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When Strategies Matter More Than Tools: A Systematic Review of Smart Classroom Practices and EFL Speaking Fluency

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Abstract

A growing body of evidence challenges the assumption that smart classroom technologies, on their own, produce meaningful gains in English as a Foreign Language (EFL) speaking ability. This study reports a Systematic Literature Review (SLR) of 86 empirical investigations indexed in Scopus and published from 2020 to 2024, examining the conditions under which digitally enhanced learning environments contribute to speaking fluency development. Guided by PRISMA 2020 protocols, the review synthesizes findings across quantitative, qualitative, and mixed-method studies to identify how metacognitive, affective, and social learning strategies mediate the relationship between technological affordances and fluency outcomes. Results indicate that technologies such as artificial intelligence (AI)-based feedback systems, learning management systems (LMS), and immersive environments function primarily as enablers of strategic processes rather than as independent agents of learning. Substantial improvements in temporal fluency, lexical range, and interactional competence were observed predominantly in instructional contexts where strategy scaffolding was deliberately embedded in pedagogical design. Based on these findings, the study introduces the Strategy-Affordance-Fluency (SAF) model, a theoretically grounded framework that reconceptualizes fluency development as a product of purposeful alignment among learner strategies, technological affordances, and instructional architecture. The review identifies two critical gaps: the near-absence of longitudinal inquiry and the persistent neglect of equity dimensions in technology-enhanced learning research. Implications are discussed for researchers, practitioners, and language program designers seeking to move beyond superficial technology integration toward more principled, process-oriented approaches.

Keywords: Strategy-Mediated Learning, Smart Classroom, EFL Speaking Fluency, Systematic Literature Review, TEL

Introduction

The rapid diffusion of digital tools into language classrooms has generated considerable optimism about improving speaking outcomes in EFL settings. Over the past decade, smart classrooms, defined here as instructional environments integrating learning management systems (LMS), AI-driven analytics, mobile platforms, and immersive technologies, have become increasingly prevalent across diverse educational systems. This expansion rests on an implicit assumption: that technological sophistication translates directly into communicative competence.

This assumption warrants critical scrutiny. A careful reading of the existing literature reveals that many studies treat access to digital tools as a proxy for learning quality,

conflating the presence of technology with the occurrence of substantive learning processes. In practice, digital tools frequently function as upgraded delivery systems rather than catalystsfor deeper engagement. The result is a paradox: despite significant institutional investment in smart classroom infrastructure, improvements in speaking fluency often remain modest and difficult to sustain (Bao, 2023; Godwin-Jones, 2020).

Speaking fluency occupies a uniquely complex position in EFL instruction. Contemporary research treats it as a multidimensional construct shaped by temporal control, lexical breadth, and interactional skill (Sato & Loewen, 2022; Pawlak et al., 2021). Unlike receptive skills, oral production demands real-time processing, self-monitoring, and the capacity to adapt to interlocutor responses. Yet EFL learners routinely encounter barriers that technology alone cannot resolve: chronic anxiety, restricted access to authentic oral interaction, and instructional cultures that privilege accuracy over communicative risk-taking.

Smart classroom technologies address some of these barriers by providing platforms for low-stakes asynchronous communication, AI-generated feedback, and virtual peer interaction. However, as the literature consistently demonstrates, these affordances do not automatically translate into fluency gains (Alavi & Taghizadeh, 2021; Zhang & Zou, 2022). Without deliberate pedagogical scaffolding, learners often engage with digital tools at a surface level, completing tasks without the sustained strategic engagement required for deep processing and long-term fluency development.

These observations align with a broader theoretical shift in applied linguistics and technology-enhanced language teaching (TELL): from evaluating what technology is present to understanding how learners engage with it. Theoretically, smart classrooms find their most coherent grounding in Vygotskyan sociocultural theory, which frames learning as an inherently mediated activity shaped by the intersection of tools, interaction, and sociohistorical context (Mercer & Dornyei, 2020). Within this view, digital technologies function as mediational artifacts that create conditions for the collaborative construction of knowledge; it is through active engagement with affordances, not passive exposure to them, that meaningful learning occurs. This sociocultural perspective is complemented by self-regulated learning (SRL) theory, which emphasizes the internal regulatory processes, including goal-setting, strategy selection, progress monitoring, and adaptive adjustment, through which effective learners manage task engagement (Lai & Li, 2023; Xu & Peng, 2024).

Despite these theoretical advances, much of the empirical literature continues to evaluate smart classrooms through frameworks such as SAMR and PICRAT. While these models provide useful taxonomies of technology integration levels, they describe the extent to which technology is incorporated into instruction without illuminating the cognitive and social processes through which learners engage with it. Specifically, SAMR (Substitution, Augmentation, Modification, Redefinition) and PICRAT (Passive/Interactive/Creative; Replace/Amplify/Transform) implicitly assume that higher levels of integration correlate with better learning outcomes, an assumption the present evidence challenges. There is growing consensus that progress in this field requires moving from mapping technology use toward understanding the mediated processes that technology enables or constrains (Hampel & Stickler, 2022; Lai & Li, 2023).

The present review proceeds from this premise. Drawing on 86 empirical studies, it traces the mechanisms through which strategic engagement transforms technological potential into measurable fluency gains. To organize these insights, the study introduces the Strategy-Affordance-Fluency (SAF) framework, which positions learner strategies, technological affordances, and instructional design as three interdependent dimensions whose alignment determines the quality of fluency development. The framework offers both a

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theoretically coherent account of smart classroom learning and a practical resource for educators and researchers committed to more principled approaches to technology-enhanced language instruction.

Method

This study adopts a Systematic Literature Review (SLR) design to examine the conditions under which strategy-mediated smart classroom practices support EFL speaking fluency development. The methodological procedures adhered to the PRISMA 2020 (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines, ensuring transparency, reproducibility, and a structured approach to evidence synthesis. An SLR design was selected because it allows for comprehensive retrieval of relevant literature while applying systematic safeguards against the selective inclusion and confirmation biases that frequently compromise traditional narrative reviews.

The literature search was conducted across four major academic databases: Scopus, Web of Science, ERIC, and Google Scholar. These databases were chosen for their comprehensive coverage of peer-reviewed scholarship in applied linguistics, language education, and educational technology. The temporal scope was restricted to 2020-2024, reflecting both the accelerated development of smart classroom technologies during this period and the transformative impact of pandemic-driven shifts toward digital learning environments.

A Boolean search strategy was constructed to capture studies at the intersection of technology-enhanced learning, strategy use, and speaking fluency. The search string applied was: ("smart classroom" OR "digital classroom" OR "technology-enhanced classroom") AND ("EFL" OR "ESL") AND ("speaking fluency" OR "oral communication" OR "spoken production") AND ("learning strategies" OR "metacognitive" OR "self-regulated" OR "affective strategies"). This string was deliberately constructed to avoid over-specification while ensuring sufficient focus on the core constructs of interest.

Inclusion criteria required studies to be: (a) empirical in nature (quantitative, qualitative, or mixed-method); (b) focused on EFL or ESL speaking instruction; (c) conducted in smart classroom or digitally enhanced learning contexts; (d) addressing learning strategies, whether metacognitive, affective, or social in orientation; and (e) published in peer-reviewed academic journals. Studies were excluded if they were: theoretical or conceptual papers lacking original empirical data; focused exclusively on non-speaking skills; technology-focused without substantive attention to pedagogical or strategic processes; or published in non-peer-reviewed outlets.

The initial search returned 312 records. Following deduplication, 248 articles proceeded to title and abstract screening, from which 124 studies were retained for full-text review. Thirty-eight studies were subsequently excluded on grounds of insufficient attention to speaking fluency, absence of strategy-related analysis, or failure to meet methodological quality standards. The final corpus comprised 86 studies.

Quality appraisal was conducted using a five-criterion rubric adapted from established appraisal tools for educational research: (1) clarity of research design and stated objectives; (2) validity and reliability of measurement instruments (e.g., inter-rater reliability coefficients of 0.80 or above for oral performance coding); (3) transparency of data collection and analytical procedures; (4) coherence between empirical findings and interpretive claims; and (5) explicitness of strategy-related constructs (i.e., whether metacognitive, affective, or social strategies were operationally defined rather than merely referenced). Studies were rated on a

three-point scale (0 = not met, 1 = partially met, 2 = fully met), and those with total scores below 6 were flagged with methodological caveats during synthesis.

Each of the 86 included studies was subjected to a structured data extraction protocol aligned with the SAF framework across four dimensions: (1) technology types employed, including AI tools such as automated speech recognition for formative feedback, LMS platforms such as Moodle-based task delivery, mobile applications such as voice recording and peer review apps, and VR/AR environments such as virtual role-play simulations; (2) strategy categories, covering metacognitive strategies (pre-task planning, self-monitoring, post-task reflection), affective strategies (anxiety management, confidence-building prompts), social strategies (peer collaboration, co-constructed dialogue), and integrated multi-strategy designs; (3) fluency outcomes assessed, including temporal measures (speech rate, pause frequency), lexical measures (type-token ratio, lexical diversity indices), and interactional measures (turn-taking, responsiveness, conversational sustaining); and (4) digital scaffolding mechanisms identified, comprising pre-task prompts, analytics dashboards, AI-generated corrective feedback, and collaborative platforms. This granular coding approach enabled systematic cross-study comparison and thematic synthesis. Data analysis employed thematic synthesis, combining descriptive quantitative profiling of publication trends, geographic distribution, and research design patterns with interpretive qualitative coding to identify recurring themes in strategy-affordance-fluency interactions. Analytical attention concentrated on identifying conditions under which strategy integration was associated with robust fluency outcomes, recognizing patterns of technology use and their pedagogical implications, and tracing the role of instructional design as a mediating variable.

Results

The following section presents synthesized empirical findings from the 86 reviewed studies, organized thematically across four areas: the relationship between technology adoption and strategy mediation, the differential contributions of strategy types, digital scaffolding mechanisms, and the emergent SAF framework. Theoretical interpretation of these findings is addressed in the Discussion.

From Technology Adoption to Strategy Mediation

Across diverse geographic and institutional contexts, the corpus consistently shows that technology effectiveness depended not on tool sophistication but on whether tools were embedded within pedagogically structured, strategy-supportive environments. Studies in which technology was deployed without deliberate strategy scaffolding, representing approximately one-third of the corpus, consistently reported limited or inconsistent gains. In these cases, improvements tended to be restricted to surface-level indicators such as participation rates or task completion frequencies, with minimal impact on lexical variety and interactional responsiveness. Quantitatively, 61 of 86 studies (71%) reported statistically significant fluency gains only in conditions where explicit strategy instruction or scaffolding was present. Studies that compared strategy-embedded versus non-embedded technology use consistently favored the former, with effect sizes ranging from moderate (d = 0.45-0.62) to large (d = 0.80 and above) in metacognitive scaffolding conditions.

Differential Contributions of Strategy Types

The coding of strategy use across the corpus reveals clearly differentiated outcome patterns. Metacognitive strategies, operationalized through pre-task planning activities, in-task self-monitoring protocols, and post-task reflective assignments, demonstrated the most consistent association with temporal fluency improvements. Learners who received structured

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metacognitive scaffolding showed measurable increases in speech rate, reductions in unplanned pause frequency, and greater perceived control over production. These effects were particularly pronounced in studies employing AI-generated feedback loops and reflective performance dashboards (Dai et al., 2022; Sun & Zhang, 2021). Across 24 metacognition-focused studies, 21 reported significant gains on at least one temporal fluency measure.

Affective strategies yielded a distinct but complementary contribution. Studies incorporating low-stakes speaking environments, supportive peer feedback structures, and self-regulation prompts reported improvements primarily in the smoothness and continuity of speech production, dimensions closely linked to anxiety reduction. This body of evidence Underscores the importance of emotional architecture in speaking instruction: the degree to which learners feel psychologically safe to take communicative risks significantly influences their capacity to develop fluency (Derakhshan et al., 2022). Seventeen of 22 affective-strategy studies reported improvements in speech continuity measures alongside reductions in self-reported anxiety.

Social strategies, enacted through peer collaboration tasks, cooperative learning structures, and synchronous digital interaction, demonstrated the strongest associations with interactional competence. Studies utilizing collaborative platforms and video-mediated communication reported gains in turn-taking facility, communicative responsiveness, and the ability to sustain extended exchanges, outcomes that are difficult to cultivate through individual technology practice alone (Li & Hafner, 2022; O'Dowd, 2020). Studies integrating multiple strategy types within a coherent instructional design produced the most robust fluency outcomes across all three dimensions, supporting the conceptualization of speaking fluency as a multidimensional construct requiring an integrated pedagogical architecture.

Digital Scaffolds as Mechanisms of Strategy Enactment

A notable contribution of this review lies in its identification of digital scaffolding mechanisms as the operational bridges between technological affordances and strategy use. Four principal scaffold types emerged from the analysis. Pre-task prompts provided structured preparation time, supporting metacognitive goal-setting and planning. Reflective dashboards displaying performance analytics enabled self-monitoring and comparative evaluation across practice sessions. AI-generated feedback systems facilitated error recognition and performance adjustment between speaking attempts. Collaborative platforms created conditions for socially mediated learning through peer interaction and co-construction of communication strategies.

The presence, quality, and instructional integration of these scaffolds proved to be among the most consequential variables in the dataset. Studies that explicitly incorporated scaffolding mechanisms and connected them to specific strategy objectives consistently reported more substantial and more durable fluency improvements than studies that referenced strategies in abstract terms without operationalizing them through concrete instructional supports. This finding highlights a critical design principle: strategies do not emerge spontaneously from exposure to technology; they must be actively cultivated through structured scaffolding (Nguyen, 2022; Xu & Peng, 2024).

The Strategy-Affordance-Fluency (SAF) Framework

The synthesis of coded data across the 86 studies provides the empirical foundation for the SAF framework. The framework proposes that EFL speaking fluency develops through the deliberate alignment of three interdependent components: (1) Learner Strategies, comprising the metacognitive, affective, and social processes that regulate task engagement; (2) Technological Affordances, encompassing the feedback, interaction, and multimodal input opportunities provided by digital tools; and (3) Instructional Design, referring to the

pedagogical structures including task sequencing, scaffolding architecture, and teacher facilitation that guide and sustain strategic learning. The framework's central claim is that alignment among these three dimensions determines whether technological affordances are pedagogically productive. A visual representation of the SAF framework is provided in Figure 1.

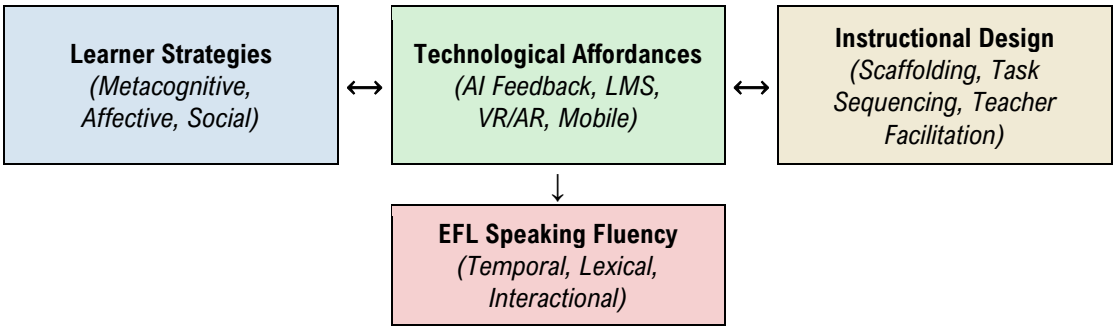

Figure 1. The Strategy-Affordance-Fluency (SAF) Framework

Note. Bidirectional arrows indicate interdependence among the three dimensions; fluency outcomes emerge from their purposeful alignment.

When learners engage in metacognitive planning within a task structure that includes AI feedback and reflective opportunities, fluency gains are systematically stronger than when any one component is absent or misaligned. In cases of misalignment, for instance when sophisticated AI tools are deployed in instructional designs that offer no strategy guidance, the technological potential remains latent and observed gains are marginal.

This explanatory logic sets the SAF framework apart from existing technology integration models. Rather than classifying how technology is used, it explains why technology produces the outcomes it does, offering a more actionable theoretical lens for practitioners designing effective smart classroom instruction.

Methodological Patterns and Research Gaps

The reviewed corpus exhibits several notable methodological characteristics. The dominant designs are quasi-experimental pretest-posttest studies (n = 48; 56%) and mixed-method investigations (n = 29; 34%). While appropriate for documenting short-term learning outcomes, implementation periods of six to sixteen weeks provide limited evidence about long-term fluency development, which requires sustained practice, iterative feedback, and accumulated interactional experience.

Geographic concentration is a further concern. The majority of studies were conducted in East and Southeast Asian EFL contexts, particularly China (n = 31), Indonesia (n = 19), South Korea (n = 11), and Japan (n = 8), reflecting national investments in digital education infrastructure. Not a single study in the corpus tracked fluency development over a period exceeding one academic year, representing a fundamental limitation in the field's capacity to make well-grounded claims about long-term technology-enhanced learning outcomes

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A related gap concerns equity and accessibility. Despite the prevalence of advanced AI and immersive technology studies in the corpus, remarkably few investigations (n = 4; 5%) systematically examined differences in technology access, digital literacy, or the specific challenges facing learners from under-resourced educational environments. The field's tendency to generalize findings from well-equipped contexts to the wider EFL population risks producing a structurally biased research base.

Discussion

The cumulative evidence from this review constitutes a substantial challenge to technology-centric narratives of smart classroom learning. The empirical pattern is clear: the pedagogical value of digital tools in EFL speaking instruction is not determined by their technical sophistication but by the conditions of strategic and instructional embedding that surround them. This conclusion calls for a fundamental reorientation of how technology-enhanced language learning is conceptualized, evaluated, and implemented.

Existing technology integration frameworks, specifically SAMR and PICRAT, offer useful vocabulary for categorizing levels of technology use but are silent on the question of learning quality. The evidence assembled here suggests that the critical variable is not how deeply technology is embedded in instruction but whether that embedding activates and sustains productive learning processes. The SAF framework offers a theoretically and empirically grounded alternative. By positioning learner strategies as the primary mediating variable, it provides a framework through which researchers and educators can ask more precise questions: not whether learners had access to AI feedback or immersive environments, but whether they were equipped with the metacognitive, affective, and social strategies needed to exploit those affordances productively.

A critical implication concerns the role of the teacher. A common narrative in educational technology literature positions teachers as facilitators whose central function is to deploy and manage tools. The evidence reviewed here suggests a more substantive role: teachers are the primary architects of the strategic environments within which technology operates. It is teacher decisions about task design, scaffolding structure, and the orchestration of feedback that determine whether digital affordances are pedagogically realized or inert (Teo et al., 2023; Hampel & Stickler, 2022). This finding resonates with research on teacher professional development in technology-enhanced settings, which consistently shows that pedagogical design capacity is a stronger predictor of learning outcomes than tool access (Hiver et al., 2021).

A second implication concerns the dynamic nature of strategy deployment. Learners do not apply strategies as fixed procedures; they adapt them continuously in response to task demands, feedback, and the evolving social context of interaction. This adaptive quality aligns with SRL theory as a cyclical process involving goal-setting, performance monitoring, and strategic revision. Effective smart classroom instruction must therefore be designed not merely to introduce strategies but to cultivate the flexibility to deploy them responsively.

The findings regarding the absence of longitudinal research and the neglect of equity carry particularly important practical implications for developing countries and institutions with limited digital infrastructure. EFL programs in under-resourced contexts, including many in South and Southeast Asia, Sub-Saharan Africa, and Latin America, cannot replicate the AI-intensive, VR-enabled environments represented in the majority of reviewed studies. However, the SAF framework's core insight remains applicable: what matters is not the sophistication of the tools but the strategic quality of the instructional environment. Low-

technology implementations, such as structured peer dialogue tasks with metacognitive reflection prompts or mobile voice-recording activities paired with teacher feedback, can embody SAF alignment when designed with deliberate attention to strategy scaffolding. Research that investigates such implementations and systematically documents their outcomes over extended periods would both extend the empirical base and serve the majority of EFL learners worldwide who operate outside well-resourced institutional contexts.

The methodological limitations of the reviewed corpus must temper these conclusions. The dominance of short-term quasi-experimental designs means that findings speak primarily to immediate instructional effects rather than to the processes through which fluency develops and stabilizes over time. The geographic concentration similarly limits the scope of inference. Caution is also warranted regarding equity: findings derived predominantly from well-resourced contexts cannot be assumed to generalize across the full range of global EFL settings.

Conclusion

This review was motivated by a concern that the field of technology-enhanced language learning has been more attentive to what technologies are than to how learning occurs through them. Across 86 empirical studies, the consistent finding is that smart classroom technologies produce meaningful gains in EFL speaking fluency when, and only when, they are integrated into pedagogical designs that actively scaffold and sustain strategic learning processes.

The SAF framework offers a response to this insight at the level of theory. By formalizing the relationship among learner strategies, technological affordances, and instructional design, it provides researchers and practitioners with a conceptual architecture that is simultaneously explanatory and actionable. It explains why some smart classroom interventions succeed while others do not, and it points toward the specific dimensions of instructional design, namely strategy scaffolding, feedback architecture, and task sequencing, which determine pedagogical effectiveness.

At a practical level, the framework invites language educators to shift their evaluative gaze from technology inventories to learning processes. The relevant question is not whether a classroom contains AI tools or VR environments, but whether learners in that classroom are developing the strategic capacities needed to engage with those tools in ways that promote fluency. This is a demanding standard, and one that requires sustained attention to pedagogy rather than investment in infrastructure, a principle that applies across well-resourced and under-resourced contexts alike.

The most pressing research priorities are threefold. First, genuinely longitudinal designs, those that track learners across a year or more and across multiple instructional cycles, are needed to understand how strategic orientations toward speaking become habitual. Second, more responsive AI feedback systems capable of recognizing strategic uncertainty, tracking interactional behavior across sessions, and providing strategy-tied feedback are required. Third, systematic inquiry into what SAF-aligned instruction looks like, and what it can realistically achieve, in contexts with constrained technology access, lower digital literacy, and limited teacher training capacity would substantially deepen the field's empirical base and ensure that its insights serve the majority of EFL students worldwide rather than the advantaged few.

Ultimately, the contribution of this study lies less in the accumulation of evidence than in the reframing it proposes. Smart classrooms are not learning environments because of the

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tools they contain; they become learning environments through the pedagogical intelligence that governs how those tools are used. That intelligence, as the SAF framework suggests, is irreducibly human.

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