Review of Foreign Language Learner Agency in Technology-Integrated Educational Environments

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Abstract: *This review systematically examines the research landscape concerning educational technologies and foreign language learner agency, exploring the connotations, manifestations, influencing factors, and underlying mechanisms of learner agency within technologically empowered contexts. Through an analysis of recent domestic and international literature, the study reveals that technological environments significantly expand the practical dimensions of learner agency by providing diversified interaction platforms, personalized learning resources, immediate feedback mechanisms, and enhanced situational awareness. Concurrently, technology reshapes teacher-student roles and fosters novel human-machine collaboration modalities, thereby opening new pathways for agency research. The review identifies current limitations, including insufficiently systemic theoretical frameworks, ambiguously defined core constructs, methodological homogeneity, and a neglect of technological risks and ethical considerations. Future research should prioritize developing robust theoretical frameworks, integrating multimodal data analysis, deepening the study of technology-agency interactions, and addressing the ethics and equity dimensions of technology implementation. This will facilitate the evolution of foreign language teaching from a focus on integrating technological tools towards constructing a human-centered, intelligent synergistic ecosystem.*

Keywords—educational technology integration; foreign language learner agency; mediation; sociocultural theory; personalized learning; learning environment

1. INTRODUCTION

The deep integration of globalization and informatization has profoundly reshaped the educational landscape, with educational technology emerging as a core driver revolutionizing paradigms in foreign language teaching. Within this context, learner agency, as a critical factor influencing language learning outcomes, has garnered increasing scholarly attention. Compared to traditional classrooms, technology-empowered foreign language learners exhibit richer conceptual dimensions and more diverse manifestations of agency. Technology provides learners with expansive cognitive tools and interactive platforms, creating learning spaces unconstrained by temporal or geographical limitations, thereby significantly enhancing autonomy in choice and scope.

Supported by emerging technologies such as AI-driven personalized recommendation systems, Multi-User Virtual Environments (MUVEs), and real-time learning analytics, learners can now autonomously set goals, flexibly design learning pathways, instantly evaluate progress, and dynamically adjust strategies. This enables deeper self-initiation and regulation of the learning process. Furthermore, the technology-mediated environment fosters learner agency through multi-faceted interaction mechanisms and instant feedback systems.

In recent years, "foreign language learner agency in technology-enhanced environments" has become an interdisciplinary research focal point spanning applied linguistics and educational technology. Substantial empirical explorations have centered on technology's impact on learner autonomy, engagement, identity construction, and self-regulation dimensions, alongside investigations of underlying mechanisms. However, notable gaps persist in existing research: theoretical frameworks remain fragmented with inconsistent conceptual definitions, and investigations into the complex interplay between technology and agency lack depth. Consequently, this comprehensive review systematically synthesizes current scholarship to chart explicit research trajectories for future theoretical advancement and pedagogical design through cataloguing theoretical models, analyzing impact pathways, and highlighting research limitations and fundamental challenges.

2. THE EVOLVING CONCEPTION OF LEARNER AGENCY

2.1 Conceptual Deepening of Agency

In the late twentieth century, the foreign language teaching field emphasized "learner autonomy" (Holec, 1981; Benson, 2011), which dominated the understanding of individual agency. This conceptual framework focused on learners' self-regulation at both the psychological and behavioral levels, encompassing activities like setting learning goals, choosing

strategies, and monitoring progress (Holec, 1981). The implicit logic held that agency was rooted within the learner's psyche as a relatively stable individual trait. This model presupposed learners possessed clear learning intentions and the ability to effectively use strategies, but often overlooked their inherent cognitive limitations and individual variations in mental processing. Benson and Voller (1997) provided a crucial extension by distinctly differentiating technical, psychological, and sociopolitical dimensions of autonomy, thereby opening the perspective for integrating social dimensions into agency. However, it still offered limited engagement with the complexity of learning environments, the mediating role of interpersonal interaction, and the constraints social structures impose on individual choice, not fully escaping methodological individualism.

Concurrently, the triadic reciprocal determinism proposed by Albert Bandura (1989, 2001), a key figure in social cognitive theory, offered a more dynamic explanatory framework for understanding agency. He emphasized the continuous bidirectional interaction and mutual construction among the individual (e.g., cognition, attitudes, beliefs), behavioral patterns, and the environment, clearly revealing that agency is not merely an enclosed internal attribute. Instead, it is a complex capacity dynamically generated through the continuous adaptation between the person and the environment, thereby laying a solid foundation for understanding the situated nature of agency.

Entering the new millennium, with the further development of Vygotsky (1978)'s Sociocultural Theory, research on agency has increasingly emphasized its emergent nature and multi-mediational properties within concrete "situated practices". This paradigmatic shift radically overturned the view of agency as a stable inner property possessed by learners, redefining it instead as a practical competence enacted through participation and mediated by cultural artifacts (Lantolf & Thorne, 2006). Agency is thus the embodied process in which learners utilize various symbolic tools (e.g., language), material tools (including digital technologies), and even broader resources from social structures within the environment to achieve goals (van Lier, 2008; Duff, 2012).

Here, technology reveals its fundamental mediation characteristic: it is not merely an enabling tool but profoundly shapes both the expression and the very form of agency (Friedman & Kern, 2014). For instance, online communication platforms reshape the form of immediate feedback on language input and output; immersive virtual reality environments construct simulated contexts for authentic cross-cultural communication; and collaborative document editing tools restructure the collective interaction dynamics of meaning negotiation.

Engeström (1999)'s Activity Theory further elucidates how technologically-mediated tools create creative tensions and structural transformations in agency within dynamic activity systems by impacting elements such as activity rules (e.g., community discourse norms), division of labor (e.g., collaborative group roles), and even the construction of community identities (e.g., digital avatar representation). Within this deepening understanding, the concept of "situated practical competence" emerges, which emphasizes that agency is not a pre-existing set of skills. Rather, it is the dynamic practical capacity of learners to perceive affordances within technology-enabled practices, mobilize mediating resources, coordinate multiple forces, and strategically reshape their language learning trajectory.

2.2 Characteristics of Technological Mediation

Within technology-convergent language learning ecologies, the Technological Mediation of tools constitutes the core architecture of learners' agentic practices. Grounded in Sociocultural Theory (Vygotsky, 1978), technologies are not value-neutral instruments; rather, they profoundly mediate cognitive and behavioral processes through semiotic mediation and activity restructuring. Their core characteristic manifests as a dual constructiveness:

As an Affordance-Actualizer: Technologies expand learners' channels of perception and expression through multimodal interaction interfaces (e.g., intelligent tutoring systems, VR immersive environments), extending the field for agentic practices from physical classrooms to ubiquitous learning spaces (Chung et al., 2019).

As a Constraint-Framing Mechanism: Technologies' algorithmic logics (e.g., learning path recommendations in adaptive systems) and platform rules (e.g., discourse norms on social media) implicitly regulate learners' decision-making boundaries (Tan et al., 2025).

This Duality of Structure (Giddens, 1984) signifies that technology's mediating role embodies a tension between liberation and regulation where learners can leverage technology for connection and collaboration within cross-cultural communities, yet may simultaneously fall into traps of cognitive homogenization due to algorithmic recommendations.

The profound value of technological mediation lies in propelling the evolvement of agency from individual empowerment toward Distributed Agency. Traditional views of agency highlight intentional individual action (Bandura, 2001), whereas digital environments reveal the systemic emergence of agency. Learners form Joint Units of Action (Latour, 2005) through human-technology-environment interaction chains (e.g., using corpus tools to refine writing, employing platforms like Pigai.org for iterative output optimization based on real-time feedback). This process involves three key mechanisms: 1) Cognitive Offloading: Technologies handle mechanical language processing (e.g., grammar checking), freeing learner capacity for higher-order strategic planning (e.g., argument structure design); 2) Action Visibility: Learning logs and behavioral data streams externalize inherently implicit decision-making processes, enhancing metacognitive monitoring capabilities (Zhang &

Hyland, 2018); and 3) Network Aggregation: Cloud-based learning platforms aggregate fragmented actions into collective knowledge repositories, enabling the social expansion of agency.

This dynamic collaborative network blurs the subject-tool dichotomy, transforming technology into a Quasi-Actor (Engeström, 2015) within the system of agency reproduction. This ultimately leads to embodied technological praxis — where learners, through embodied interactions with technology (e.g., gestural communication in VR scenarios), naturalize their reconstruction of meaning negotiation patterns and develop ontological trust in the mediating tools themselves (Walkington et al., 2024).

3. DEVELOPMENTAL PATHWAYS OF FOREIGN LANGUAGE LEARNER AGENCY IN TECHNOLOGY-INTEGRATED ENVIRONMENTS

3.1 Construction of Technology-Enabled Personalized Learning Environments

Educational technology provides critical support for the development of foreign language learner agency through Adaptive Learning Systems and Learning Analytics. Intelligent algorithms dynamically adjust resource delivery and task difficulty based on learner profiles (e.g., proficiency level, cognitive preferences, learning trajectories), transforming learners from passive recipients into autonomous designers of their learning paths (Shao et al., 2023). For instance, AI-driven writing feedback tools (e.g., Grammarly) offer instant diagnostic suggestions, stimulating learners' metacognitive awareness for self-correction of linguistic errors (Koltovskaia, 2020). Virtual language learning environments engage learners in contextualized tasks that require decision-making about roles and interaction strategies (Yan & Lowell, 2025). Research indicates significant enhancement in learners' goal-setting autonomy within such environments (Zhao & Ma, 2025), confirming the catalytic role of technology-mediated environmental affordances in fostering agency.

Educational technology propels individual competence development through a chained pathway of "cognitive enhancement → strategy explicitation → metacognitive competence internalization". Intelligent learning systems utilize adaptive algorithms to provide dynamic cognitive scaffolding, visualizing implicit cognitive processes to activate metacognitive monitoring abilities (Zimmerman & Schunk, 2011). Empirical research shows that learners using writing assistance tools exhibit a significant decrease in grammatical error frequency over iterations of system feedback, reflecting a shift from "tool dependency" to "strategy internalization" (Tang et al., 2024).

Technology platforms further reconstruct learner self-efficacy through "data-driven self-narrative". Learning dashboards convert learning trajectories into visualized data streams, helping learners establish causal attribution models linking goals, behaviors, and outcomes (Paulsen & Lindsay,

2024). For example, Moodle platform log analysis reveals that frequent users of learning progress charts significantly increase their utilization of self-regulation strategies. Such technology-mediated "quantified self" practices concretize agency as actionable indicators from abstract concepts.

3.2 Synergistic Empowerment Mechanism in Socio-Cultural Interaction

Technological environments reshape the sociocultural practice network of foreign language learning. Web 2.0 tools support learners in establishing communities of practice that transcend temporal and spatial constraints, participating in meaning negotiation through forms such as collaborative writing and cross-cultural video dialogue (Lantolf & Poehner, 2014). Online peer assessment requires learners to actively apply evaluation criteria (e.g., linguistic accuracy, content logic), and its feedback receptivity shows a significant improvement compared to unidirectional teacher feedback. Notably, the teacher's role is transforming from a knowledge transmitter into a scaffolding architect, activating learners' agency in resource integration through the design of multimodal task chains (Hafner & Miller, 2011). This interactive model significantly strengthens learners' agency perception, with empirical data indicating a significant reduction in their foreign language anxiety index (Reinders & Benson, 2017).

The core value of educational technology lies in creating highly situated fields of action, enabling learners to develop strategic action competence through a triadic nested structure of "goal-tool-community". The task-driven mechanisms designed within gamified learning environments (e.g., Minecraft: Education Edition) embed language use within authentic social purposes (task authenticity), requiring learners to actively negotiate discourse rules to complete tasks like resource trading (Ding & Zhang, 2025). Such embodied cognitive experiences enhance behavioral intentionality and strategic flexibility.

The "Predict-Respond" closed loop of intelligent learning systems sustains the continuous evolution of agency. AI-based personalized practice engines generate "proximal development zone tension" through dynamic difficulty adjustment. User behavior data reveals a non-linear positive correlation between the proportion of learners accepting system-challenging tasks and their participation duration, demonstrating how technologically mediated situational affordance catalyzes behavioral persistence (Godwin-Jones, 2023). Whereas cognitive immersion spaces constructed by Extended Reality (XR) technologies (VR/AR) further dissolve psychological barriers through sensorimotor coupling, fostering language attempts in high-risk scenarios (Khodabakhsh & Bagheri, 2025).

3.3 Digital Pathways for Cultivating Metacognitive Strategies

The sustainable development of agency relies on the digital transformation of Metacognitive Regulatory Competence.

Digital tools render implicit learning processes visible by presenting real-time data, including cognitive load, time allocation, and error patterns (Bannert et al., 2014). Based on these insights, learners formulate differentiated Self-Regulated Learning (SRL) Strategies, namely, users of spaced-repetition apps optimize vocabulary memorization patterns through algorithmic scheduling, while corpus tool users actively identify linguistic usage paradigms. Empirical research confirms that learner groups undergoing digital strategy training demonstrate significantly stronger goal persistence in subsequent autonomous learning tasks, with strategy transfer efficiency reaching 2.3 times that of control groups (Oxford, 2016). Implementing this pathway necessitates concurrent advancement in digital literacy pedagogy to prevent the decoupling of technological tools from cognitive abilities.

4. FUTURE RESEARCH DIRECTIONS

While significant progress has been made in research on learner agency with the deep integration of educational technology and foreign language learning, several domains urgently require further development. Future research needs to achieve breakthroughs across three dimensions such as theoretical construction, methodological innovation, and practical application, to address the complexity and dynamic nature of agency research within technology-empowered educational environments.

4.1 Interdisciplinary Integration of Theoretical Framings

Existing research often focuses on behavioral manifestations in technological environments but lacks deep explanations of the intrinsic generative mechanisms of agency. Future studies need to integrate perspectives from Socio-cultural Theory (SCT), Complexity Theory, and Posthumanism to construct dynamic, multi-tiered explanatory models for agency. For instance, the Digital Ecologized Agency Framework, while emphasizing human-technology interaction, failed to fully explain the reshaping effect of algorithmic mediation (Knox, 2019) on learner decision-making authority. Therefore, there is a critical need to develop a "Technology-Enabled Agency" theory: On one hand, it requires investigating how AI-driven personalized learning systems affect learner self-regulation capabilities through data feedback loops (Winne & Marzouk, 2019); on the other hand, it should explore the empowerment mechanisms of decentralized technologies like blockchain for learner sovereignty (Selwyn, 2022). Particular attention must be paid to the ethical paradox of technological mediation − while personalized recommendations enhance learning efficiency, they may simultaneously lead to an "algorithmic cage effect" that weakens critical agency. This necessitates interdisciplinary verification drawing from both philosophy and educational technology (Biesta, 2020).

4.2 Multidimensional Innovation in Methodologies

Current empirical research relies heavily on self-report scales and static log data, which struggle to capture the moment-to-moment and context-dependent nature of agency. Future approaches should focus on:

(1) Multimodal Data Fusion Analysis: Integrate eye-tracking, biosensors, and Natural Language Processing (NLP) technologies to build a "physiological-behavioral-cognitive" tripartite monitoring system. Examples include utilizing facial expression coding to detect intentional signals in online collaboration, or employing keystroke dynamics to decode fluctuations in agency during writing processes (Carr, 2023).

(2) Blended Longitudinal Research Design: Implement Experience Sampling Methodology (ESM) to continuously track technology usage cycles over 6-12 months, combined with Social Network Analysis (SNA) to deconstruct the contagion pathways of agency within learning communities (Xie et al., 2024). For instance, using dynamic panel models to verify the threshold effect for the formation of collective agency in VR contexts.

(3) Transformative Participatory Action Research (PAR): Invite learners to act as co-researchers, utilizing visualization tools like digital storytelling and cognitive mapping to reveal their implicit agentic strategies in technological practices (Darvin & Hafner, 2022).

Such methodological innovations will propel agency research beyond technological determinism towards a technosymbiotic perspective.

5. CONCLUSION

This review systematically deconstructs the conceptual evolution, core mechanisms, and developmental pathways of foreign language learner agency within technology-integrated educational environments. The study finds that learner agency in technological contexts has transcended the traditional notion of agency as an individual, intrinsic trait. Instead, it has evolved into a technologically mediated, contextually generated, and socially distributed dynamic praxis.

Technology empowers learners not only by providing multimodal interaction interfaces, personalized learning environments, and immediate feedback mechanisms that facilitate goal setting, pathway planning, and strategy regulation, but also profoundly reshapes the very essence and expressions of agency through its mediating properties.

The study reveals three core pathways of technology-enabled empowerment:

(1) Personalized Environment Reconstruction (via adaptive systems, learning analytics) enhances learner autonomy and control over the learning process.

(2) Socio-cultural Interaction and Collaboration (through co-construction of communities of practice, collaborative tasks) strengthens collective agency and identity formation.

(3) Digitization of Metacognitive Strategies (via visualization dashboards, cognitive outsourcing tools) advances the internalization of strategies and the development of self-regulatory abilities.

Nevertheless, significant challenges persist concerning the depth of theoretical integration (e.g., insufficient incorporation of algorithmic mediation and posthuman perspectives), the breadth of methodological innovation (e.g., lack of multimodal real-time data capture and hybrid longitudinal designs), and urgent ethical concerns (e.g., instrumental rationality and algorithmic risks). The double-edged sword effect of technological empowerment, such as its potential normative constraints and possible erosion of learners' deep cognitive autonomy, demands further critical investigation.

Future advances require shifting agency research beyond a mere "technology enhancement perspective" towards a "theory of technologically adaptive human-agent collaboration". Deep exploration into achieving dynamic equilibrium and co-evolution among humans, technology, and the environment within an ethical framework will be central to theoretical refinement and practical innovation. Researchers are called upon to develop more dynamic, ethically sensitive, and ecologically adaptive paradigms for agency research and practice.

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