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Article

Constructing a GenAI-Driven "Learning–Assessment–Competition" Ecosystem for the Digital Transformation of University Language Labs

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Abstract: To address inefficient resource utilization, monotonous learning experiences, and insufficient motivational feedback in university foreign language laboratories, this study proposes a Generative AI (GenAI)-driven "Learning–Assessment–Competition" (LAC) integrated autonomous learning platform. The platform integrates GenAI's intelligent generation and personalized adaptation capabilities with laboratories' multimodal resources (e.g., VR pods, speech terminals, video corpora) to construct a three-dimensional ecosystem linking teaching support, autonomous learning, and competition incentives, thereby forming a closed-loop learning pathway from knowledge input to ability output to motivation activation. A one-semester pilot implementation showed that average daily laboratory usage doubled from 4 to 8 h, students' speaking performance improved significantly according to internal assessments, and teachers' lesson-preparation time decreased by approximately 35%. Based on these outcomes, this study proposes an LAC collaboration mechanism and a three-stage rollout strategy, offering a replicable and sustainable paradigm for the digital transformation of university foreign language laboratories.

Keywords: Generative Artificial Intelligence (GenAI); university foreign language laboratory; Learning–Assessment–Competition integration; autonomous language learning platform

1. Introduction

Amid the wave of educational digital transformation, China's 14th Five-Year Plan for Educational Informatization articulates the core goal of building a personalized, intelligent, and digital learning ecology [1]. The rapid advancement of Generative AI (GenAI)—exemplified by GPT-4's dynamic content generation, ERNIE (Wenxin Yiyan)'s adaptive recommendations, and Claude 3's multimodal interaction—provides critical technical support for overcoming the bottleneck of standardized input in language learning [2]. GenAI aligns with the input–output–feedback mechanisms of language acquisition: it dynamically calibrates content difficulty to learner proficiency, simulates authentic communicative scenarios through multimodal interaction, and delivers instant, actionable formative feedback, facilitating a shift from passive reception to active construction.

As a core venue for foreign language teaching, university language laboratories should serve as a hub connecting classroom instruction and real-world application, leveraging multi-screen interactive speech rooms, immersive VR scenarios, and curated audiovisual corpora to support both course-based practice and autonomous learning [3–5]. However, the long-standing "hardware-heavy, ecology-light" operational model has resulted in

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underutilization: VR devices average fewer than two hours of daily use; 68% of students report a mismatch between materials and proficiency; and 72% of teachers cite low resource-use efficiency [6]. Activating dormant resources with GenAI and reconstructing personalized, immersive, closed-loop learning scenarios have thus become urgent imperatives for the digital transformation of university foreign language education [7].

In response, this study advances a platform that integrates GenAI with an LAC framework and multimodal scenarios. Grounded in constructivism, multimodal learning theory, and task-based language teaching [8], it operationalizes a closed loop from learning (knowledge input) to assessment (ability output) to competition (motivation activation), tightly coupling GenAI's personalization capabilities with laboratory multimodality to produce a replicable practice paradigm.

2. Scene Characteristics and Core Dilemmas of University Foreign Language Laboratories

University foreign language laboratories are composite settings linking physical space, digital resources, and heterogeneous user needs. On the hardware side, multi-screen interactive speech rooms with directional microphones, VR pods supporting head tracking and gesture interaction, and curated film corpora form a multimodal interaction matrix spanning vision, audition, and action. On the user side, laboratories serve English majors and large College English cohorts, balancing high-stakes examination preparation with communicative application (see Figure 1).

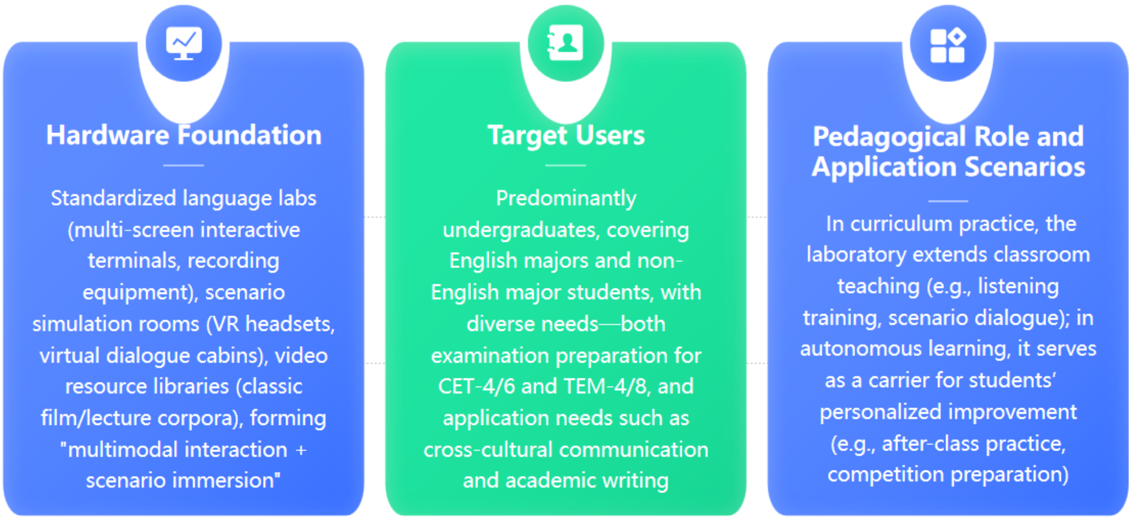

Figure 1. Scene characteristics.

Despite its rich hardware resources and clear functional positioning, the traditional operational model faces significant shortcomings (Table 1):

Table 1. Three constraints and their manifestations in laboratories.

Dimension	Manifestations
Inefficient resource utilization	Devices are predominantly "course-task driven", resulting in low frequencies of student-initiated use; advanced devices (e.g., VR) are underused due to limited content diversity (some devices average < 2 h/day)
Monotonous learning experience	Practice content is fixed (often tied to textbook exercises) and inadequately adapted to learners' proficiency differences (both underperforming and advanced students use identical materials)
Insufficient motivation/ feedback	Students complete tasks passively with limited competitive incentives; teacher feedback (e.g., essay marking, oral comments) is time-consuming (5–10 min per essay) and has limited coverage (only ~30% of personalized needs)

3. Practice Logic and Pathway of the "Learning–Assessment–Competition Integration" Platform

The LAC integration is the platform's core logic. GenAI connects knowledge input, ability output, and motivation activation into a dynamic loop that replaces fragmented memorization with systematic construction. Learning provides the knowledge substrate for assessment; assessment bridges knowledge to performance within authentic tasks; and competition energizes both through peer-visible goals and standards of excellence.

3.1. Learning: Knowledge Construction through the Fusion of Multimodality and GenAI

"Learning" represents the starting point of language acquisition—it focuses on transforming abstract grammar, vocabulary, and cultural knowledge into experiences that are "perceptible, interactive, and extensible", thereby achieving a leap from "fragmented input" to "systematic cognition".

Multimodal knowledge presentation forms the foundational support for "learning":

Grammar learning: The platform uses animations to visualize the embedding logic of relative clauses (e.g., connecting "the girl" and "likes cats" with "who"); learners can drag "who/that/which" to complete a "clause assembly" mini-game, with GenAI providing instant corrective hints.

Vocabulary learning: For polysemous words like "bank" (financial institution/riverbank), the platform integrates Text-to-Speech (TTS) pronunciation, contrastive images (skyscraper vs. riverbank), and clips from Harry Potter to support contextualized understanding. GenAI pushes quick-fire reviews on Days 3 and 7 following the forgetting curve (e.g., "hear 'bank' and select the correct image") [9].

Cultural learning: With VR headsets, learners can "immerse" themselves in Western table etiquette (order of cutlery, napkin placement rules). GenAI generates scenario-based questions (e.g., "Where should the napkin be placed if you leave the table mid-meal?"). Incorrect responses trigger VR replay of key clips (e.g., "fold and place on the chair") to solidify learning [5].

GenAI-driven intelligent guidance deepens the learning process: Upon entry, learners first complete diagnostic tests (covering vocabulary size, grammar, and listening), based on which AI generates personalized learning paths—basic track (vocabulary < 4000) starts with simple past tense and daily vocabulary; advanced track (vocabulary > 6000) focuses on academic abstract writing and Western business etiquette. Learners can query AI at any time (e.g., "What is the difference between 'affect' and 'effect'?"), and the AI responds with "part of speech + examples" (e.g., "affect (v.): Smoking affects health; effect (n.): Smoking has a bad effect"), recommends a TED talk containing the target words, and then pushes cloze exercises. After completing "present perfect," the AI automatically links to "past/future perfect," provides a comparative timeline with examples, and annotates common misuse scenarios (e. g., " 'since + past time' pairs with present perfect"), aiding the construction of a coherent tense system [9].

Ultimately, through multimodal interaction to reduce the abstractness of knowledge and GenAI's personalized guidance to close the loop of "explain–exemplify–apply," the "learning" component drives the transition from "knowledge fragments" to "systematic understanding."

3.2. Assessment: AI-Enabled Ability Output and Iterative Improvement

Assessment is the core hub of the learning–competition chain, transformed from a traditional testing tool into a performance-oriented practice ground. The aim is growth rather than selection: verify transfer of what was learned to authentic use, integrate fragmented drills into complete task outputs, and align with competition standards (e.g., FLTRP Cup, National College English Contest) to rehearse higher-level performance.

Task design centers on adaptivity, multimodality, and task authenticity. Adaptivity: weakness in the simple past prompts a weekend-activity paragraph; mastery of intercultural business communication prompts a delayed-shipment email; competition preparation prompts an "AI and language learning" speech. Multimodality: a VR international conference scene corrects stress in presentation, prompts inclusion of pilot data, and gives body-language feedback; an airport check-in scene flags long pauses after because and suggests polite fee-reduction requests [10]. Task authenticity: a Spring Festival invitation letter, consultation with an AI study-abroad advisor, and a stance piece on AI translation to avoid mechanical drills.

Notably, the value of assessment lies in post-output iteration: four-dimensional diagnosis (linguistic accuracy, pragmatic appropriateness, logical coherence, situational fit) → personalized prescriptions (e.g., affect/effect drills, discourse-marker micro-lessons, business politeness expressions) → data looping back to learning and competition to update mastery, pathways, and capability reports, forming a continuous optimization cycle.

3.3. Competition: AI-Supported Motivation Activation and Outcome Verification

Competition transforms individual practice into social performance and serves as a sustained motivational engine. Simulated competitions reduce anxiety while calibrating expectations to authentic rubrics. For speech events such as the FLTRP Cup, learners perform within a VR stage-and-audience setting; the system scores content originality, argument–evidence–conclusion coherence, and delivery (prosody and body language); and it returns time-anchored improvement suggestions alongside targeted micro-lessons. For writing modeled on national competitions, chart-based prompts are used, double-blind review simulates unbiased scoring, and feedback emphasizes data interpretation, linguistic variety, and format compliance, complemented by exemplars that foreground discourse strategies and lexical upgrades.

Furthermore, authentic competitions are scaffolded end-to-end. Before events, GenAI distills high-frequency topics from recent cycles and the VR pod simulates pressure via judge interruptions and audience applause; during events, speech-to-text transcribes judges' questions to prevent missed comprehension, and grammar-checking plugins support rapid drafting; after events, a performance radar chart spanning content, language, logic, and delivery highlights strengths and weaknesses and anchors structured review that includes video replay and one-to-one coaching. By closing the loop from rehearsal to verification to reflective enhancement, competition is transformed into sustained motivation and measurable progress.

4. Platform Implementation and Effectiveness

4.1. Implementation Path

Implementation aligns technology, function, and ecology in stages. In the resource digitization and GenAI adaptation phase, speech-room endpoints are upgraded for voice-and-gesture interaction and VR devices are connected to a curated scenario library spanning business negotiations and academic conferences. Legacy resources such as TEM-4 papers and audiovisual corpora are consolidated into a knowledge graph via GenAI-assisted cleaning and annotation by grammar point and topic. Faculty development focuses on leveled exercise generation, learning analytics interpretation, and task alignment, and institutionalizes a teacher–technology collaboration mechanism in which weekly instructional needs trigger 48-h technical responses and product iteration.

In the pilot phase, the platform is embedded in two College English courses with two hours per week of laboratory-based practice plus autonomous learning; semi-structured interviews triangulate perceived resource fit, learning effort, and classroom support. In the university-wide phase, the platform is written into the curriculum, requiring twenty hours per semester of autonomous laboratory learning linked to credit, and a five-to-eight-member operations team (administrator, technician, student assistants) conducts daily maintenance, updates topic-driven resources monthly, and provides just-in-time student support within ten minutes.

A "teacher review + model fine-tuning + parameter control" governance chain ensures instructional alignment: instructors curate high-quality exemplars by genre and goal for small-sample fine-tuning, and the parameter panel controls topic weights, difficulty bands, and lexical thresholds to anchor generation to curriculum outcomes.

4.2. Practical Effectiveness

After one semester of pilot use, the laboratory achieved substantial teaching gains: average daily laboratory usage doubled from 4 to 8 h; student self-booked sessions accounted for over 60%; VR usage frequency rose from 2 to 6 sessions/day. Internal platform evaluations indicated significant improvement in oral performance (task-based speaking participation reached 85% of students), and interviewed students reported that competition incentives increased their daily study time by an average of 30 min. Teachers' preparation and grading time decreased, and most teachers found the "learning analytics report" clearly helpful. Students in the pilot classes won five provincial awards and achieved a breakthrough at the national level (one award).

5. Challenges and Prospects

5.1. Application Challenges and Responses

The stochastic nature of GenAI can drift content away from instructional targets, for example when Business English practice is requested but casual small talk is generated. The platform counters this with an integrated mechanism combining teacher curation, small-sample fine-tuning, and parameter control. Teachers label high-quality samples by genre and objective for inclusion in the fine-tuning corpus, and the parameter panel sets topic weights, difficulty bands, and lexical thresholds to preserve alignment with curriculum goals at the source.

Privacy and security are addressed through a "local-first, minimal-necessary, role-based" governance strategy: all data reside solely on university servers with no third-party sharing; personally identifiable information is de-identified, retaining only anonymized behavioral traces for analysis; teachers access anonymized group data limited to their classes; and laboratory administrators hold device-maintenance privileges only. The framework complies with the Personal Information Protection Law of the People's Republic of China [11]. Ethically, the platform obtains institutional review approval, discloses data use, consent, and opt-out mechanisms, and deploys sensitive-content filtering and harm detection to mitigate bias and risk. These measures safeguard instructional fit and data security while preserving the analytic capacity required for personalization.

5.2. Future Outlook

We will deepen the platform's value in three directions: multilingual expansion to include Japanese, Russian, and other languages; cross-modal generation optimization by integrating GenAI technologies to construct full "language + vision + audition + action" scenarios; ecosystem linkages across classroom, after-class, and workplace contexts, aligning language output directly with employability needs. These directions will further strengthen the platform's "personalization, immersion, and practicality", enabling language learning to extend "from laboratories to full-scenario contexts" and progress "from knowledge mastery to ability deployment".

6. Conclusions

This work highlights how a GenAI-driven LAC platform reconstructs the learning ecology of university foreign language laboratories by coupling technological enablement with pedagogical integration. Dormant multimodal resources are transformed into personalized learning scenarios, passive task completion into active ability construction, and isolated facilities into hubs linking classroom and real-world communication. The one-semester pilot indicates substantial improvements across resources, experience, and motivation, providing a replicable, scalable pathway for transformation.

Conceptually, the platform establishes a transparent evidence chain from explanation to application to diagnosis to prescription under GenAI mediation, advancing theoretical understanding of technology-enhanced language learning ecosystems. Practically, it details an implementable architecture and governance workflow aligned with curricular targets and compliance requirements, offering actionable guidance for universities seeking to digitize foreign language laboratories. As GenAI advances toward finer-grained adaptation and more natural multimodal interaction, university laboratories are poised to evolve into intelligent learning communities that launch students to explore and connect with the world through language.

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The authors declare no conflict of interest.

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