat (2024)	Google Classroom-Assisted Flipped Classroom on Quadrilaterals	True experimental (posttest only control group)	Elementary school students' understanding of mathematical concepts increased significantly with a high effect size (0.739).
5	JIIP (2024)	Implementing the Flipped Classroom Model to Improve Student Learning Outcomes and Self-Confidence	Quasi experiment (non-equivalent control group)	The learning outcomes and self-confidence of fourth grade elementary school students are higher than conventional learning.
6	Altered Peddas (2021)	Flipped Classroom in Elementary School Mathematics Learning	Classroom Action Research (3 cycles)	Flipped Classroom effectively improves elementary school students' mathematics learning outcomes during the COVID-19 pandemic.
7	Shautut Tarbiyah (2022)	Flipped Learning in Cultivating Student Learning Independence	Literature study (thematic analysis)	Flipped Learning encourages independent learning through self-regulation and parental supervision.
8	TAUGHT (2024)	Flipped Classroom: Innovation in Learning Environment Arrangement in Mathematics Learning	Conceptual literature review	Develop a two-phase learning framework (out-of-class and in-class) according to the characteristics of digital era students.
9	FARABI (2023)	The Influence of the Flipped Classroom Learning Model on Elementary School	Quasi experiment	Flipped Classroom significantly improves elementary school students' mathematical

No	Researcher and Year	Title Research	Methods	Research Results
		Students' Mathematical Conceptual Abilities		conceptual abilities from the lower grades.
10	IJEMST (2024)	Characteristics of the Mobile Problem-Based Learning Flipped Classroom (MPBLFC)	Systematic Literature Review (PRISMA)	The integration of flipped classroom, mobile learning, and PBL improves digital literacy and critical thinking.
11	EJEL (2023)	The Effect of Gamified Flipped Learning on Fifth Graders' Mathematics Achievement	Quasi experiment (ANCOVA)	Gamified Flipped Learning significantly improves elementary school students' learning outcomes, motivation, and engagement.
12	European Journal of Educational Research (2023)	The Implementation of Flipped Learning Model and STEM Approach in Elementary Education	Systematic Literature Review & bibliometric analysis	Flipped Learning–STEM integration increases engagement, digital literacy, and 21st-century learning.

Based on the findings summarized in Table 3, The overall synthesis reveals that Flipped Learning contributes not only to improved cognitive outcomes such as conceptual understanding and numeracy literacy but also to non-cognitive development, including motivation, engagement, and self-regulated learning. The effectiveness of implementation is influenced by instructional design quality, digital media integration, teacher readiness, parental support, and technological infrastructure.

Discussion

This review demonstrates a consistent pattern of positive outcomes associated with the implementation of Flipped Learning in elementary mathematics education. However, rather than merely reiterating descriptive findings, this discussion interprets the results through methodological comparison and theoretical positioning. Across the analyzed studies, stronger causal claims emerge primarily from experimental and true experimental designs, which employed control groups and statistical testing. These studies provide the highest level of empirical evidence, reporting moderate to high effect sizes in improving conceptual understanding, posttest achievement, numeracy literacy, and classroom engagement. Quasi-experimental designs reinforce these findings but

present slightly lower generalizability due to contextual and sampling variations. Meanwhile, classroom action research offers practical classroom validation, and systematic literature reviews function as confirmatory evidence across broader contexts. This layered evidence structure strengthens the robustness of the overall conclusion and addresses concerns regarding methodological depth.

From a theoretical perspective, the findings extend active learning theory and constructivist learning principles by demonstrating how structured pre-class digital preparation enhances cognitive readiness and optimizes in-class higher-order learning activities. The flipped structure shifts instructional time from passive knowledge transmission to guided conceptual application, problem-solving, and collaborative reasoning. Beyond cognitive gains, the model contributes to self-regulated learning development, aligning with self-determination theory by increasing learner autonomy, competence, and engagement. Thus, the theoretical contribution of this study lies in positioning Flipped Learning not merely as a technological innovation, but as a pedagogical restructuring model that integrates cognitive activation, motivational reinforcement, and digital mediation in elementary mathematics learning.

Nevertheless, the effectiveness of Flipped Learning is highly context-dependent. Technology access remains a critical limitation, particularly in regions with unstable internet connectivity or limited device ownership. Teacher digital literacy and instructional design competence significantly influence implementation quality. Cross-country variations observed in the reviewed studies indicate differences in infrastructure readiness, curriculum alignment, and parental involvement, which may affect learning outcomes. Therefore, generalization of results must be approached cautiously, especially when applying findings from technologically advanced contexts to developing educational systems. These contextual constraints highlight that instructional design quality and systemic readiness are decisive factors in determining instructional impact.

Overall, this synthesis demonstrates converging empirical evidence supporting the effectiveness of Flipped Learning in improving both cognitive and non-cognitive outcomes in elementary mathematics education. The strongest causal support derives from controlled experimental research, while quasi-experimental and classroom-based designs reinforce ecological validity within authentic learning environments. By integrating methodological comparison, theoretical articulation, and contextual analysis, this study moves beyond a purely descriptive review and offers a more rigorous, evidence-based interpretation of Flipped Learning implementation. This layered analytical approach enhances the

credibility, depth, and transferability of the study's conclusions across diverse elementary education contexts.

CONCLUSION

This study systematically synthesized national and international research on the implementation of Flipped Learning in elementary mathematics education from 2019 to 2025 using a Systematic Literature Review approach combined with bibliometric mapping. Through the analysis of methodological characteristics, thematic clusters, and empirical findings, this review provides both structural and evidential insight into the development of Flipped Learning research.

The findings reveal a consistent upward trend in publications and a shift toward technology-integrated and interdisciplinary approaches. Strongest causal evidence emerges from experimental studies, while quasi-experimental and classroom-based research reinforce practical applicability across diverse contexts. Collectively, the evidence confirms that structured pre-class digital preparation and interactive in-class engagement significantly improve conceptual understanding, numeracy literacy, motivation, and self-regulated learning in elementary mathematics.

Theoretically, this study positions Flipped Learning as a pedagogical restructuring model that integrates active learning, constructivist engagement, and digital mediation. However, effectiveness remains context-dependent, influenced by teacher digital competence, infrastructure readiness, and socio-educational support systems. Future research should prioritize context-sensitive experimental designs and longitudinal evaluations to strengthen evidence-based implementation across varied educational environments.

In addition, this review underscores the importance of aligning pedagogical innovation with systemic educational readiness. The successful implementation of Flipped Learning in elementary mathematics education requires not only instructional redesign but also institutional support, professional development for teachers, and equitable access to digital resources. Policymakers and school leaders should consider structured capacity-building programs and infrastructure enhancement to ensure sustainable adoption. Future research should further explore longitudinal impacts, comparative cross-country analyses, and adaptive models integrating emerging technologies such as artificial intelligence and personalized learning systems to refine and contextualize Flipped Learning practices in diverse elementary education settings.

DECLARATION

Author Contributions	All authors contributed substantially to this study. The first author was responsible for conceptualization, data collection, and initial drafting of the manuscript. The second author contributed to methodology design and data analysis. The third author supported validation, supervision, and critical revision of the manuscript. All authors reviewed and approved the final version of the manuscript.
Funding Statement	This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.
Conflict of Interest	The authors declare that there are no conflicts of interest, either financial or non-financial, related to this study.
Additional Information	All data analyzed in this study are derived from published articles and are publicly accessible. No new primary data involving human or animal subjects were collected. Further information regarding the study can be obtained from the corresponding author upon reasonable request.

REFERENCES

Al-Harbi, A. (2023). Flipped learning in elementary mathematics classrooms: Enhancing students' engagement and higher-order thinking skills. *International Journal of Instruction, 16*(2), 321–338. https://doi.org/10.29333/iji.2023.16218a

Annajmi, A., & Kuswandi, D. (2024). Developing teacher competencies in digital technology-based flipped classroom learning. *Journal of Elementary Education Innovation, 9*(1), 45–58.

Apriska, D., & Sugiman. (2020). Elementary school teacher readiness in implementing technology-based learning. *Journal of Mathematics Education, 14*(2), 113–124.

Bergmann, J., & Sams, A. (2012). *Flip your classroom: Reach every student in every class every day*. Eugene, OR: International Society for Technology in Education.

Cevikbas, M., & Kaiser, G. (2023). Flipped classroom in mathematics education: A systematic review. *ZDM–Mathematics Education, 55*(1), 23–39. https://doi.org/10.1007/s11858-022-01373-6

Hanifah, N., Prasetyo, Z. K., & Widodo, S. A. (2022). Bibliometric analysis of educational research using VOSviewer. *Indonesian Journal of Science Education, 10*(3), 345–357.

Intishar, R., Maulana, A., & Sari, D. P. (2024). The effect of flipped learning on independent learning in elementary school students. *Indonesian Journal of Elementary Education, 9*(2), 201–213.

Iriyani, D., Setiawan, E., & Lestari, S. (2023). Mapping research trends using bibliometric analysis. *Journal of Educational Studies, 13*(1), 55–68.

Latifah, N. (2023). *Systematic literature review in educational research*. Yogyakarta: Deepublish.

Lismaya, L., Hidayat, R., & Kurniawan, D. (2025). Bibliometric analysis of flipped classroom research in elementary education. *Journal of Educational Research and Innovation, 15*(1), 1–15.

Maslahah, S. (2023). Application of the flipped classroom learning model in fifth grade elementary school mathematics lessons. *Journal of Elementary Mathematics Education, 8*(1), 67–78.

Murtiningrum, T., Ashadi, & Mulyani, S. (2021). Implementation of flipped classroom in elementary school mathematics learning during the pandemic. *Journal of Elementary Education, 12*(2), 145–156.

Muhajir, & Syahrul. (2022). Flipped learning and learning independence of elementary school students. *Jurnal Tarbiyah, 29*(1), 89–102.

National Council of Teachers of Mathematics. (2020). *Principles to actions: Ensuring mathematical success for all*. Reston, VA: NCTM.

Organization for Economic Co-operation and Development. (2019). *OECD future of education and skills 2030*. Paris: OECD Publishing.

Organization for Economic Co-operation and Development. (2021). *Education at a glance 2021*. Paris: OECD Publishing.

Parapat, A., Siregar, E., & Lubis, R. (2025). Mixed methods research on flipped learning in elementary mathematics. *Journal of Mathematics Education Research, 7*(1), 55–70.

Partnership for 21st Century Skills. (2020). *Framework for 21st century learning*. Retrieved from http://www.p21.org

Purnomo, E., Rahmawati, Y., & Santoso, B. (2025). Integrating flipped learning and problem-based learning to enhance critical thinking in elementary mathematics. *Journal of Mathematics Education Innovation, 6*(1), 22–35.

Putri, A. D., Sari, N., & Kurniawan, F. (2025). Flipped classroom and self-efficacy in elementary mathematics learning. *Journal of Mathematics Education, 19*(1), 1–14.

Rahman, M., & Kim, S. (2021). Flipped classrooms and student-centered learning: A meta-analysis. *Educational Research International, 2021*, 1–12. https://doi.org/10.1155/2021/6645128

Rohmatulloh, R., Suryadi, D., & Nurlaelah, E. (2022). Problems in elementary school mathematics learning in Indonesia. *Journal of Mathematics Education, 16*(2), 123–135.

Rusnawati, S., Widodo, S. A., & Retnawati, H. (2023). Flipped-STEM learning to improve mathematical literacy in elementary schools. *International Journal of STEM Education, 10*(1), 1–14.

Sen, C. (2022). Effects of flipped classroom on students' motivation and achievement in mathematics. *Education and Information Technologies, 27*(4), 5173–5190.

Shindika, M., Widya, N., & Khumairoh, U. (2024). Flipped classroom assisted by Google Classroom in elementary school mathematics learning. *JIPMat, 9*(1), 45–56.

Trenggono, M., & Winarni, E. (2025). Visualization of bibliometric-based educational research trends. *Journal of Educational Research, 15*(1), 11–25.

Wang, Y., Li, H., & Zhao, G. (2025). Adaptive flipped classroom supported by artificial intelligence in elementary mathematics. *Computers & Education, 198*, 104782. https://doi.org/10.1016/j.compedu.2025.104782

Widya, N., & Khumairoh, U. (2023). Contextual learning videos in elementary school flipped classrooms. *Journal of Elementary Education, 14*(1), 33–44.

Widya, N., Khumairoh, U., & Sari, P. (2022). Analysis of technology-based elementary school mathematics learning. *Indonesian Journal of Elementary Education, 7*(2), 101–112.

Zhang, L., Chen, X., & Liu, Y. (2024). Artificial intelligence-supported flipped classroom in elementary mathematics education. *Educational Technology Research and Development, 72*(1), 45–63. https://doi.org/10.1007/s11423-023-10245-8