Research on Foreign Language Collaborative Learning in Contemporary Educational Technology Environments

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Abstract: *The rapid advancement of information technology has propelled the deep integration of educational technology and foreign language teaching into a significant trend in educational reform. Collaborative learning, as a pedagogical approach fostering student interaction and enhancing comprehensive language application skills, is demonstrating renewed vitality and expanding potential within modern technology-supported educational environments. This study systematically reviews recent domestic and international research on foreign language collaborative learning in contemporary educational technology settings. It summarizes the theoretical foundations and conceptual underpinnings, identifies key research themes regarding technology-supported collaborative foreign language learning, and analyzes prevalent challenges and future research directions. Findings indicate that collaborative learning leveraging technological tools—such as online collaborative platforms, social media, virtual reality, and artificial intelligence—can effectively enhance learners' communicative competence, cultural understanding, and collaborative problem-solving abilities. However, persistent challenges exist concerning interaction quality, technology acceptance, and the transformation of instructor and learner roles. Future research should prioritize interdisciplinary integration, the development of intelligent collaborative support systems, and the refinement of blended collaborative learning models, thereby achieving a balanced development between "instrumental rationality" and "humanistic value".*

Keywords—educational technology; foreign language collaborative learning; interaction tools; sociocultural theory; technological environments

1. INTRODUCTION

The accelerating process of globalization coupled with the deep integration of the digital technology revolution has fundamentally reshaped the foundational paradigms of language learning (Warschauer, 1997). As a core vehicle for fostering intercultural competence, foreign language education faces an imperative need to explore practical pathways for synergistic innovation that integrates technology and pedagogical methodologies. The traditional teacher-centered instructional model demonstrates significant limitations in developing language communicative skills. In contrast, Cooperative Learning theory, which promotes meaning negotiation among learners through structured task design, has been validated as an effective approach for enhancing the quality of language output (Johnson & Johnson, 1999).

In recent years, contemporary educational technologies, which were epitomized by artificial intelligence, learning analytics, and cloud-based collaborative platforms, have provided the foundational infrastructure for reimagining foreign language collaborative learning. Virtual learning environments transcend the constraints of time and space (Blake, 2013); intelligent feedback systems optimize cognitive load management (Sweller, 2011); and multimodal interaction interfaces enhance contextualized input (Kress, 2010). This

technology-mediated affordance has precipitated three significant shifts in collaborative learning practices: 1) From purely offline, synchronous collaboration toward extended blended community practices (Storch, 2013); 2) From a focus on discrete language skill training toward the collaborative development of digital literacies; and 3) From static, homogeneous groupings toward an evolution toward intelligent, adaptive, and dynamically formed teams (Chiu et al., 2013). However, current research exhibits notable fragmentation. While substantial empirical evidence exists at the micro-level, detailing myriad applications of specific technologies, there is a conspicuous lack of comprehensive models that systematically integrate technology, collaborative structures, and the underlying mechanisms of language acquisition. Furthermore, the majority of empirical studies concentrate on short-term instructional interventions, offering insufficient exploration into the long-term developmental trajectories and sustainability of intercultural virtual collaboration (O'Dowd, 2018). Another critical gap lies in the frequent disconnect between the selection and deployment of technological tools and established language learning theories (Golonka et al., 2014).

In light of these considerations, this study employs a systematic literature review methodology to synthesize recent scholarship on technology-supported foreign language collaborative learning. Its primary objective is to construct a

"Technology-Collaboration-Language" analytical framework, thereby contributing empirically grounded insights to guide pedagogical reforms in foreign language teaching amidst ongoing digital transformation.

2. THEORETICAL FOUNDATIONS AND CONCEPTUAL INTEGRATION

2.1 Collaborative Learning through a Sociocultural Theory Lens

Sociocultural Theory (SCT), originating from the seminal work of Soviet psychologist Lev Vygotsky, provides a fundamental framework for understanding the social construction of knowledge and individual cognitive development. Its core proposition posits that higher-order human cognition is first constructed and developed through processes of social interaction, before subsequently being internalized as core components of individual psychological functioning (Vygotsky, 1978). Collaborative learning (CL), therefore, is not merely an instructional grouping format; it is a critical social pathway facilitating learners' cognitive construction. From the sociocultural perspective, the value of foreign language collaborative learning is deeply rooted in its theoretical underpinnings, which can be examined across three principal dimensions.

Social Construction of Knowledge and Internalization Mechanisms: Vygotsky (1978) emphasized that learning is fundamentally a process of social negotiation and co-construction of meaning. Individual understanding does not arise simply from receiving external information but is continuously "negotiated, revised, and ultimately internalized" within networks of social interaction. In the context of foreign language (FL) learning, learners collaboratively construct linguistic knowledge, form-meaning mappings, and pragmatic strategies through interactions like meaning negotiation, joint writing, and problem-solving while engaging in group tasks conducted in the target language (TL). This interaction provides the indispensable linguistic practice arena for individuals to transform external social speech into inner self-regulation (private speech) and, eventually, internalize it as part of their individual language competence – a psychological transition process moving from the interpsychological (social) to the intrapsychological (individual) plane (Lantolf & Thorne, 2006). This mechanism fundamentally surpasses isolated, unidirectional models of language input, positioning collaborative learning environments as pivotal platforms for the social genesis and internalization of language knowledge.

The Zone of Proximal Development (ZPD) and Scaffolding: The ZPD defines the gap between an individual's "actual developmental level as determined by independent problem solving" and the "potential level of development as determined through problem solving under adult guidance or in collaboration with more capable peers" (Vygotsky, 1978). Collaborative learning groups naturally create dynamic, multi-directional ZPDs for each member. Within this environment, peers exhibiting relatively higher proficiency, or those assuming an "expert" role, can provide cognitive support and linguistic input through strategies like prompting, questioning, modeling, or corrective feedback-enacting scaffolding (Wood et al., 1976). Learners whose current abilities require support can, within a secure setting, observe, imitate, attempt output, and receive feedback. This differential interaction constitutes a distributed cognition system, enabling the group collectively to transcend the current individual limits of their language abilities and advance together towards higher levels of linguistic comprehension and production (Swain et al., 2015). Supported by modern educational technology, digital tools such as social network-based collaborative writing platforms, interactive whiteboards, and multimodal discussion forums enrich expressivity. They make cross-spatiotemporal peer scaffolding technically feasible and enhance the visibility and traceability of collaborative interactions.

The Centrality of Mediating Tools and Semiotic Resources: SCT asserts that cognitive functions are essentially mediated by physical and psychological tools, most significantly by signs and symbols, with language being paramount. Within foreign language collaborative learning, language itself (TL/L1), communication rules, task instructions, multimedia resources (images, charts, audio/video), and indeed modern technological tools (e.g., online translators, corpora, features of interactive platforms like reply tags, audio annotations) all constitute critical mediational means or cultural and linguistic tools (Wertsch, 1991). Learners are not passive recipients of these tools; driven by collaborative tasks, they actively and strategically deploy them to organize ideas, achieve consensus, express meaning, and resolve linguistic and cultural/logistic challenges. In doing so, the tools become instrumental resources for extending thinking capacity, expanding social-cognitive boundaries, and augmenting expressive possibilities (Kozulin, 2003). The modern technological environment, particularly the rich array of semiotic resources and collaborative tools offered by digital platforms, vastly expands the traditional "repertoire of mediational resources" available in classroom settings. This expansion paves the way for the multimodal co-creation and deep construction of meaning in foreign languages (Lantolf & Xi, 2023). Furthermore, technology facilitates the systematic recording and analysis of language use data streams and interaction trajectories within collaboration, establishing the data infrastructure essential for targeted teacher intervention (or adaptive system prompting) and robust formative assessment.

In summary, Sociocultural Theory elucidates the inherent nature of collaborative learning as socially situated cognitive construction practice. It provides a powerful hermeneutic framework for understanding the value of collaboration in foreign language learning: collaboration not only stimulates learners to transcend individual linguistic boundaries (expanding their ZPD) and promote the internalization of language knowledge, but also cultivates strategic competence – empowering learners to effectively select and deploy diverse mediational resources for successful communication within

complex linguistic ecosystems. Modern educational technology is profoundly reshaping the forms and scope of mediational tools, thereby creating greater operational potential and fertile research horizons for harnessing the full potential of collaborative learning.

2.2 The Synergistic Mechanism Between Educational Technology and Collaborative Learning

The rise of modern educational technology has infused new impetus into foreign language collaborative learning (FLL), fundamentally reshaping its interaction patterns, resource base, and cognitive processes, thereby establishing a deeply-coupled synergistic enhancement mechanism. This synergy manifests primarily across two interrelated dimensions:

(1) Technological Enablement: Reshaping Collaborative Interaction Architectures and Resource Environments. Educational technology first acts as a powerful set of enabling tools, significantly expanding the physical and virtual boundaries of collaborative learning and optimizing interactional processes (Warschauer, 1997).

Synchronous technologies (e.g., video conferencing platforms like Zoom, real-time collaborative document editors like Google Docs or Tencent Docs) allow geographically distributed learners to overcome spatiotemporal barriers, engaging in immediate target language (TL) dialogue, joint text construction, and problem negotiation, simulating or even surpassing the immediacy characteristic of face-to-face communication (Kessler, 2009).

Asynchronous platforms (e.g., discussion forums within Learning Management Systems - LMS, Wiki co-editing spaces) provide flexible environments conducive to deep meaning negotiation, critical reflection, and structured language output. This affords learners time for deliberate language organization and thoughtful refinement of ideas (O'Dowd & Ware, 2009).

Technology environments also offer robust multimodal resource support. Resources such as images, audio, video, interactive simulations, online corpora, and intelligent grammar/translation tools function not merely as information channels, but as essential cognitive partners within the collaborative process. They assist learners in jointly interpreting complex information, resolving linguistic challenges, and constructing multimodal communicative meaning (Chapelle, 2001). Collectively, these technological features construct a connected, flexible, and resource-rich collaborative ecosystem, laying the foundational conditions for effective co-construction (Hubbard, 2009).

(2) Cognitive Synergy: Deepening Interaction Quality and Collective Knowledge Building. The core value of technology extends further as cognitive amplifiers and process regulators, deepening the cognitive dimensions of collaborative interaction and enhancing language learning efficacy (Dillenbourg, 1999).

Visualizing Interaction Structures and Processes: Technology can render implicit thinking processes and linguistic negotiations explicit through the real-time visualization of data such as editing histories, discussion threads, contribution metrics, and word frequency analyses logged by collaborative platforms. This aids in metacognitive monitoring of collaboration – allowing learners to track group progress, reflect on interaction logics, foster more equitable participation, and facilitate efficient conflict resolution (Strijbos & Weinberger, 2010).

Providing Dynamic Feedback & Adaptive Scaffolding: Intelligent technologies can offer immediate, adaptive support, such as AI-powered writing tools providing instant suggestions on grammar, vocabulary, and style (e.g., Grammarly), or learning analytics systems generating prompts based on analysis of discussion participation patterns and collaborative modes. This forms the basis for implementing intelligent and precise socio-cognitive scaffolding by teachers or more capable peers (Lantolf & Poehner, 2014).

Structuring Collaborative Processes: Technology platforms often embed guiding tools (e.g., task-specific templates, structured activity prompts) that regulate workflow, ensuring collaborative activities remain orderly, goal-directed, and focused on depth of language use (De Wever et al., 2006).

Ultimately, the technological environment evolves into a distributed cognitive network that supports the externalization of collective knowledge, the refinement of shared understandings, and the iterative construction of a shared linguistic knowledge base. Technology thus not only underpins collaboration at the level of "accomplishing tasks together" but actively catalyzes deeper meaning negotiation, the emergence of collective intelligence, and the co-development and internalization of linguistic and cognitive strategies. This substantively elevates the productive outcomes of collaborative learning in terms of both linguistic competencies (e.g., complexity, accuracy) and strategic competencies (e.g., collaborative skills, metacognitive skills, problem-solving abilities) (Li & Peng, 2024).

3. MAJOR RESEARCH THEMES IN TECHNOLOGY-ENHANCED COLLABORATIVE FOREIGN LANGUAGE LEARNING

3.1 Research on Language Proficiency Enhancement

A core research issue concerning technology-enhanced collaborative foreign language learning lies in how it systematically fosters the multidimensional development of learners' language abilities. Research in this domain, primarily grounded in constructivist and sociocultural theories, emphasizes that technologically mediated collaborative tasks can activate "collective cognitive scaffolding". This facilitates the internalization of linguistic competence through intensive language input, output, and interactional negotiation (Warschauer, 1997). Empirical evidence indicates that co-constructing multimodal texts via cloud-based collaboration platforms significantly enhances vocabulary acquisition and

grammatical awareness. Conversely, virtual synchronous communication environments created by video conferencing tools drive learners to improve linguistic accuracy and fluency through continuous negotiation of meaning (Ziegler, 2016). For instance, during online collaborative writing tasks, peer feedback and joint revision mechanisms facilitated by technology not only expand the repertoire of target language expressions but also deepen learners' awareness of discourse structure (Storch, 2013). Notably, intelligent learning analytics systems provide visualized empirical evidence for proficiency development trajectories by quantifying data such as interaction frequency and instances of linguistic correction (Li & Zhu, 2017), thereby revealing the dynamic mechanisms underlying technology-enhanced collaborative gains.

Recent research further investigates how technology catalyzes the differential development of specific language skills. In the domain of speaking, peer assessment supported by asynchronous audio-video tools has proven effective in reducing speaking anxiety and promoting nuanced practice of pronunciation and intonation (Liu et al., 2025). AI-driven virtual conversational agents (e.g., Chatbots), meanwhile, offer learners low-risk environments for repetitive practice, accelerating the development of automaticity in language production (Fryer et al., 2020). Regarding writing proficiency, corpus-based collaborative writing tools enhance sensitivity to linguistic form through automatic grammatical error tagging and alternative suggestion features. Annotation systems designed for social interaction guide collaborative text evaluation activities, strengthening metacognitive monitoring of rhetorical strategies (Zhu et al., 2023). Fostering Intercultural Communicative Competence (ICC) represents a particularly significant research focus: Virtual exchange projects, involving multinational teamwork on intercultural topics, demonstrate that technology can catalyze learners' ability to critically analyze and deconstruct language-culture interrelationships (O'Dowd, 2018). This finding holds important implications for reorienting foreign language pedagogies within globalized educational contexts.

3.2 Affective and Socialization Dimensions

Modern research on technology-enhanced collaborative foreign language learning increasingly focuses on the synergistic mechanisms between affective factors and socialization processes. Technology-mediated collaborative environments significantly influence learners' affective experiences by reshaping interaction patterns, where anonymity and its anxiety-reducing effect are particularly crucial. Asynchronous discussion tools grant introverted learners ample preparation time, effectively lowering foreign language anxiety, while avatar systems mitigate perceptions of social threat through identity concealment (Zhang et al., 2024). Research indicates that real-time affective feedback tools (e.g., emoticons, AI emotion recognition) within online collaborative tasks enable timely instructor intervention during emotional crises, thereby sustaining a positive learning atmosphere (Zhang et al., 2021). However, technology also

presents a double-edged sword: multi-tasking interfaces can increase cognitive load, and social absence in remote collaboration may exacerbate feelings of disconnection and a lack of belonging. This necessitates establishing principles for affective-technological alignment in instructional design—for instance, incorporating stepwise exposure mechanisms involving virtual audiences within VR conversation scenarios to systematically reduce stage fright.

At the group socialization level, technology-supported collaborative learning reshapes intercultural social bonds and facilitates distributed emotion regulation. Multilingual social platforms, through transnational project-based learning tasks, foster meaning negotiation and co-construction of identities among culturally heterogeneous communities, cultivating cultural empathy. Big data analysis reveals that digital traces within cloud collaboration—such as the duration of shared document editing and frequency of online participation—can quantitatively illustrate the evolution of group cohesion. Within this context, contextualized GIF stickers used in instant messaging tools effectively compensate for the lack of non-verbal cues and strengthen affective connections (Hwang et al., 2021). Notably, learners utilize technology to implement strategies for collective emotion management: features like "virtual applause" in video conferences promote the sharing of achievements, while graphic emotion maps on shared digital whiteboards foster peer-to-peer emotional support. Future research must further explore AI-related ethical issues: algorithmically recommended collaborative groupings may reinforce cultural stereotypes, and immersive technologies like holographic projections require safeguards against unintended emotional colonization. These findings compel educators to integrate sociotechnical literacy into the assessment frameworks for foreign language collaborative competencies (Lantolf & Poehner, 2014).

3.3 Teacher Roles and Technology Empowerment

The modern educational technology environment has reconstituted the role positioning and practical paradigms of teachers in foreign language collaborative learning, propelling their evolution from traditional knowledge transmitters to digital-webbed orchestrators. Learning analytics-based monitoring systems enable teachers to capture the dynamic trajectories of group collaboration in real-time, identifying lurkers and cognitive disjunctures (Ning et al., 2025) via visual heatmaps, thereby facilitating precise intervention.

The design of AI-empowered collaborative scaffolding has emerged as a new core competency. Teachers utilize adaptive grouping algorithms to optimize heterogeneous team structures (Deiglmayr & Spada, 2010) and leverage XR technologies to create contextualized collaborative tasks (e.g., VR business negotiation scenarios), driving linguistic negotiation behaviors within authentic contexts. Research confirms that customized technology-mediated intervention strategies—such as establishing peer-review rules for Wikipedia editing or designing cross-platform jigsaw task

flows—enhance the efficiency of achieving collaborative objectives.

Notably, technology has catalyzed distributed pedagogical leadership. Version history features in cloud-based collaborative documents enable teachers to transparently assess individual contributions, while blockchain-empowered smart contracts ensure the fair attribution of collaborative outcomes (Koivuniemi et al., 2018).

Technology empowerment also fosters a paradigm shift in teacher professional development, manifesting through the dual restructuring of data literacy and technology-mediated feedback. Learning analytics dashboards providing cognitive network diagrams (e.g., SNA social network analysis) allow teachers to identify pivotal nodes in idea evolution, optimizing collaboration structures (Avissar & Yondler, 2025). Simultaneously, multimodal transcription tools support microanalysis of group discourse, deepening diagnostic capabilities regarding collaboration quality (Yang et al., 2024). Within feedback practices, AI teaching assistant systems automate the processing of linguistic form errors, freeing teachers to concentrate on guiding higher-order cognitive skills (Koltovskaia, 2020). Annotation trails on synchronous collaborative whiteboards foster a shift of formative assessment from unidirectional evaluation towards multi-agent co-construction (Storch, 2013).

However, the pitfalls of technology dependency warrant vigilance: algorithm-driven predictions of collaborative efficacy may narrow teaching decision-making, while automated grouping risks overlooking socio-affective bonding needs. Future directions advocate establishing a teacher-technology co-evolution paradigm (Uluyol & Sahin, 2016). This entails developing explainable AI tools to enhance teaching decision-making transparency and constructing technology ethics negotiation mechanisms within cross-institutional teacher communities of practice.

4. CURRENT CHALLENGES IN RESEARCH AND PRACTICE

Despite the new impetus modern educational technology provides for collaborative foreign language learning, its research and application continue to encounter multiple structural challenges. At the theoretical level, existing research exhibits an overreliance on social constructivist frameworks derived from Western contexts, demonstrating a significant insufficiency in adapting interpretations to fit the collectivistic learning cultures inherent in East Asian educational traditions. Empirical data from global virtual collaboration projects reveal that technology-driven collaborative tasks are often reduced to instrumental interactions, overlooking the deep-seated influence of cultural scripts on collaboration norms. Concurrently, the issue of assessment lag becomes pronounced: traditional outcome-oriented evaluations (e.g., group PPT grading) fail to capture the technologically-mediated collaborative processes, while doubts persist regarding the causal relationship between digital behavioral indicators gathered via emerging learning analytics (e.g., screen click rates, speech turn-taking) and actual language proficiency development (Smith & González-Lloret, 2021).

At the implementation level, three major obstacles are particularly salient. First, the fragmented nature of the technological ecosystem: the lack of data interoperability among various tools (e.g., VR systems, collaboration platforms, AI grammar checkers) forces learners to navigate between non-integrated interfaces, resulting in fragmented attention and cognitive overload (Sweller, 2020). Second, digital inequity is proliferating globally. Within the Chinese context, the disparity in techno-pedagogical belief between urban and rural teachers further exacerbates this imbalance: rural teachers exhibit significantly lower average scores in Technological Content Knowledge (TCK) literacy compared to their urban counterparts (Li, 2025). Third, ethical risks are proliferating. In human-computer collaboration scenarios, algorithm-driven grouping mechanisms risk reinforcing cultural stereotypes, while the misuse of surveillance technologies such as eye-tracking and voice emotion analysis has sparked debates concerning privacy infringement. Consequently, there is an urgent need to construct a responsible technology framework to safeguard the ontological value of education amidst technological innovation.

5. CONCLUSION

The environment shaped by modern educational technologies has profoundly reshaped the forms, pathways, and outcome dimensions of collaborative foreign language learning. Leveraging intelligent platforms, multimodal interaction tools, and data analytics, collaborative learning has extended beyond physical spaces into blended reality constructs, thereby enhancing engagement, authenticity, and efficacy in foreign language acquisition. However, achieving a balanced advancement of "technology and humanism" necessitates resolving deeper issues of technological burden, societal equity concerns, and ethical boundaries. Future research should concentrate on co-constructing "context-embedded", "intelligent", and "humanism-centered" collaborative learning systems, propelling foreign language pedagogy towards deeper integration, cooperative innovation, and enhanced humanistic care.

REFERENCES

[1] Avissar, N., & Yondler, Y. (2025). Polyphonic education in teacher training: Constructing a new paradigm through professional learning communities. *Journal of Digital Learning in Teacher Education*, 41(2-3), 116-128. https://doi.org/10.1080/21532974.2025.2483207

[2] Blake, R. J. (2013). *Brave New Digital Classroom: Technology and Foreign Language Learning*. Washington DC: Georgetown University Press.

[3] Chapelle, C. A. (2001). *Computer Applications in Second Language Acquisition: Foundations for teaching, testing and research*. Cambridge University Press.

[4] Chiu, C.-y., Ng, S., & Au, E. W. M. (2013). Culture and social cognition. In D. E. Carlston (Ed.), *The Oxford handbook of social cognition* (pp. 767-785). Oxford University Press.

[5] De Wever, B., Schellens, T., Valcke, M., & Van Keer, H. (2006). Content analysis schemes to analyze transcripts of online asynchronous discussion groups: A review. *Computers & Education*, 46(1), 6-28. https://doi.org/10.1016/j.compedu.2005.04.005

[6] Deiglmayr, A., & Spada, H. (2010). Developing Adaptive Collaboration Support: The Example of an Effective Training for Collaborative Inferences. *Educational Psychology Review*, 22, 103-113. https://doi.org/10.1007/s10648-010-9119-6

[7] Dillenbourg, P. (1999). *Collaborative Learning: Cognitive and Computational Approaches*. Elsevier/Pergamon.

[8] Fryer, L. K., Nakao, K., & Thompson, A. (2020). Chatbot learning partners: Connecting learning experiences, interest and competence. *Computers in Human Behavior*, 93, 278-289. https://doi.org/10.1016/j.chb.2018.12.023

[9] Golonka, E.M., Bowles, A.R., Frank, V., & Richardson, D. L. (2014). Technologies for Foreign Language Learning: A Review of Technology Types and Their Effectiveness. *Computer Assisted Language Learning*, 27, 70-105. https://doi.org/10.1080/09588221.2012.700315

[10] Hubbard, P. (2009). *Computer-Assisted Language Learning: Critical Concepts in Linguistics*. Routledge.

[11] Hwang, G.-J., Wang, S.-Y., & Lai, C.-L. (2021). Effects of a social regulation-based online learning framework on students' learning achievements and behaviors in mathematics. *Computers & Education*, 160: 104031. https://doi.org/10.1016/j.compedu.2020.104031

[12] Johnson, D. W., & Johnson, R. T. (1999). *Learning together and alone. Cooperative, competitive and individualistic learning* (5th ed.). Boston, MA: Allyn & Bacon.

[13] Kessler, G. (2009). Student-initiated attention to form in wiki-based collaborative writing. *Language Learning & Technology*, 13(1), 79-95.

[14] Koivuniemi, M., Järvenoja, H., Järvelä, S. (2018). Teacher education students' strategic activities in challenging collaborative learning situations. *Learning, Culture and Social Interaction*, 19, 109-123. https://doi.org/10.1016/j.lcsi.2018.05.002

[15] Koltovskaia, S. (2020). Student engagement with automated written corrective feedback (AWCF) provided by Grammarly: A multiple case study. *Assessing Writing*, 44: 100450. https://doi.org/10.1016/j.asw.2020.100450

[16] Kozulin, A. (2003). Psychological Tools and Mediated Learning. In A. Kozulin, B. Gindis, V. S. Ageyev, & S. M. Miller (Eds.), *Vygotsky's Educational Theory in Cultural Context* (pp. 15-38). Cambridge University Press.

[17] Kress, G. (2010). *Multimodality: A social semiotic approach to contemporary communication*. Abingdon: Routledge.

[18] Lantolf, J. P., & Poehner, M. E. (2014). *Sociocultural Theory and the Pedagogical Imperative in L2 Education: Vygotskian Praxis and the Research/Practice Divide*. Routledge.

[19] Lantolf, J. P., & Thorne, S. L. (2006). *Sociocultural Theory and The Genesis of Second Language Development*. Oxford: Oxford University Press.

[20] Lantolf, J. P., & Xi, J. (2023). Digital Language Learning: A Sociocultural Theory Perspective. *TESOL Quarterly*, 57(2), 702-715. https://doi.org/10.1002/tesq.3218

[21] Li, M. (2025). Exploring the digital divide in primary education: A comparative study of urban and rural mathematics teachers' TPACK and attitudes towards technology integration in post-pandemic China. *Education and Informational Technologies*, 30, 1913-1945. https://doi.org/10.1007/s10639-024-12890-x

[22] Li, M., & Zhu, W. (2017). Explaining dynamic interactions in wiki-based collaborative writing. *Language Learning & Technology*, 21(2), 96-120.

[23] Liu, X. J., Wang, J., & Zou, B. (2025). Evaluating an AI speaking assessment tool: Score accuracy, perceived validity, and oral peer feedback as feedback enhancement. *Journal of English for Academic Purposes*, 75: 101505. https://doi.org/10.1016/j.jeap.2025.101505

[24] Ning, J., Ma, Z., Yao, J., Wang, Q., & Zhang, B. (2025). Personalized learning supported by learning analytics: a systematic review of functions, pathways, and educational outcomes. *Interactive Learning Environments*, 33(8), 5042–5064. https://doi.org/10.1080/10494820.2025.2478437

[25] O'Dowd, R. (2018). From telecollaboration to virtual exchange: State-of-the-art and the role of UNICollaboration. *Journal of Virtual Exchange*, 1, 1-23. https://doi.org/10.14705/rpnet.2018.jve.1

[26] O'Dowd, R., & Ware, P. (2009). Critical issues in telecollaborative task design. *Computer Assisted Language Learning*, 22(2), 173-188. https://doi.org/10.1080/09588220902778369

[27] Smith, B., & González-Lloret, M. (2021). Technology-mediated task-based language teaching: A research agenda. *Language Teaching*, 54(4), 518-534. https://doi.org/10.1017/S0261444820000233

[28] Storch, N. (2013). *Collaborative writing in L2 classrooms*. Multilingual Matters.

[29] Strijbos, J. W., & Weinberger, A. (2010). Emerging and scripted roles in computer-supported collaborative learning. *Computers in Human Behavior*, 26(4), 491-494. https://doi.org/10.1016/j.chb.2009.08.006

[30] Swain, M., Kinnear, P., & Steinman, L. (2015). *Sociocultural Theory in Second Language Education: An Introduction through Narratives* (2nd ed.). Multilingual Matters.

[31] Sweller, J. (2011). Cognitive load theory. In J. P. Mestre & B. H. Ross (Eds.), *The psychology of learning and motivation: Cognition in education* (pp. 37-76). Elsevier Academic Press.

[32] Sweller, J. (2020). Cognitive load theory and educational technology. *Educational Technology Research and Development*, 68(1), 1-16. https://doi.org/10.1007/s11423-019-09701-3

[33] Uluyol, Ç., & Sahin, S. (2016). Elementary school teachers' ICT use in the classroom and their motivators for using ICT. *British Journal of Educational Technology*, 47(1), 65-75. https://doi.org/10.1111/bjet.12220

[34] Vygotsky, L. S. (1978). *Mind in Society: The Development of Higher Psychological Processes*. Cambridge, MA: Harvard University Press.

[35] Warschauer, M. (1997). Computer-mediated collaborative learning: Theory and practice. *The Modern Language Journal*, 81(4), 470-481. https://doi.org/10.1111/j.1540-4781.1997.tb05514.x

[36] Wertsch, J. V. (1991). *Voices of the Mind: A Sociocultural Approach to Mediated Action*. Harvard University Press.

[37] Wood, D., Bruner, J. S., & Ross, G. (1976). The role of tutoring in problem solving. *Journal of Child Psychology and Psychiatry*, 17(2), 89-100. https://doi.org/10.1111/j.1469-7610.1976.tb00381.x

[38] Yang, Y., Yuan, K., Zhu, G., & Jiao, L. (2024). Collaborative analytics-enhanced reflective assessment to foster conducive epistemic emotions in knowledge building, *Computers & Education*, 209: 104950. https://doi.org/10.1016/j.compedu.2023.104950

[39] Zhang, Z., Liu, T., & Lee, C. B. (2021). Language learners' enjoyment and emotion regulation in online collaborative learning. *System*, 98: 102478. https://doi.org/10.1016/j.system.2021.102478

[40] Zhang, Z., Zhang, E., Liu, H., & Han, S. (2024). Examining the association between discussion strategies and learners' critical thinking in asynchronous online discussion. *Thinking Skills and Creativity*, 53: 101588. https://doi.org/10.1016/j.tsc.2024.101588

[41] Zhu, X., Shui, H., & Chen, B. (2023). Beyond reading together: Facilitating knowledge construction through participation roles and social annotation in college classrooms. *The Internet and Higher Education*, 59: 100919. https://doi.org/10.1016/j.iheduc.2023.100919

[42] Ziegler, N. (2016). Taking technology to task: Technology-mediated TBLT, performance, and production. *Annual Review of Applied Linguistics*, 6, 136-163. https://doi.org/10.1017/S0267190516000039