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Collaborative Learning in Primary Schools: A Systematic Review of Development, Strategies, and Effectiveness

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Abstract
Collaborative learning has established itself as one of the most significant pedagogical approaches in 21st-century primary education. This study presents a systematic review of the development, implementation strategies, and effectiveness of collaborative learning in primary schools, drawing on analysis of 198 Scopus-indexed articles published between 2010 and 2026. Rather than mapping epistemological trends, this review adopts a practice-oriented perspective, examining how collaborative learning works, which strategies have proven effective, under what conditions effectiveness is optimal, and what fundamental implementation challenges exist in real classrooms. Five developmental phases are identified, characterized by successive shifts in focus: from dialogic technology (2010–2014), structuring of cooperative models (2015–2019), redefinition of collaboration in the pandemic era (2020–2022), integration of social-emotional learning and artificial intelligence (2023–2024), and an orientation toward inclusion and educational equity (2025–2026). Strategies such as Jigsaw, STAD, peer tutoring, and collaborative project-based learning consistently demonstrate positive effects on academic achievement (Hedges' g = 0.71–0.79), social-emotional skills, learning motivation, and the formation of long-term social preferences. Critically, this effectiveness is not automatic and is highly dependent on implementation quality, teacher facilitation competence, task design that ensures positive interdependence, and group composition that accounts for cognitive capacity. The most significant challenges identified include the reduction of collaborative learning to procedural group work, weak group process regulation, and unanticipated cognitive heterogeneity. In the Indonesian context, collaborative learning carries strong cultural and policy resonance with the value of gotong royong and the spirit of Kurikulum Merdeka, yet the gap between policy rhetoric and meaningful classroom practice still requires serious attention.

Keywords: Collaborative Learning, Cooperative Learning, Primary Education, Learning Effectiveness

Introduction

Collaborative learning occupies a strategic position in global pedagogical discourse, not merely because it has become a policy trend, but because it directly responds to a fundamental human developmental need: that learning is essentially a social process taking

place in the context of relationships, interaction, and mutual interdependence. For primary school students, collaborative learning addresses the reality of child development, recognizing that children learn most naturally through peer interaction, conversation, play, negotiation of meaning, and shared responsibility.

Empirical evidence speaks clearly to its effectiveness. A meta-analysis of more than 40 experimental studies reports effect sizes in the medium-to-large range (Hedges' g = 0.71–0.79) for improvements in mathematics achievement through cooperative models in primary schools (Talkhan et al., 2025). A decade of research documents the consistent effect of peer tutoring on reading comprehension (Flores et al., 2024). Dimensions of cooperative learning significantly predict prosocial behavior in students (León-García et al., 2025). Most strikingly, cooperative curricula in primary school correlate with the formation of social preferences, including altruism, reciprocity, and cooperation, that persist into adulthood (Ito et al., 2022).

Yet these findings conceal a complexity that must not be oversimplified. The effectiveness of collaborative learning does not arise automatically simply because students are placed in groups. Students with low working memory capacity do not benefit from group interaction in the same way as their peers (Du et al., 2022). The group's ability to regulate its shared learning process, a prerequisite for success, rarely emerges spontaneously without explicitly designed scaffolding (Hogenkamp et al., 2021). Teachers' beliefs about students' capacity to collaborate meaningfully is a stronger predictor of successful implementation than the choice of any instructional model (Veldman et al., 2020).

In Indonesia, current policy momentum has created a context more conducive to collaborative learning than at any previous point in history. Kurikulum Merdeka with its spirit of project-based learning, the Projek "*Penguatan Profil Pelajar Pancasila*" (P5) that requires authentic cross-disciplinary collaboration, and the Bergotong-Royong dimension of the Profil Pelajar Pancasila all converge on a single urgent need: a deeper, evidence-based understanding of how collaborative learning should be designed, implemented, and evaluated.

Drawing on the same corpus of 198 Scopus-indexed articles (2010–2026), a companion analysis (Saputra et al., 2026) mapped the developmental trajectory of this literature through an epistemological lens, identifying five phases of conceptual and methodological evolution and a set of theoretical, methodological, and practical gaps. While that mapping clarifies how the field's knowledge base has evolved over time, it does not address how collaborative learning strategies function in classroom practice, under what conditions their effectiveness is optimal, or what fundamental implementation challenges educators encounter. This article addresses that gap by offering a complementary, practice-oriented reading of the same evidence base, systematically analyzing which strategies have proven effective with accountable effect sizes, under what conditions their effectiveness is optimal, and what fundamental implementation challenges educators and policymakers must anticipate. In doing so, this review aims not only to enrich the academic literature, but to provide an actionable roadmap for the development of meaningful collaborative learning in Indonesian primary schools.

Research Method

This study employs a systematic literature review approach guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) protocol (Page et al., 2021; Saputra et al., 2025). The analytical orientation is empirico-critical: not merely

summarizing what has been found, but evaluating the strength and limitations of available evidence to produce nuanced and usable understanding.

Data were drawn from the Scopus database, selected for its broad coverage of international journals and high publication quality standards. The literature search combined keywords including collaborative learning, cooperative learning, primary education, elementary school, and primary school, applied to titles, abstracts, and keywords, covering the period from 2010 to 2026. Reliance on a single database, while offering high indexing consistency, inevitably narrows the corpus relative to a multi-database search; the implications of this scope decision are addressed in the Limitations discussion below. In this review, collaborative learning is used inclusively to encompass cooperative learning, given that the two share significant conceptual overlap in primary education, although cooperative learning tends to be more procedurally structured. The article selection process is presented in detail through the PRISMA diagram in Figure 1.

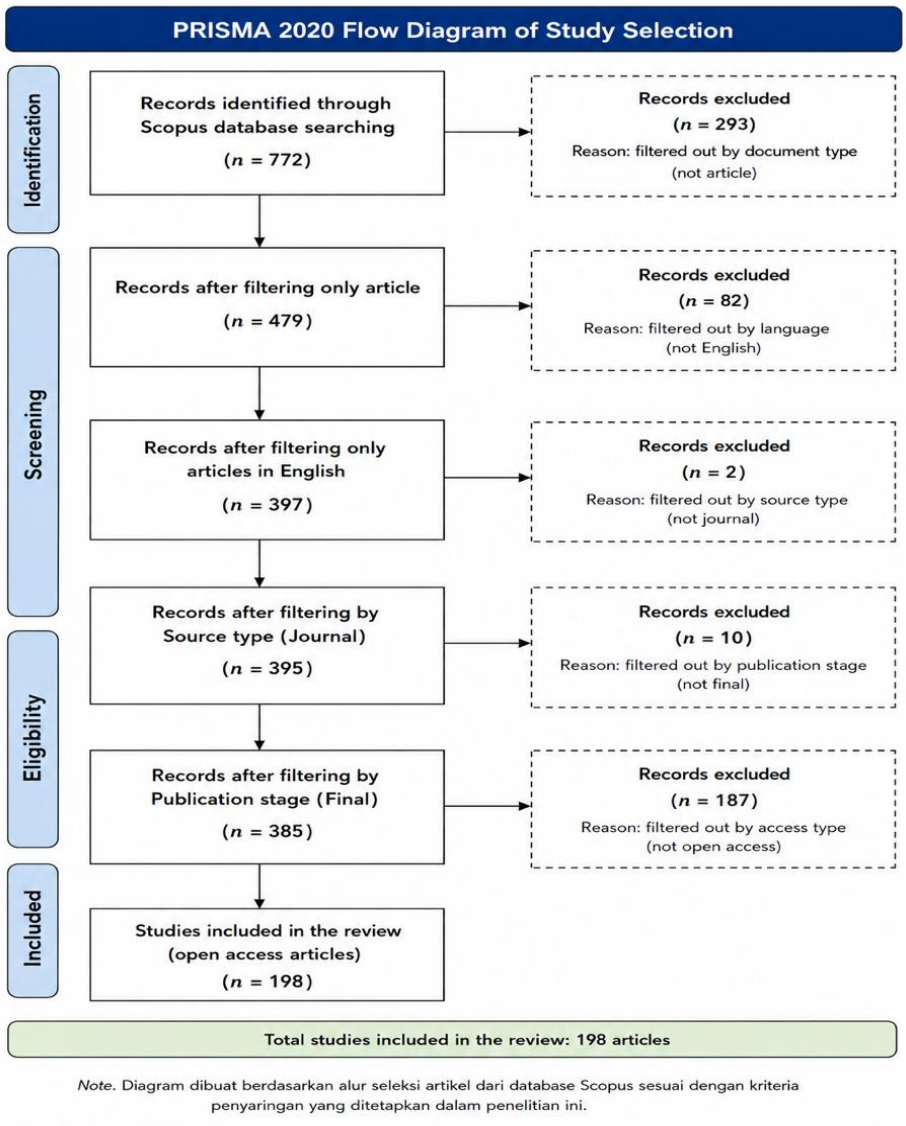

Figure 1 Article Selection Flowchart Based on the Prisma Protocol (Page Et Al., 2021)

The selection process proceeded in four stages: from 772 initial articles, filtering by document type (journal articles only) yielded 479; filtering by language (English only) yielded 397; filtering by source type and publication status yielded 385; and filtering by

open-access accessibility yielded 198 final articles for inclusion. The open-access criterion was applied primarily to ensure full-text accessibility for coding and synthesis given the authors' institutional access constraints; as this stage removed nearly half of the eligible pool (385 to 198), its implications for the representativeness of the synthesized evidence are discussed further in the Limitations section. Analysis was conducted in three complementary layers. First, bibliographic characteristic analysis mapped the temporal, geographic, methodological, and thematic distribution of the corpus. Second, thematic analysis and narrative synthesis integrated findings across studies on development, strategies, and effectiveness. Third, critical evaluation of the methodological strength of each claim produced assessments that go beyond mere confirmation, using a narrative rating scheme — rather than a standardized instrument such as MMAT or JBI — developed specifically for this review. Claims were rated as Strong when supported by meta-analytic evidence or multiple converging studies with consistently reported effect sizes; Fairly strong when supported by several independent studies with consistent directional findings but no meta-analytic aggregation; Moderate when supported by a limited number of studies constrained by short duration, small samples, or the absence of controls; and Unique & strategic when raised by very few studies yet carrying substantial conceptual or policy relevance that merits attention despite limited empirical volume. Validity was maintained through PRISMA-based selection transparency and source triangulation across research types.

Results and Discussion

Characteristics of the Research Corpus

Analysis of the 198 included articles reveals several structural patterns of importance. The distribution of article characteristics is presented in Table 1.

Table 1 Characteristics of Articles Included in the Systematic Review (N = 198)

Characteristic	Category	n	%	Representative Studies
Year of Publication	2010–2014	15	7.6	(Pifarré & Kleine Staarman, 2011; Warwick et al., 2010)
	2015–2019	26	13.1	(Fernández-Río & Suarez, 2016; Viilo et al., 2018)
	2020–2022	72	36.4	(Du et al., 2022; Erbil & Kocabaş, 2020)
	2023–2026	85	42.9	(Chen & Huang, 2024; Paavilainen et al., 2026; Talkhan et al., 2025)
First Author Country	Spain	59	29.8	(León-García et al., 2025; Rivera-Pérez et al., 2021)
	Indonesia	17	8.6	(Hardianti et al., 2025; Karmina et al., 2024)
	United States	16	8.1	(Du et al., 2022; Webb et al., 2021)
	Netherlands	11	5.6	(Hogenkamp et al., 2021; Veldman et al., 2025; Veldman et al., 2020)
	Others (>35 countries)	95	48.0	(Naparan & Alinsug, 2021; Park & Nuntrakune, 2013)
Research Design	Quantitative/ Experimental	98	49.5	(Andreatti & Morselli, 2026; Talkhan et al., 2025)
	Qualitative	42	21.2	(Hogenkamp et al., 2021; Montanero & Franco, 2024)
	Mixed Methods	35	17.7	(Karmina et al., 2024; Vu et al., 2024)
	SLR/Meta-Analysis	12	6.1	(Flores et al., 2024; Talkhan et al., 2025)
	R&D/Development	11	5.6	(Liu et al., 2026; Saif et al., 2021)
Education Level	Primary School (direct)	126	63.6	(Du et al., 2022; León-García et al., 2025)

Characteristic	Category	n	%	Representative Studies
Subject Area	Primary Teacher Education	51	25.8	(Lakkala & Ilomäki, 2015; Veldman et al., 2020)
	Mixed Context	21	10.6	(Barnes-Story et al., 2025)
	Mathematics	38	19.2	(Akkuş & Doymuş, 2022; İlhan, 2021; Talkhan et al., 2025)
	Language/Literacy	28	14.1	(Flores et al., 2024; Vega et al., 2020)
	Technology/Programming	25	12.6	(Chen & Huang, 2024; Liu et al., 2026)
	Science	22	11.1	(Lu et al., 2022; Lupión-Cobos et al., 2023)
	Cross-disciplinary/General	85	43.0	(Jakavonytė-Staškuvienė et al., 2021; Karmina et al., 2024)

Three patterns merit particular attention. First, more than 79% of articles were published between 2020 and 2026, reflecting an acceleration driven by the COVID-19 pandemic alongside a momentum that must be seized strategically. Second, Spain dominates with 29.8% of articles, reflecting its strong tradition of research in collaborative physical education and primary teacher education, while Indonesia emerges as an increasingly active contributor at 8.6%, a trend that correlates directly with the implementation of Kurikulum Merdeka. Third, the dominance of quantitative designs (49.5%) reflects the drive to produce strong evidence of effectiveness, while the significant presence of mixed-methods studies (17.7%) signals a growing awareness that the complexity of collaboration cannot be fully captured by numbers alone.

Five Phases in the Development of Collaborative Learning

The developmental map of collaborative learning research in primary schools reveals five phases that reflect the evolution of research questions, methodological approaches, and value orientations characterizing each period. Table 2 summarizes this development.

Table 2 Five Phases in the Development of Collaborative Learning Research in Primary Schools (2010–2026)

Period	Theme & Central Question	Dominant Strategies & Models	Key Empirical Findings	Pedagogical Implications
2010–2014	Technology as a mediator of dialogic collaboration	Wikis, IWBs, e-textbooks; early CSCL	Technology opens dialogic spaces but depends on quality of teacher instruction (Pifarré & Kleine Staarman, 2011; Warwick et al., 2010)	Technology does not automatically improve collaboration; the teacher's role as interaction designer is decisive
2015–2019	Structuring cooperative models for 21st-century competencies	Jigsaw, STAD, TAI, cooperative games	Models are consistently positive, but teacher facilitation matters more than model choice (Fernández-Río & Suarez, 2016; Viilo et al., 2018)	Effectiveness is determined more by implementation quality than the type of model selected
2020–2022	Redefining collaboration in crisis	Collaborative e-learning, Flipped Classroom + CL, AR/VR	E-CL is flexible but the pandemic exposed digital access inequalities (Du et al., 2022; Erbil & Kocabaş, 2020)	CL design must be responsive to diversity in access and students' cognitive capacities

Period	Theme & Central Question	Dominant Strategies & Models	Key Empirical Findings	Pedagogical Implications
2023–2024	CL as an academic-social-digital ecosystem	Metaverse Jigsaw, AI-assisted CL, digital game-based learning	CL transcends academic strategy; SEL, AI, and immersive environments open new dimensions (Chen & Huang, 2024; León-García et al., 2025)	SEL development and social skills must be systematically integrated into CL design
2025–2026	Inclusivity and equity	SR-CoP, multigrade CL, inclusive EdTech, neurodidactics	CL is meaningful for all when designed with contextual sensitivity; inclusion becomes primary agenda (Liu et al., 2026; Paavilainen et al., 2026)	CL models must be adaptive to student diversity; inclusion is a design principle, not an add-on

Note: Phase boundaries are based on analysis of shifts in dominant research questions, not purely chronological periodization.

The first phase (2010–2014) established the foundational insight that technology does not automatically produce meaningful collaboration; rather, it depends on the quality of the teacher's pedagogical design. Wikis can create authentic dialogic spaces, yet digital textbooks that support active learning face significant teacher readiness barriers (Minelli-de-Oliveira et al., 2014; Pifarré & Kleine Staarman, 2011). The lesson of this phase is that technology is an enabler, not a guarantee of collaboration.

The second phase (2015–2019) shifted the central question from whether technology helps to which model is most effective, producing a stronger evidence base for structured models such as Jigsaw and STAD. A critical warning emerged from this period: the success of collaborative learning is more determined by the teacher's ability to orchestrate the interaction process than by the mere selection of a model, inviting a shift in focus from 'what model' to 'how is it implemented' (Viilo et al., 2018).

The third phase (2020–2022) was the most empirically productive. The COVID-19 pandemic forced a fundamental redefinition of collaboration from physical presence to digital interaction while exposing digital access inequalities that had long been concealed. The most important lesson of this phase is that collaborative learning effectiveness is not universal; it depends heavily on the specific conditions and cognitive capacities of each student (Du et al., 2022; Erbil & Kocabaş, 2020).

The fourth phase (2023–2024) marked conceptual maturity by integrating social-emotional intelligence, artificial intelligence, and immersive environments into the collaborative framework, demonstrating that collaborative learning transcends academic strategy and constitutes an ecosystem of holistic human development (León-García et al., 2025). The fifth phase (2025–2026), still ongoing, places inclusivity and equity at the center of the agenda, asking who has not yet been reached by collaborative learning and how to design it meaningfully for all students, including those in the most challenging contexts (Paavilainen et al., 2026; Zhao et al., 2026).

Collaborative Learning Strategies: Mechanisms, Conditions, and Limitations

Synthesis across 198 articles reveals a broad spectrum of collaborative learning strategies, from well-established structured models to technology-based approaches still in exploratory stages. Table 3 presents a comprehensive strategy map based on empirical analysis.

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Table 3 Collaborative Learning Strategies and Models in Primary Schools: Mechanisms, Context, and Critical Evaluation

Strategy/ Model	Core Mechanism & How It Works	Optimal Implementation Context	Empirical Evidence & Critical Notes
A. CLASSIC STRUCTURED MODELS			
Jigsaw	Each member receives unique material and becomes an 'expert' responsible for teaching their portion to the home group	Mathematics, Science, Language; mixed-ability classes; content divisible into complementary parts	Meta-analysis: Hedges' g = 0.71–0.79; consistently positive. Effect depends on the quality of the expert group phase, which is frequently overlooked (Akkuş & Doymuş, 2022; Talkhan et al., 2025)
STAD	Inter-team competition based on individual progress; rewards given for improvement, not absolute scores	Mathematics and Social Studies; contexts where extrinsic motivation is needed as a bridge	Consistently positive effects. Risk: extrinsic motivation may dominate; competition can hinder genuine cooperation over time (Erbil & Kocabaş, 2020; Talkhan et al., 2025)
TAI	Self-directed learning within a group structure; individualization of needs within a cooperative framework	Mathematics; high cognitive heterogeneity; contexts where individual pacing matters	Effective for bridging individual and collaborative learning (Najoan et al., 2024; Wyman & Watson, 2020)
B. TUTORING-BASED STRATEGIES			
Peer Tutoring	More capable students guide others in a structured way; reciprocal tutoring is more effective than one-directional tutoring	Literacy, Mathematics, Language; effective across ages; can be reciprocal or cross-age	d = 0.43–0.97 on reading comprehension over 10 years. Effectiveness depends heavily on tutor training quality, which is often neglected (Flores et al., 2024; Montanero & Franco, 2024)
C. PROJECT- AND INQUIRY-BASED STRATEGIES			
Collaborative Project-Based Learning	Authentic cross-disciplinary projects completed in groups; real products serve as evidence of collaboration	STEAM, Social Studies, Language; highly compatible with P5 in Kurikulum Merdeka	Most consistently develops 21st-century competencies holistically (Lupión-Cobos et al., 2023; Vicente et al., 2020)
Inquiry Collaborative Learning	Question-based investigation within scientific groups; students build knowledge through joint inquiry	Science, STEAM; contexts where exploration and curiosity drive learning	Requires strong teacher orchestration support (Lupión-Cobos et al., 2023; Viilo et al., 2018)
D. TECHNOLOGY-BASED STRATEGIES			
Flipped Classroom Cooperative	Content studied independently at home; class time optimized for active collaborative activities	Mathematics, Social Studies; contexts with adequate home technology access	Improves achievement and engagement. Digital access gaps remain a structural barrier in many contexts (Erbil & Kocabaş, 2020)
Collaborative Game-Based Learning	Digital or non-digital games that structurally require active teamwork to succeed	Language, Mathematics, Literacy; highly effective for increasing motivation and engagement	RCT evidence available. Transfer from game context to real learning context is not always confirmed (Andreatti & Morselli, 2026; Jeliseh et al., 2026)

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Strategy/ Model	Core Mechanism & How It Works	Optimal Implementation Context	Empirical Evidence & Critical Notes
CSCL	Digital platforms to support computer-based collaboration; interaction can be synchronous or asynchronous	Science, Language, Programming; contexts with adequate digital infrastructure	Strong theoretical foundation; implementation still constrained by infrastructure in developing countries (Pifarré & Kleine Staarman, 2011; Vega et al., 2020)
AR-Enhanced Collaborative Learning	AR integrated into group activities; virtual environment enriches spatial and conceptual interaction	Science, Language; innovative contexts with adequate device support	Promising for engagement; long-term studies are still very limited (Lu et al., 2022; Saif et al., 2021)
Metaverse Jigsaw (JCLM-MVS)	Jigsaw implemented in a metaverse virtual space; students collaborate as avatars in an immersive environment	Technology/Coding; students with high digital access and literacy	Innovative and promising; study scale is still small and replication has not yet occurred (Chen & Huang, 2024)
E. SELF-REGULATION & CONTEXTUAL STRATEGIES			
SR-CoP	Cooperative programming with structured self-regulation strategies; integrates self-monitoring into the collaboration process	Technology/Coding; upper primary grades; contexts where metacognition is an explicit goal	Significantly improves metacognition and self-efficacy compared to individual learning (Liu et al., 2026)
Multigrade Cooperative Learning	Collaborative strategies in multi-level classrooms; students across grade levels work together in a structured way	Cross-disciplinary; remote primary schools with combined classes; highly relevant for Indonesia's 3T regions	Contextually specific but highly relevant; research in Indonesia is almost non-existent (Naparan & Alinsug, 2021)

Note: 'Strength of evidence' refers to the quality and consistency of available studies.

Several cross-strategy observations deserve emphasis. The dominance of Jigsaw and STAD in the literature must be read critically; while meta-analytic evidence shows strong effects, most analyzed studies use quasi-experimental designs with limited control, and learning gains cannot always be attributed exclusively to the model itself. The alternative Reading-Writing-Presentation method demonstrates comparable effectiveness, strengthening the argument that success lies not in the type of model but in the quality of its implementation (Akkuş & Doymuş, 2022).

Peer tutoring, despite showing the strongest consistency of positive findings in the reading literature, presents an important methodological limitation: most research relies on learning outcome measurements without exploring interaction mechanisms deeply. The neglect of tutor training quality in many studies limits the generalizability of findings (Montanero & Franco, 2024).

The development of immersive technologies presents great potential alongside significant methodological challenges. Studies on augmented reality, metaverse environments, and game-based learning show promising results, yet nearly all are conducted with limited samples and designs not yet strong enough to support generalization. Contextual variables including technological readiness, teacher digital literacy, and access gaps are frequently not systematically accounted for (Chen & Huang, 2024; Lu et al., 2022).

Effectiveness of Collaborative Learning: Evidence, Nuance, and Critical Conditions

The question of collaborative learning's effectiveness cannot be answered with a simple effective or not effective dichotomy. Empirical evidence from 198 articles shows that collaborative learning generally produces positive effects, but the intensity, consistency, and optimal conditions vary considerably. Table 4 presents a summary of effectiveness by dimension with critical evaluation of available evidence.

Table 4 Effectiveness of Collaborative Learning in Primary Schools by Learning Outcomes Dimension

Effectiveness Dimension	Main Findings	Effect Size / Indicator	Strength of Evidence	Supporting Studies & Notes
Academic Achievement – Mathematics	CL consistently improves mathematics achievement; Jigsaw & STAD show medium-to-large effects	Hedges' g = 0.71 (CI: 0.60–0.82); g = 0.79 for primary school	Strong (meta-analysis, 40+ RCTs)	Most studies are quasi-experimental with limited control (Talkhan et al., 2025)
Literacy & Reading Comprehension	Peer tutoring consistently improves reading comprehension over a decade; CSCL improves complex text comprehension	d = 0.43–0.97 (range across 10 years)	Fairly strong (SLR + meta-analysis)	Effectiveness depends on tutor training quality (Flores et al., 2024; Vega et al., 2020)
Social-Emotional Skills (SEL)	CL dimensions significantly predict prosocial behavior in students	β = 0.194; 0.095; 0.091 ($p < 0.01$)	Fairly strong (large-scale correlational study)	Mostly self-report instruments (León-García et al., 2025; Rivera-Pérez et al., 2021)
Student Engagement & Motivation	CL consistently increases intrinsic motivation and engagement; AR-based CL increases team motivation	Significant vs. control class	Moderate (majority quasi-experimental)	(Erbil & Kocabaş, 2020)
Critical & Creative Thinking	CL with open-ended tasks is most effective for creative thinking; improves critical thinking in physical education	ANCOVA significant ($p < 0.05$)	Moderate (varied designs)	(Huang et al., 2020; Titikusumawati et al., 2020)
Social Networks & Peer Relationships	CL reduces narrow cluster formation and increases openness in peer relationships longitudinally	Significant (longitudinal SNA)	Unique & methodologically strong	One of the most methodologically rigorous studies in this corpus (Veldman et al., 2025)
Self-Regulation	SR-CoP significantly improves self-regulation; but SSRL rarely emerges spontaneously without explicit scaffolding	Significant vs. control and C-CoP ($p < 0.05$)	Fairly strong (RCT)	(Hogenkamp et al., 2021; Liu et al., 2026)
Cognitive Differentiation	CL benefits high-WM students; students with low WM need different scaffolding to avoid disadvantage	Moderate effect on high-WM group; not significant for low WM	Moderate (controlled experimental)	Group designs ignoring cognitive composition risk widening the learning gap (Buchs et al., 2021; Lu et al., 2022)

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Effectiveness Dimension	Main Findings	Effect Size / Indicator	Strength of Evidence	Supporting Studies & Notes
Long-Term Social Preferences	Cooperative curriculum in primary school correlates with formation of social preferences (altruism, cooperation) into adulthood	Significant positive correlation (longitudinal study)	Unique & strategic (sole long-duration longitudinal study)	Most valuable long-term finding: CL as an investment in social character formation (Ito et al., 2022)

Note: 'Strength of Evidence' is assessed based on number of studies, consistency of findings, and methodological design strength. WM = Working Memory; SNA = Social Network Analysis.

Three findings carry the most practical implications. First, differentiation of effectiveness based on students' cognitive capacity is a finding frequently overlooked in the general narrative about collaborative learning. Students with high working memory benefit far more from group interaction than those with low working memory, and the use of identical information within groups rather than complementary information triggers counterproductive social competition (Buchs et al., 2021; Du et al., 2022). Group designs that ignore cognitive composition and task distribution risk widening rather than narrowing existing learning gaps.

Second, the findings on long-term social preferences provide the strongest policy argument from a long-term human development investment perspective. If cooperative curricula in primary school correlate with the formation of altruistic and cooperative social preferences that persist into adulthood, then collaborative learning is not merely a pedagogical strategy but a social investment (Ito et al., 2022). In the Indonesian context, where the value of gotong royong is a living cultural heritage, this finding resonates far beyond academic discourse.

Third, effectiveness on the social-emotional learning dimension shows stronger consistency than academic effectiveness. Three collaborative learning dimensions, specifically social skills, group processing, and individual accountability, significantly predict students' prosocial behavior ($\beta = 0.194; 0.095; 0.091$; $p < 0.01$) (León-García et al., 2025). This suggests that even when academic effects are not significant in certain contexts, the social-emotional benefits of collaborative learning tend to remain meaningful.

Implementation Challenges: from Theory to Classroom Practice

The gap between the theoretical potential of collaborative learning and the quality of its implementation in real classrooms is a reality that cannot be ignored. Studies employing diverse methodologies consistently identify recurring patterns of challenge. Table 5 summarizes the main challenges together with evidence-based mitigation strategies.

Table 5 Collaborative Learning Implementation Challenges in Primary Schools and Mitigation Strategies

Challenge Category	Empirical Manifestations	Impact on CL Quality	Evidence-Based Mitigation Strategies
Teacher Competence & Beliefs	CL reduced to group work without ensuring five essential elements; student behavior perceived as a barrier rather than a learning process	Low interaction quality; CL potential unrealized even when procedures are followed	Simulation-based training; sustained collegial mentoring; Lesson Study based on CL (Charong & Haruthaithanasan, 2025; Veldman, Van Kuijk, et al., 2020)
Group Dynamics Management	Free-riding; unequal participation; directive rather than facilitative assistance; social competition in groups with identical material	Active students dominate; passive students do not learn meaningfully; superficial cooperation masking learning inequalities	Task design with complementary information; measurable individual accountability; structured role rotation (Buchs et al., 2021; Le et al., 2018)
Group Process Regulation (SSRL)	Shared regulation rarely emerges spontaneously; initial group formation and final completion phases are most vulnerable	CL proceeds without group cohesion; productivity is hampered; student frustration at productive phases	Explicit scaffolding for group regulation; metacognitive prompts at beginning and end of sessions; teacher modeling of discussion regulation (Hogenkamp et al., 2021; Paavilainen et al., 2026)
Cognitive Heterogeneity	Students with low working memory do not benefit equally from CL; identical material triggers social competition; differences in learning pace disrupt group rhythm	Learning gaps may widen rather than narrow; CL effects are not universal and depend on cognitive capacity	Group formation based on cognitive profiles; complementary information distribution; differential scaffolding for low-WM students (Buchs et al., 2021; Du et al., 2022)
Infrastructure & Class Size	Oversized classes (>35 students); limited digital devices; unstable connectivity; rigid classroom layouts	CL is technically and structurally hampered; teachers struggle to facilitate all groups simultaneously	Adaptive CL design for large classes; peer leaders; affordable smartphone-based technology; flexible classroom layouts (Barnes-Story et al., 2025; Gunnars, 2025)
Cultural Context & Assessment	Individual exam pressure conflicts with CL philosophy; parents doubt CL's effectiveness for individual achievement; collective assessment struggles to measure individual contributions	Systemic resistance from parents, students, and teachers; CL marginalized as academically inefficient	Assessment systems integrating process and product; peer assessment with specialized training; proactive parent communication about CL benefits (Park & Nuntrakune, 2013; Toledo et al., 2025)

Note: Challenges are identified from analysis of qualitative, observational, and mixed-methods studies. SSRL = Socially Shared Regulation of Learning.

Two challenges carry the most fundamental implications for practice in Indonesia. The reduction of collaborative learning to procedural group work appears universal but manifests distinctly in each context. Two classrooms with nearly identical learning designs can produce very different collaboration quality, a difference almost entirely explained by how the teacher facilitates interaction and encourages reflection (Jakavonytė-Staškuvienė, 2021). This finding must be at the core of every teacher training program.

The challenge of group process regulation is the most underrated in practice. Groups capable of regulating their own learning process produce far more meaningful collaboration, but this capacity rarely emerges spontaneously. The initial group formation phase and the final task completion phase are identified as the most vulnerable points, implying that effective collaborative learning design must not stop at group formation and task distribution but must explicitly design

scaffolding for the regulation of the collaborative process itself (Hogenkamp et al., 2021; Paavilainen et al., 2026).

Implications for Primary Education in Indonesia

The findings of this systematic review carry implications that extend beyond the narrow pedagogical domain, touching on educational policy, teacher professional development, and the design of the primary education system as a whole. Table 6 summarizes the practical implications recommended based on the synthesis of empirical evidence.

Table 6 Implications of Collaborative Learning for Primary Education in the Context of Kurikulum Merdeka and 21St-Century Learning

Implication Dimension	Evidence-Based Recommendations	Relevance to Kurikulum Merdeka & PPP	21st-Century Competencies Developed
Instructional & Curriculum Design	Integrate CL as the primary approach in learning modules; design tasks with complementary information; ensure the five cooperative elements are explicitly met	Supports Bergotong-Royong dimension of PPP; highly relevant to P5 requiring authentic cross-disciplinary collaboration	4C: Collaboration, Communication, Critical Thinking, Creativity
Pre-Service Teacher Development (LPTK)	Include CL micro-teaching simulations in curricula; train facilitation and orchestration skills; build the belief that all students can collaborate meaningfully	Relevant to primary teacher pedagogy standards in Permendikbudristek No. 56/2022	Teacher as facilitator; growth mindset pedagogy
In-Service Teacher Development	CL-based Professional Learning Community programs; Lesson Study for analyzing group interaction; Merdeka Mengajar Platform as a venue for sharing effective practices	Supports Merdeka Belajar teacher development; applies CL principles at the teacher development level itself (Charong & Haruthaithanasan, 2025)	Reflective practice; collaborative professional growth
Authentic Assessment	Develop instruments measuring individual contributions within a collective context; integrate peer and self-assessment with training; use collaboration process portfolios	Aligned with formative assessment approach of Kurikulum Merdeka; supports AKM	Assessment for learning; metacognition; self-regulation
Inclusion & Learning Equity	Design CL considering cognitive heterogeneity; specialized scaffolding for low-WM students; complementary information to reduce dominance; CL for students with special needs	Supports Berkebhinekaan Global dimension and equity values in PPP; aligned with Indonesia's inclusive education policy	Equity & inclusion; social justice; empathy
Technology Integration	Use technology as a CL enabler, not a replacement for meaningful social interaction; prioritize affordable and accessible technology for all school contexts	Supports digital literacy in PPP; relevant to ICT programs in Kurikulum Merdeka	Digital citizenship; computational thinking; media literacy
Character & Social-Emotional Learning	Use CL as a vehicle for character development: empathy, shared responsibility, prosocial behavior; integrate structured group reflection at end of every CL session	Supports all 6 PPP dimensions, especially Beriman-Bertakwa and Bergotong-Royong; builds long-term social preferences (Ito et al., 2022)	SEL; character education; growth mindset; civic values

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Implication Dimension	Evidence-Based Recommendations	Relevance to Kurikulum Merdeka & PPP	21st-Century Competencies Developed
National Education Policy	Include CL as an explicit competency in primary teacher standards; contextual validation of CL models based on gotong royong values; allocate professional development budgets for simulation-based CL training	Strengthens Kurikulum Merdeka implementation; supports SDG 4 in Indonesia; positions gotong royong as Indonesia's contribution to global literature	Systems thinking; policy literacy; sustainable development

Note: PPP = Profil Pelajar Pancasila; P5 = Projek Penguatan Profil Pelajar Pancasila; PMM = Merdeka Mengajar Platform; 3T = Frontier, Outermost, and Disadvantaged regions (Terdepan, Terluar, Tertinggal).

The most pressing implication concerns teacher professional development. Teacher competence, particularly the ability to facilitate, orchestrate, and adaptively respond to group dynamics, is the strongest predictor of collaborative learning success, far surpassing the choice of model. Yet existing teacher training programs tend to focus on technical procedures without addressing the reflective capacity and pedagogical beliefs that truly determine implementation quality (Jakavonytė-Staškuvienė et al., 2021; Veldman et al., 2020). Lesson Study, which applies collaborative learning principles at the teacher development level itself, is highly relevant for integration into the Merdeka Mengajar Platform (Charong & Haruthaithanasan, 2025).

Implications for curriculum and assessment are equally important. Digital collaborative learning is one of the most frequently reported 21st-century competency dimensions in real classroom activity, interconnected with digital literacy, critical thinking, and citizenship. This framework aligns directly with the Bergotong-Royong dimension of the Profil Pelajar Pancasila and the spirit of P5. However, without an assessment system capable of measuring individual contributions within a collective context, collaborative learning risks being reduced to a conventionally graded activity (van de Oudeweetering & Voogt, 2018).

Finally, the implications for developing locally grounded models deserve special attention. The value of gotong royong carries a fundamentally different value genealogy from the Western cooperative learning tradition. While cooperation in the Johnson and Johnson (1994) tradition is an instrument for achieving individual academic goals, gotong royong positions collective progress as an intrinsic value that cannot be reduced to a calculation of individual interest. The development of an empirically validated collaborative learning model grounded in gotong royong represents Indonesia's most original contribution opportunity to global literature.

Conclusion

This systematic review of 198 Scopus-indexed articles on collaborative learning in primary schools yields a picture that is rich, nuanced, and full of practical implications. Collaborative learning is empirically proven to produce significant effects on academic achievement, social-emotional skills, learning motivation, and the formation of long-term social preferences. Yet this effectiveness is not automatic; it is the product of a complex interaction between the quality of instructional design, teacher facilitation competence, group composition and dynamics, and the specific context of implementation.

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The five developmental phases identified demonstrate that this field continues to evolve substantially. Each phase leaves behind insights that remain relevant: technology is an enabler, not a guarantee; models are scaffolding, not goals; teacher facilitation is the heart of implementation; students' cognitive capacity is a variable that must not be ignored; and equitable access is a prerequisite, not an option. The diversity of available strategies, from Jigsaw, STAD, peer tutoring, and project-based collaborative learning to continuously evolving technology-based approaches, provides educators with considerable flexibility. What matters most is not selecting the best model in the abstract, but choosing the strategy most suited to the learning objectives, student characteristics, classroom context, and teacher capacity, and then implementing it with high-quality facilitation.

The implementation challenges identified, including the reduction of collaborative learning to procedural group work, weak process regulation, and unanticipated cognitive heterogeneity, indicate that the largest gap lies not in the availability of models but in the quality of implementation in real classrooms. In the Indonesian context, these challenges must be translated into investment priorities in teacher professional development oriented toward simulation and reflection, rather than merely procedural training.

This review is subject to three related methodological limitations that should inform how its findings and implications are interpreted. First, the search was restricted to a single database (Scopus), without triangulation from complementary sources such as Web of Science or ERIC. Although Scopus offers extensive coverage of international, peer-reviewed literature, a single-database search inevitably narrows the corpus relative to a multi-database search. This limitation carries particular weight for the implications raised in this review concerning gotong royong and locally grounded collaborative models: relevant literature documenting Indonesian collaborative learning practices rooted in local culture may exist in national or regional outlets not indexed in Scopus, and may therefore be underrepresented or absent from this corpus. Second, the review was restricted to English-language publications, which excluded 82 articles at the language-screening stage. This restriction is especially consequential given this review's claim, in the Implications section, that a gotong royong-based collaborative learning model represents Indonesia's most original contribution opportunity to the global literature: relevant Indonesian-language scholarship on locally grounded collaborative practices may exist but was not captured by this English-only search, and its absence should temper claims of originality until an Indonesian-language literature search is also conducted. Third, the open-access screening stage removed nearly half of the eligible pool, reducing the count from 385 to 198 articles. This reduction was the largest single decrease across all screening stages. Because open-access status is not randomly distributed across institutions, publishers, or regions, this restriction may have disproportionately excluded studies from under-resourced contexts or non-open-access regional journals. Consequently, it introduces a potential accessibility or funding bias into the synthesized evidence. Future reviews on this topic would benefit from triangulating Scopus with regionally focused or multilingual databases, and, where feasible, negotiating institutional access to paywalled literature, to better capture locally grounded evidence.

Taken together, these limitations, a single-database search, an English-language filter, and an open-access restriction, mean that the policy recommendations summarized in Table 6, while grounded in a substantial and rigorously screened corpus, should be read

as a starting point for the Indonesian context rather than a fully generalized prescription. Validating these recommendations against Indonesian- and regionally indexed literature remains an important next step before they are adopted at scale. Ultimately, collaborative learning is not merely a teaching method. When implemented with adequate quality, it becomes a long-term social investment. In an Indonesia undergoing transformation, where the value of gotong royong is a living and relevant cultural heritage, truly effective collaborative learning does not merely help students achieve academic success; it helps them grow into members of society capable of working together, respecting one another, and moving forward in solidarity to build a shared future.

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