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Unlocking the Potential of Flipped Classroom Models in Elementary Education: A Systematic Literature Review

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Abstract. This systematic review synthesized evidence on the barriers, enabling conditions, and outcomes of flipped classroom implementation in elementary education. A Scopus search on 13 February 2026 identified 265 records from 2016–2025, with PRISMA 2020 screening retaining 27 eligible studies. The included studies underwent structured thematic synthesis following methodological quality appraisal using the Mixed Methods Appraisal Tool (MMAT). Teacher-related barriers (n = 11) and technological constraints (n = 10) predominated, while student readiness, family support, and contextual adaptation shaped implementation. Structured design (n = 16) and age-appropriate materials (n = 15) predominated, supported by teacher development, active pedagogy, motivation, and ecosystem readiness. Academic achievement (n = 16) and motivation and

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engagement (n = 14) predominated, alongside retention, higher-order thinking, socio-emotional development, and physical outcomes. However, competitive features increased anxiety, while complex motor tasks produced weaker outcomes when demands exceeded learner readiness. Conceptually, this review advances a developmentally grounded, systemic explanation of elementary flipped classroom implementation. It positions instructional alignment as the mechanism connecting technology, teacher capacity, learner readiness, family support, and institutional conditions. Successful implementation therefore depends on coherent relationships among these components and their adaptation to younger learners. These findings provide schools with evidence-based criteria for equitable, developmentally appropriate, and responsible implementation.

Keywords: flipped classroom; elementary education; implementation barriers; enabling factors; learning outcomes

1. Introduction

The rapid digital transformation of education has reshaped teaching practices at all levels of schooling. Schools are increasingly expected to use student-centered approaches that promote active learning, collaboration, and higher-order thinking (Ortega-Alvarez et al., 2025). The flipped classroom has gained attention within this wider change, moving direct instruction to the pre-class phase through digital materials (Bishop & Verleger, 2013). Students review the materials before class, which leaves more class time for discussion, problem-solving, and guided practice (Fernández-Araque et al., 2026). Studies in secondary and higher education have linked this model to better academic achievement, motivation, and satisfaction (van Alten et al., 2019). Although these findings are promising, they do not establish whether the flipped classroom produces similar outcomes among elementary school students.

However, implementation at the elementary level introduces developmental and contextual demands that differ substantially from those affecting older learners. Younger learners are still developing self-regulation, metacognitive awareness, sustained attention, and their capacity for independent learning (Robson et al., 2020). Research involving younger children likewise indicates that interactive, developmentally appropriate, and collaborative activities can strengthen communication and peer engagement (Maria & Susilowati, 2025; Putri & Hasiana, 2025). These findings support active learning among younger students while emphasizing the need for careful developmental alignment. Consequently, many students require structured support to access, understand, and complete pre-class learning materials successfully (Lo & Hew, 2017). They may also struggle to manage cognitive load and connect their pre-class preparation with classroom activities (Sweller et al., 2019). Participation at home often depends on parental guidance, while implementation is also influenced by school infrastructure and teacher readiness (Wilder, 2014). For these reasons, findings from later educational levels cannot be applied directly to elementary school contexts. A focused synthesis is therefore needed to identify the conditions under which flipped classroom implementation is appropriate and feasible for younger students.

Several review studies have examined flipped classroom implementation across school settings, including elementary education and subject-specific contexts. However, the evidence remains fragmented because existing reviews focus on particular disciplines, instructional combinations, or technological features. Cegarra (2020) situated the flipped classroom within broader technology-supported innovations in elementary education. Gosálbez-Carpena et al. (2022) examined its application in physical education across non-university educational settings. Other reviews investigate digital tools for elementary flipped classrooms (Loizou, 2022) and their integration with STEM education (Rusnilawati et al., 2023).

More recent reviews address mobile problem-based flipped classrooms in mathematics (Yuliana et al., 2024) and gamification for young learners (Fernández-Velásquez et al., 2025). Collectively, these reviews provide insight into how specific flipped classroom designs operate within selected subjects, technologies, and instructional settings. However, they do not integrate evidence on implementation barriers, enabling factors, and learning outcomes across elementary education contexts. This limitation leaves an important gap in understanding flipped classroom implementation as an interconnected pedagogical process. The fragmented evidence has important theoretical, methodological, and practical consequences for research and implementation in elementary education. At the theoretical level, subject-specific and technology-focused reviews provide limited insight into how developmental readiness and instructional design jointly shape outcomes (Loizou, 2022; Rusnilawati et al., 2023; Yuliana et al., 2024).

From a methodological perspective, their specialized scopes make findings across grade levels, subjects, technologies, and school settings difficult to compare. In practical terms, the strong emphasis on effectiveness may present an overly positive account of flipped classroom implementation. This emphasis can obscure challenges related to unequal technology access, teacher readiness, and the family support required by younger learners (Lo & Hew, 2017; Wilder, 2014). Consequently, schools receive limited guidance on the prerequisites for adopting the model effectively. Taken together, the literature explains reported outcomes more clearly than the factors underlying successful or unsuccessful implementation. A broader synthesis is therefore needed to connect implementation barriers, enabling factors, and learning outcomes within elementary education.

To address these gaps, the present review synthesizes empirical evidence on flipped classroom implementation in elementary education. It examines implementation barriers, enabling factors, and learning outcomes within a single analytical framework, thereby clarifying how implementation conditions relate to reported outcomes among younger learners. This integrated focus distinguishes the review from earlier studies centered on particular subjects, technologies, or instructional combinations. It also places students' developmental characteristics at the center of interpreting implementation processes and learning outcomes.

Conceptually, the review presents the elementary flipped classroom as a coordinated instructional system involving several interdependent components, including technology, instructional design, teachers, families, and school-level support for implementation. This system-oriented perspective provides practical guidance for instructional design, teacher development, school readiness, and educational policy. Against this background, the present review addresses the following three research questions:

1. What implementation barriers have been reported in studies of flipped classroom models in elementary education?
2. What enabling factors to have supported the successful implementation of flipped classroom models in elementary education?
3. What learning outcomes have been associated with flipped classroom models in elementary education?

2. Methodology

2.1 Research Design

This study employed a systematic literature review to synthesize empirical evidence on flipped classroom implementation in elementary education. The synthesis focused on implementation barriers, enabling factors, and reported learning outcomes. Although the review was not prospectively registered, the identification, screening, and reporting of studies followed PRISMA 2020 guidelines (Page et al., 2021).

2.2 Search Strategy and Study Selection

The literature search was conducted in Scopus on 13 February 2026 and covered articles published between 2016 and 2025. Scopus was selected for its multidisciplinary coverage and standardized metadata across education, social sciences, and technology-related fields (Mongeon & Paul-Hus, 2016). Using a single database supported consistency and reproducibility, although relevant studies indexed elsewhere may have been omitted. Only open-access articles were retained to ensure that all reviewers could independently access, examine, and verify the same full texts. This restriction may have excluded relevant subscription-based studies and was considered when interpreting the findings.

The search terms captured common expressions for flipped classroom models and elementary education and were applied to titles, abstracts, and keywords. The complete search string was:

> ("flipped classroom" OR "flipped learning" OR "flipped instruction" OR "flipped pedagogy" OR "classroom flipping" OR "inverted classroom" OR "inverted instruction" OR "inverted learning") AND ("primary school" OR "elementary school" OR "primary education" OR "elementary education" OR "basic school" OR "basic education").

Eligibility criteria were established before screening and covered publication period, document type, language, empirical design, educational level, research focus, subject area, and full-text accessibility. These operational criteria are presented in Table 1.

Table 1: Eligibility criteria

Criterion	Inclusion	Exclusion
Publication period	Studies published between 2016 and 2025	Studies published outside this period
Publication type	Publications published in peer-reviewed journals	Conference papers, book chapters, dissertations, editorials, and protocols
Language	English-language publications	Publications in other languages
Study design	Empirical quantitative, qualitative, mixed-methods, or development studies with empirical evaluation	Reviews, conceptual papers, and theoretical discussions without empirical data
Educational level	Primary or elementary education, as defined within the relevant national education system	Preschool, secondary, higher, non-formal, or inseparable mixed-level settings
Research focus	Empirical examination of flipped classroom implementation	Studies mentioning flipped classrooms without examining their implementation
Subject area	Social sciences, computer science, psychology, environmental science, arts and humanities, engineering, or mathematics	Studies indexed exclusively outside the selected subject areas

The search identified 265 records, which decreased to 256 after applying the publication-period filter and 160 after applying the document-type filter. Applying the language, accessibility, and subject-area criteria left 77 records, while duplicate checking identified no repeated entries. Two reviewers then screened the titles and abstracts independently before assessing potentially eligible full texts. Disagreements were resolved through discussion, with another reviewer consulted when consensus could not be reached. Across these stages, 50 records were excluded, leaving 27 publications that met all eligibility criteria. Figure 1 presents the number of records retained for synthesis and the reasons for exclusion at each stage.

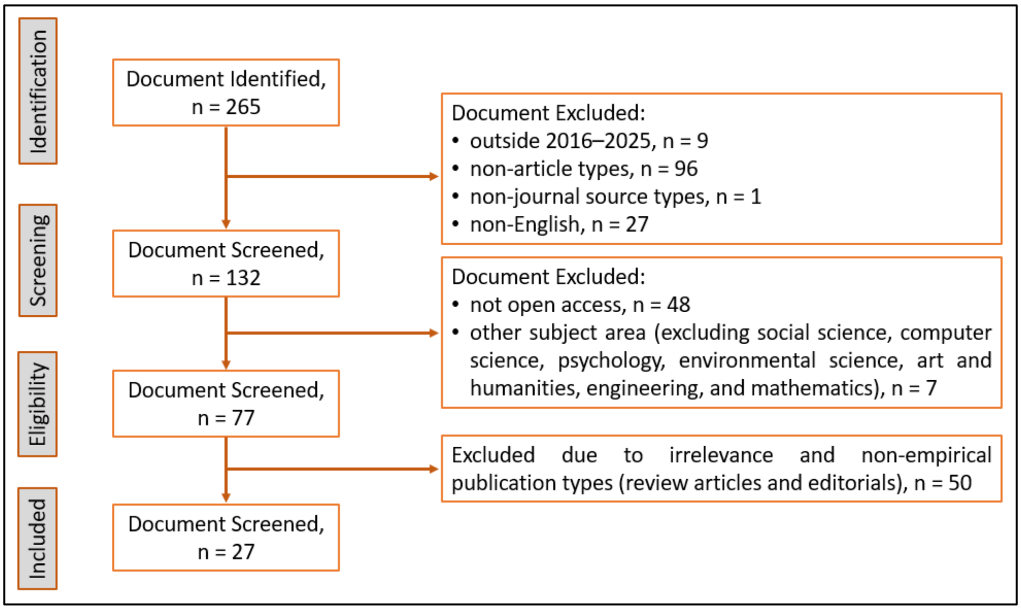

Figure 1: PRISMA flow diagram of the study selection process

2.3 Data Extraction and Methodological Quality Appraisal

Two reviewers independently extracted data using a standardized form covering author, publication year, country, grade level, subject area, research design, sample size, intervention duration, technology, implementation barriers, enabling factors, and learning outcomes. Discrepancies were resolved by revisiting the source articles and reaching consensus. The shared form retained supporting excerpts, extraction decisions, and revisions to provide an audit trail. Table 2 presents the descriptive characteristics of the included studies in the Results section.

Methodological quality was assessed using the Mixed Methods Appraisal Tool (MMAT), which accommodates qualitative, randomized, non-randomized, and mixed-methods designs (Hong et al., 2018). Two reviewers independently applied the criteria corresponding to each study design and resolved discrepancies through discussion. The appraisal informed the interpretation of the evidence but was not used to exclude otherwise eligible studies.

2.4 Data Analysis

The extracted evidence was analyzed using thematic synthesis (Nowell et al., 2017). Initial coding followed three deductive domains aligned with the review questions: implementation barriers, enabling factors, and learning outcomes. Inductive coding was then used to identify sub-themes, contextual variations, and convergent or contradictory findings within each domain.

Two researchers independently coded the extracted evidence and compared their initial classifications. Disagreements were resolved through discussion and re-examination of the original publications. Three additional authors audited the coded excerpts, code definitions, and thematic structure for conceptual consistency. Coding decisions and revisions were recorded until consensus was reached. Reliability was therefore established through independent coding, documented consensus, and audit review. No statistical agreement coefficient was calculated because the thematic framework was developed iteratively and allowed multiple codes to be assigned to each evidence segment.

3. Findings

The findings are organized into two complementary parts based on the objectives of the review. The first part describes the characteristics of the included studies and outlines the scope of the evidence base. The second part synthesizes implementation barriers, enabling factors, and reported learning outcomes across the reviewed studies.

3.1 Characteristics of the Included Studies

The 27 studies represented 16 countries or regions, with Malaysia (*n* = 5), Indonesia (*n* = 3), Türkiye (*n* = 3), and Jordan (*n* = 3) accounting for the largest shares. Quasi-experimental approaches, including mixed-methods variants, predominated (*n* = 16). The remaining studies used randomized, qualitative, action research, development, mixed-methods, or experimental designs. Language learning, science, and physical education were the most common subject areas. Intervention durations ranged from two weeks to one academic year, while seven studies did not specify their duration. Table 2 presents the characteristics extracted from each study.

Table 2: Characteristics of the included studies (*N* = 27)

Study	Context: country; grade; subject	Design and sample size	Duration
Russali and Tasir (2025)	Malaysia; Grade 5; science	Mixed-methods quasi-experimental; *N* = 40	4 weeks
Bārdule (2021)	Latvia; Grades 5–6; general elementary learning	Qualitative case study; 98 students (52 in flipped lessons)	NR
Nuryadin et al. (2023)	Indonesia; Grades 4–6; general elementary learning	Mixed-methods case study; 136 students and 3 teachers	NR
Sik and Topkaya (2024)	Türkiye; Grade 4; English vocabulary	Mixed-methods quasi-experimental study; *N* = 65	4 weeks
Waldi et al. (2025)	Indonesia; Grade 5; civics education	Development research (4D); *N* = 15	NR
Loizou and Lee (2020)	Cyprus; ages 8–11; inquiry-based learning	Qualitative multi-case study; 77 students, 5 teachers, and 48 parents	1 academic year
AlAli et al. (2024)	Jordan; primary education; reading comprehension	Quasi-experimental study; *N* = 186	NR
Parati et al. (2023)	Malaysia; Year 3; language learning	Quasi-experimental study; *N* = 31	4 weeks

Study	Context: country; grade; subject	Design and sample size	Duration
Jabučanin et al. (2025)	Montenegro; Grade 6; general elementary	Quasi-experimental study; $N = 40$	8 weeks
Jalaluddin et al. (2024)	Malaysia; primary education; writing	Quasi-experimental study; 4 classes with 30–40 students each	14 weeks
Gasparič et al. (2024)	Slovenia; Grade 7; mathematics	Quasi-experimental study; $N = 55$	3 months plus delayed post-test
Wijayanti et al. (2025)	Indonesia; Grade 4; science	Quasi-experimental study; $N = 128$	NR
Sarfaraj et al. (2025)	India; Grade 1; ESL	Quasi-experimental study; $N = 56$	18 sessions
Tiep and Huong (2025)	Vietnam; Grades 4–5; natural and social sciences	Mixed-methods randomized trial; $N = 453$	16 weeks
Zakaria and Yunus (2020)	Malaysia; Year 3; ESL	Mixed-methods study; $N = 36$	NR
Núñez et al. (2020)	Spain; secondary education; healthy eating	Quasi-experimental study; $N = 115$	6 sessions
Girmen and Kaya (2019)	Türkiye; Grade 4; Turkish language	Action research; $N = 23$	9 hours
AlManafi et al. (2023)	Libya; Grade 9; EFL reading	Quasi-experimental study; $N = 120$	12 weeks
Erbil and Kocabaş (2020)	Türkiye; Grade 4; social studies	Quasi-experimental study; $N = 100$	16 weeks
Wang et al. (2023)	China; Grades 3–4; physical education	Quasi-experimental study; $N = 160$	12 weeks
Stajić et al. (2025)	Serbia; Grade 7; geography	Randomized experiment; $N = 192$	4 weeks
Al-Momani (2022)	Jordan; Grade 7; science	Quasi-experimental study; $N = 80$	2 months
Khasawneh (2021)	Jordan; Grade 5; Arabic grammar	Quasi-experimental study; $N = 52$	NR
Mahmood and Mohammad-zadeh (2022)	Iraq; Grades 5–6; EFL	Experimental study; $N = 80$	1 semester
Santhanasamy and Yunus (2022)	Malaysia; Year 3; English speaking	Mixed-methods study; $N = 40$	7 weeks

Study	Context: country; grade; subject	Design and sample size	Duration
Chen et al. (2023)	China; Grade 2; Chinese character learning	Randomized experiment; N = 90	3 weeks
Yip et al. (2023)	Hong Kong; Grade 5; physical education	Quasi-experimental study; N = 111	2 weeks

Note. NR indicates that intervention duration was not reported. Jalaluddin et al. (2024) reported the number and size range of participating classes but did not provide an exact total sample.

3.2 Integrated Thematic Synthesis

Table 3 presents an integrated synthesis of evidence across the three dimensions examined in this review. It summarizes the major themes, their frequencies, representative indicators, and selected studies supporting each thematic category. This organization facilitates comparison of recurring patterns and relationships among barriers, enabling factors, and reported learning outcomes.

Table 3: Integrated thematic synthesis of barriers, enabling factors, and learning outcomes

Dimension and theme	Representative indicators	Representative studies
Barriers: teacher-related challenges (n = 11)	Digital competence, training, workload, lesson orchestration, and pedagogical adaptation	Nuryadin et al. (2023); Sık and Topkaya (2024); Stajić et al. (2025)
Barriers: technology and digital access (n = 10)	Internet connectivity, devices, school infrastructure, and unequal ICT access	Sarfaraj et al. (2025); Zakaria and Yunus (2020); Mahmood and Mohammadzadeh (2022)
Barriers: student-related challenges (n = 7)	Digital and cognitive readiness, engagement, language proficiency, and delayed feedback	Bārdule (2021); Parati et al. (2023); Gasparič et al. (2024); Chen et al. (2023)
Barriers: parental and home support (n = 6)	Monitoring, encouragement, and adjustment to home-based preparation	Loizou and Lee (2020); Erbil and Kocabaş (2020); Stajić et al. (2025)
Barriers: contextual constraints (n = 6)	Curriculum fit, rural conditions, validation, and local adaptation	AlAli et al. (2024); Wang et al. (2023); Santhanasamy and Yunus (2022)
Enablers: structured instructional design (n = 16)	ADDIE, 4D, inquiry structures, sequenced lessons, and curriculum alignment	Russali and Tasir (2025); Waldi et al. (2025); Loizou and Lee (2020); Tiep and Huong (2025)
Enablers: age-appropriate materials and resources (n = 15)	Short videos, multimedia, digital books, replay, and mobile access	AlAli et al. (2024); Gasparič et al. (2024); Sarfaraj et al. (2025); Chen et al. (2023)

Dimension and theme	Representative indicators	Representative studies
Enablers: teacher capacity development (*n* = 8)	Training, mentoring, collaborative planning, and instructional guidance	Al-Momani (2022); AlManafi et al. (2023); Khasawneh (2021); Wang et al. (2023)
Enablers: active classroom pedagogy (*n* = 8)	Cooperative learning, inquiry, differentiation, assessment, and scaffolding	Erbil and Kocabaş (2020); Wijayanti et al. (2025); Sarfaraj et al. (2025); Tiep and Huong (2025)
Enablers: learner engagement and motivation (*n* = 8)	Gamification, feedback, storytelling, immersive tools, and self-paced learning	Russali and Tasir (2025); Jalaluddin et al. (2024); Chen et al. (2023); Yip et al. (2023)
Enablers: ecosystem-level support (*n* = 4)	Parental involvement, administrative support, curriculum alignment, and contextual adaptation	Nuryadin et al. (2023); Sık and Topkaya (2024); Loizou and Lee (2020); Zakaria and Yunus (2020)
Outcomes: academic achievement and subject mastery (*n* = 16)	Achievement, reading, vocabulary, grammar, science, concepts, and digital literacy	Russali and Tasir (2025); Sık and Topkaya (2024); AlAli et al. (2024); Wijayanti et al. (2025)
Outcomes: motivation and engagement (*n* = 14)	Motivation, autonomy, participation, interest, and intrinsic motivation	Al-Momani (2022); Chen et al. (2023); Erbil and Kocabaş (2020); Santhanasamy and Yunus (2022)
Outcomes: higher-order thinking and retention (*n* = 8)	Critical and inferential thinking, reasoning, retention, and conceptual understanding	Loizou and Lee (2020); Gasparič et al. (2024); Sarfaraj et al. (2025); Tiep and Huong (2025)
Outcomes: socio-emotional and behavioral development (*n* = 7)	Collaboration, confidence, attitudes, problem-solving, and reduced anxiety	Bārdule (2021); Girmen and Kaya (2019); Wang et al. (2023); Mahmood and Mohammadzadeh (2022)
Outcomes: physical activity and motor skills (*n* = 3)	Motor performance, active participation, and reduced sedentary behavior	Jabučanin et al. (2025); Wang et al. (2023); Yip et al. (2023)

Note. Frequency indicates the number of included studies reporting each theme. One study could contribute to multiple themes, so frequencies exceed the number of included studies.

3.2.1 Implementation barriers

The thematic synthesis identified five interconnected barrier themes across the 27 included empirical studies. Teacher-related challenges (*n* = 11) and technological infrastructure and digital access (*n* = 10) were the most frequently reported. Student-related challenges (*n* = 7), parental support (*n* = 6), and contextual constraints (*n* = 6) were reported less frequently but remained relevant. Teacher-related and technological barriers occurred consistently across different countries, subjects, grade levels, and intervention settings. Parental support received greater attention in studies involving younger learners, while contextual constraints were more evident in rural, technology-limited, or locally adapted settings.

The reviewed evidence showed that these barrier themes frequently overlapped and reinforced one another. Limited connectivity and device access increased teacher workload and interrupted students' pre-class participation. Limited teacher preparation affected material design and feedback, while weak parental support compounded students' difficulties with independent preparation. Reported benefits were also sensitive to the alignment between instructional design and students' developmental readiness. Competitive game features increased learner anxiety in one reviewed study (Russali & Tasir, 2025). Similarly, complex motor tasks produced weaker results when task demands exceeded learner readiness (Jabučanin et al., 2025).

3.2.2 Enabling factors

The thematic synthesis identified six enabling themes that supported flipped classroom implementation across elementary education settings. Structured instructional design (n = 16) and developmentally appropriate pre-class materials (n = 15) were the most frequently reported. Teacher development, active classroom pedagogy, and learner engagement strategies each appeared in eight studies. Ecosystem-level support was reported less frequently and was identified in four of the included studies. Structured instructional design and high-quality materials appeared consistently across different subjects and educational contexts. Teacher development became especially important when interventions incorporated advanced technologies requiring unfamiliar instructional knowledge and skills. Parental and administrative support received greater emphasis when successful preparation depended heavily on home learning.

The enabling conditions functioned as interconnected supports that strengthened one another throughout implementation. Structured planning aligned learning objectives, pre-class preparation, classroom activities, and assessment within coherent instructional sequences. Teacher training supported the development and use of appropriate materials, while active learning transformed pre-class preparation into deeper classroom participation. Feedback, gamification, and self-paced access strengthened engagement, while family and school support sustained continuity between home and classroom activities.

3.2.3 Reported learning outcomes

The thematic synthesis identified five outcome themes reported across the 27 included empirical studies. Academic achievement and subject mastery were reported most frequently (n = 16), followed by motivation and learner engagement (n = 14). Eight studies reported on higher-order thinking and knowledge retention, while seven reported on socio-emotional and behavioral development. Physical activity and motor skills were reported less frequently, occurring in three physical education studies. Academic gains were reported across language, science, mathematics, civics, and physical education contexts.

Physical outcomes were confined to physical education, while higher-order thinking was more evident in inquiry-based and technology-enhanced settings.

The reported outcomes also formed interconnected patterns across cognitive, motivational, socio-emotional, behavioral, and physical domains. Greater engagement and autonomy were often associated with stronger achievement and retention, while collaborative activities supported confidence, problem-solving, and positive learning behaviors. The magnitude and direction of reported effects were not fully consistent across the included studies. One study reported only a positive trend toward higher-level knowledge development (Stajić et al., 2025). Other studies showed that anxiety or task complexity could limit the expected learning benefits. These variations provide a basis for examining conditional and contradictory effects in the Discussion.

4. Discussion

4.1 Implementation of Barriers and Conditions of Failure

This review shows that implementation barriers operate as an interconnected system across elementary education contexts. Technology limitations interact with teacher capacity, learner readiness, family support, and institutional conditions (van Dijk, 2017). Accordingly, implementation difficulties cannot be attributed to devices or connectivity alone without considering the surrounding instructional arrangements. This systemic interpretation extends research emphasizing that technology integration requires coordinated pedagogical and organizational change (Ertmer & Ottenbreit-Leftwich, 2010).

The most persistent technological barriers involved unstable connectivity, insufficient devices, and limited access to school-supported digital platforms. These constraints interrupted pre-class preparation and created unequal opportunities for classroom participation (Mahmood & Mohammadzadeh, 2022). Similar access problems appeared across multiple settings, suggesting that they extend beyond a single national context (Sarfaraj et al., 2025). However, infrastructure affected learning indirectly through teachers' responses, home access, and students' preparation routines. Therefore, digital provision remains necessary, although equitable participation requires coordinated pedagogical and family support (van Dijk, 2017).

Teacher-related barriers were reported most frequently, indicating that access to technology alone cannot guarantee coherent instructional practice. Limited digital competence increased preparation time and weakened connections between pre-class materials and classroom activities (Nuryadin et al., 2023). Workload became especially demanding when teachers produced videos, managed platforms, and redesigned assessments simultaneously (Stajić et al., 2025). Teachers also struggled when training emphasized technical operation without addressing lesson sequencing and classroom facilitation. These findings support the technological pedagogical content knowledge (TPACK) framework, which explains effective technology integration through the combined development of technological, pedagogical, and content knowledge (Mishra & Koehler, 2006).

Student-related barriers reflected developmental differences in attention, self-regulation, metacognition, and confidence during independent preparation. Younger learners often required explicit routines, shorter materials, and immediate guidance to sustain pre-class engagement. Some students also struggled with asynchronous materials because immediate clarification was unavailable during preparation (Gasparič et al., 2024). When multimedia exceeded working-memory capacity, increased cognitive demands reduced comprehension and subsequent classroom participation. This pattern aligns with cognitive load theory and its emphasis on the limited capacity of working memory (Sweller et al., 2019). It also supports self-regulated learning theory, which emphasizes planning, monitoring, and evaluation during independent learning (Panadero, 2017).

Parental involvement became particularly important when younger students completed pre-class preparation using shared household devices. However, families differed in available time, digital literacy, and confidence with unfamiliar instructional routines. Insufficient support magnified access problems and reduced students' readiness for classroom activities (Loizou & Lee, 2020). Parental uncertainty also weakened monitoring when families did not understand the purpose of pre-class preparation (Stajić et al., 2025). These patterns indicate that home support represents an important implementation condition in elementary education. This interpretation aligns with school–family partnership theory, which connects parental engagement with children's learning opportunities (Epstein, 2018).

Contextual constraints further shaped implementation across rural, technology-limited, and locally adapted school settings (Wang et al., 2023). Curriculum compatibility and local validation became essential when interventions introduced unfamiliar technologies or pedagogical structures (AlAli et al., 2024). Administrative commitment also shaped whether teachers received planning time, training, and access to reliable infrastructure. These constraints interacted with one another, as limited infrastructure increased teacher workload and students' dependence on family support. Limited teacher preparation, in turn, weakened material design, feedback quality, and students' engagement during pre-class learning. Flipped classroom implementation may therefore be less effective when these interconnected conditions are addressed separately. Schools should establish accessible infrastructure, sustained teacher development, age-appropriate materials, and reliable school–family communication before adoption.

4.2 Enabling Conditions and Instructional Alignment

The synthesis identified instructional alignment as the primary mechanism supporting flipped classroom effectiveness in elementary education. Technology expands access to content, while instructional alignment determines how pre-class preparation supports meaningful classroom activity. Successful models connected learning objectives, pre-class materials, classroom tasks, feedback, and assessment within coherent instructional sequences. Comparable technologies therefore produced different outcomes when schools differed in pedagogical coherence and implementation readiness.

Structured instructional design was the most frequently reported enabling condition across the reviewed studies. Models such as ADDIE and 4D supported teachers in coordinating objectives, resources, activities, and assessment (Russali & Tasir, 2025). Clear sequencing also reduced fragmentation between home preparation and collaborative classroom learning (Loizou & Lee, 2020). Constructive alignment explains how digital materials become effective when embedded within coherent learning sequences (Biggs, 2014). For elementary students, this coherence can reduce uncertainty and support transitions between learning environments.

Developmentally appropriate materials were the second most frequently reported condition supporting successful implementation. Short videos, replay options, embedded questions, and visual scaffolds supported manageable cognitive processing (Fiorella & Mayer, 2018). Interactive features supported pre-class preparation when they clarified content and guided students toward defined learning goals (AlAli et al., 2024). Excessive multimedia, competition, or complexity could produce distraction, anxiety, and unnecessary cognitive demands. Effective material design therefore requires developmental calibration and purposeful selection of digital features.

Teacher professional development supported implementation when it integrated technological skills with pedagogical decision-making. Practice-oriented training helped teachers design materials, monitor preparation, facilitate interaction, and adjust classroom support. Collaborative planning distributed workload and strengthened consistency across subjects, classes, and assessment practices. Prior experience with blended learning also supported smoother transitions to flipped classroom implementation (Nuryadin et al., 2023). Consequently, professional learning should continue throughout implementation and respond to challenges identified in practice (Darling-Hammond et al., 2020).

Active classroom pedagogy transformed students' pre-class preparation into discussion, inquiry, problem-solving, and guided application. Without this conversion, flipped classrooms risk becoming conventional homework followed by largely unchanged classroom instruction. Feedback and scaffolding helped teachers identify incomplete preparation before students encountered more demanding activities. These findings highlight that classroom interaction remains central, even when content delivery occurs before class (Bishop & Verleger, 2013).

Learner engagement strategies formed distinct enabling conditions because younger students still require structured motivational support. Gamification, timely feedback, immersive tools, and self-paced access encouraged participation across several studies (Chen et al., 2023). However, these features were effective only when they matched students' developmental readiness and instructional goals. Autonomy-supportive activities strengthened motivation by supporting competence, choice, and meaningful peer interaction (Deci & Ryan, 2000). This relationship shows how engagement strategies connect material design with sustained participation across both learning phases.

Although reported less frequently, ecosystem-level support remained essential for sustaining implementation beyond individual classrooms. Family communication connected home preparation with classroom expectations and available learning resources (Epstein, 2018). Administrative commitment also protected planning time, supported infrastructure, and encouraged collaborative professional learning. Accessible platforms and mobile communication further improved coordination among teachers, students, and families (Parati et al., 2023).

Together, these enabling conditions created continuity across technological, pedagogical, developmental, and organizational components. High-quality materials supported teacher facilitation, while family communication enhanced students' preparation and subsequent classroom participation. Instructional alignment therefore represents the mechanism that connects these resources into a developmentally responsive implementation system.

4.3 Learning Outcomes and Contradictory Evidence

Across the reviewed studies, academic achievement and learner engagement were the most frequently reported outcomes. Academic gains appeared across language, science, mathematics, civics, and physical education, confirming broad curricular applicability. Comparable benefits across subjects were reported by Erbil and Kocabaş (2020) and Wijayanti et al. (2025). However, these patterns should not be interpreted as evidence of automatic or universally consistent effectiveness. Most positive effects occurred when pre-class preparation, classroom activity, feedback, and assessment were coherently connected.

Pre-class exposure appeared to reduce initial processing demands and create additional time for guided application. Classroom discussion supported clarification, retrieval, elaboration, and collaborative knowledge construction (Chi & Wylie, 2014). These mechanisms may help explain improvements in achievement, retention, and higher-order thinking across several studies. Delayed assessments in mathematics and language contexts indicated that some gains persisted beyond immediate testing (Gasparič et al., 2024). Higher-order thinking gains appeared most clearly in inquiry-based and technology-enhanced settings (Loizou & Lee, 2020). Scaffolding remained essential because younger learners could not consistently translate initial exposure into understanding independently (Belland et al., 2017).

Motivational benefits emerged when students experienced autonomy, competence, timely feedback, and meaningful peer interaction. Self-paced and interactive activities supported confidence, participation, and social connection across several studies (Chen et al., 2023). These patterns align with self-determination theory and its emphasis on autonomy, competence, and relatedness (Deci & Ryan, 2000). Greater engagement was also associated with stronger achievement, suggesting a relationship between motivational and academic outcomes. Motivation therefore functioned as both an outcome and a mechanism supporting continued engagement.

Socio-emotional and behavioral outcomes emerged when classroom activities emphasized collaboration, confidence, problem-solving, and supportive interaction. Positive socio-emotional changes were especially visible within collaborative and student-centered learning environments (Girmen & Kaya, 2019). These outcomes suggest that active classroom participation may be associated with changes in students' attitudes and learning behavior alongside academic performance. Physical outcomes appeared only in physical education studies, including higher moderate-to-vigorous physical activity and reduced sedentary behavior (Yip et al., 2023). However, their limited disciplinary range restricts broader generalization to other elementary school subjects (Wang et al., 2023).

Contradictory evidence nuances the generally positive pattern and strengthens the contextual interpretation of the review. Competitive game features increased anxiety in one study, despite their intended motivational purpose (Russali & Tasir, 2025). Complex motor tasks also produced weaker benefits when instructional demands exceeded students' readiness (Jabučanin et al., 2025). Stajić et al. (2025) reported only a positive trend for higher-level knowledge, indicating uneven cognitive effects. These findings suggest that engagement strategies can become barriers when design features conflict with developmental needs.

Reported outcomes also varied because access, teacher readiness, and family support shaped participation before classroom learning. Students unable to complete pre-class preparation entered classroom activities with unequal levels of prior knowledge. Such differences can widen existing inequalities even when average achievement improves across the full sample (van Dijk, 2017). Accordingly, effectiveness should be evaluated in terms of outcome patterns, participation equity, and implementation quality.

Overall, technology created instructional possibilities, while aligned pedagogy transformed those possibilities into measurable learning outcomes. The model supported learning when each phase prepared students for the cognitive demands of subsequent activities. Weaker results emerged when limitations in access, preparation, or classroom scaffolding disrupted this instructional sequence. This conditional pattern provides a plausible explanation for the variation in reported outcomes without broadly attributing success to digital innovation alone.

4.4 Theoretical Contributions and Practical Implications

The principal theoretical contribution is a developmentally grounded, systemic explanation of flipped classroom implementation in elementary education. This explanation positions instructional alignment as the mechanism connecting technology, teacher capacity, learner readiness, family support, and institutional conditions. Technology creates instructional opportunities, while coherent alignment determines whether these opportunities translate into meaningful learning outcomes. This interpretation extends systemic innovation perspectives by integrating developmental readiness with pedagogical and institutional alignment (Harris, 2010). The framework also helps explain the conditional outcome patterns and implementation difficulties identified across the reviewed studies.

Elementary education requires a distinct flipped classroom model because younger learners need stronger guidance across learning phases. Pre-class preparation depends on developing attention, metacognition, self-regulation, and access to timely clarification. These developmental demands increase students' reliance on teachers and families during independent learning activities. Cognitive load management is therefore essential when teachers design multimedia resources for younger learners (Mayer, 2014). Self-regulated learning theory further explains why explicit routines, monitoring, and feedback remain necessary (Zimmerman, 2013).

The review identified five mutually reinforcing components within a developmentally responsive implementation system. These components comprise coherent design, teacher capacity, learner readiness, family partnership, and equitable technological infrastructure. Weakness within one component can disrupt other components and reduce the model's overall educational value. For example, limited connectivity can increase teacher workload, weaken pre-class preparation, and intensify dependence on family support. Systemic coherence therefore provides a practical criterion for explaining variation in outcomes across subjects, grades, and settings.

Before adoption, schools should assess device access, connectivity, teacher readiness, curriculum compatibility, and family capacity. Leaders should then provide sustained professional development and protected time for collaborative instructional planning. Continuous, practice-oriented professional development can support teachers' long-term pedagogical transformation (Darling-Hammond, 2017). Instructional objectives, materials, classroom activities, and assessment should remain coherently aligned throughout implementation (Han & Ellis, 2019). Teachers should pilot concise materials, monitor completion, and adapt classroom activities using evidence from pre-class preparation. Wider adoption should follow formative evaluation confirming instructional coherence, developmental suitability, and equitable participation.

Schools must also establish reliable communication that links home preparation with classroom expectations and available support. Families need clear guidance on monitoring responsibilities without assuming the teacher's instructional role. School–family partnerships can sustain continuity because elementary learners remain dependent on adult guidance (Epstein, 2018). Alternative access arrangements are essential for students lacking devices, connectivity, or consistent household assistance. Equitable infrastructure protects participation and reduces the risk that existing digital inequalities will shape educational outcomes (van Dijk, 2017).

Future research should test this systemic explanation across lower and upper elementary grades. Comparative studies should examine whether relationships among barriers differ across subjects, technologies, socioeconomic conditions, and school locations. Longitudinal designs could determine whether improvements in achievement, motivation, autonomy, and engagement are sustained beyond the initial implementation period. Researchers should report negative and null findings to clarify the developmental and contextual boundaries of effectiveness. These directions can refine flipped classroom theory while providing schools with stronger evidence for responsible adoption. Ultimately, responsible implementation can expand active learning opportunities while reducing avoidable inequalities and implementation difficulties.

5. Conclusion

This review integrated evidence on barriers, enabling conditions, and outcomes associated with flipped classroom implementation in elementary education. Barriers involved teacher capacity, technological access, learner readiness, family support, and contextual adaptation. The enabling conditions comprised coherent design, developmentally appropriate materials, sustained teacher development, active pedagogy, motivational support, and ecosystem readiness. Together, these findings position flipped classroom implementation as a systemic instructional reform governed by instructional alignment. Conceptually, the review identified alignment and developmental readiness as central mechanisms through which digital resources can be transformed into meaningful learning.

Within this system, academic achievement and learner engagement were the most frequently reported outcomes across subjects. Additional benefits included retention, higher-order thinking, socio-emotional development, and physical outcomes, although these remained context-specific. Physical outcomes were confined to physical education, while higher-order gains appeared mainly in inquiry-based and technology-enhanced settings. However, competitive features, complex tasks, and inconsistent preparation produced anxiety or weaker benefits in several contexts. These variations suggest that effectiveness emerges through interactions among instructional design, learner readiness, teacher support, and implementation context.

These conclusions have direct practical implications for schools preparing to adopt flipped classroom models. Before implementation, schools should assess infrastructure, teacher readiness, curriculum compatibility, learner needs, and family capacity. Professional development should integrate technological competence with instructional design, assessment, feedback, and classroom facilitation. Pre-class materials should remain concise, accessible, age-appropriate, and directly connected to subsequent classroom activities. Schools should provide alternative access arrangements and clear guidance for families to promote equitable participation during pre-class preparation. Formative evaluation should guide wider adoption by examining instructional coherence, developmental suitability, participation, and emerging outcomes.

Nevertheless, this systematic review has several limitations that should guide the interpretation of its conclusions. Using only Scopus may have excluded relevant studies elsewhere and limited the evidence base. Restricting eligibility to English-language and open-access articles may also have introduced language and selection biases. Methodological and contextual heterogeneity prevented quantitative comparison and limited conclusions about comparative effect sizes. Future reviews should combine multiple databases, broader access routes, and meta-analytic techniques where sufficient data are available. Longitudinal studies should examine developmental mechanisms, equity, and outcome sustainability across elementary grade levels. Researchers should also report negative and null findings to define the model's contextual boundaries more precisely.

Conflict of Interest

All authors affirm that there are no conflicts of interest in the composition and dissemination of this study.

6. Declaration of the Use of AI

Artificial intelligence tools were used during the preparation of this manuscript to improve linguistic clarity and coherence. These tools were not used for data analysis or interpretation. All AI-assisted outputs were carefully reviewed and revised by the authors to ensure contextual and conceptual accuracy. Grammarly was also used to support grammar and language verification.

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