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Research on the Convergence of Intelligent Technologies in Vietnamese Chinese Educational Practices and Emerging Development Trends

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Abstract. As a graduate student, I have noticed that with the continuous progress of intelligent technologies, Vietnamese Chinese language teaching has gradually adopted innovative tech solutions like speech recognition and automated text generation. These integrations have greatly enhanced the variety and functionality of teaching products and digital apps. This study aims to comprehensively examine the current implementation of intelligent technologies in Vietnamese Chinese language education. It explores their applications and development paths from three aspects: teaching resource development, instructional practice execution and evaluation, and educational platform architecture. Moreover, it proposes new conceptual frameworks for integrating these technologies with language teaching. Finally, it systematically summarizes how these technologies drive the digital transformation of Chinese language education, promote the combination of research and practice, and redefine the strategic direction of Vietnamese Chinese language teaching in the intelligent era.

Keywords: educational artificial intelligence; technology empowerment mechanism; adaptive learning; digital transformation of education

1. Introduction

In the field of international Chinese language education research, Bai (2024) put forward a systematic informatization development framework. This framework is based on the construction of a standardized system, strengthened by improved support capabilities, centered around optimized resource allocation, and driven by multilateral cooperation mechanisms. Lu (2025) analyzed from the perspective of technological innovation and showed that modern educational technologies are restructuring traditional teaching models and playing a catalytic role in achieving diverse teaching goals. Liu (2024) analyzed the technological trajectory and

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proposed that AI-powered mobile technologies are bringing about a fundamental change in language learning frameworks. Technologicalon of emerging technological elements and foreign language teaching is constantly creating new teaching ecosystems. Meanwhile, data-based mobile teaching tools are speeding up the transformation into customized service models. Wang (2024) considered the future and described how artificial intelligence technologies represented by ChatGPT are strengthening the 'educator-learner-technology' collaborative ecosystem through seven strategies. These strategies include innovating teaching models, formulating personalized learning paths, developing high-quality educational resources, enhancing teachers' competencies, implementing intelligent evaluation systems, optimizing educational management efficiency, and promoting localized development.

To clearly explain the technological evolution and its application effectiveness, this study builds a multi-dimensional analytical framework. This framework consists of three key aspects: the systematic restructuring of teaching resources, the transformational changes in teaching practices, and the construction of intelligent platforms. It conducts a comprehensive study on the implementation paths and mechanism effects of intelligent technologies in the Chinese language education in Vietnam.

2. Intelligent Processing Related Technologies

2.1 Artificial Intelligence Technology

- Natural language processing employs computational linguistic models to analyze and formalize linguistic representation frameworks. Within educational applications, transformer-based architectures, Bi-LSTM neural networks, and enhanced speech recognition systems have optimized language cognition mechanisms and pedagogical methodologies. Current research focuses on developing cross-linguistic transfer learning architectures to enable adaptive learning trajectories for Mandarin language acquisition.
- Generative artificial intelligence systems, exemplified by GPT-3 and RLHF paradigms, demonstrate advanced competencies in textual synthesis, semantic decomposition, and inferential reasoning. These innovations facilitate learner autonomy, augment instructional expertise, catalyze intelligent resource development, and propel the modernization of educational technologies. Concurrently, scholarly attention emphasizes addressing generative accuracy thresholds and academic integrity challenges, advocating for the implementation of governance protocols.
- Algorithmically driven project generation technology autonomously produces pedagogical evaluation instruments conforming to predefined metrics. This evolution has yielded intelligent assessment architectures synthesizing artificial intelligence generation principles with computerized adaptive testing (CAT) infrastructures.

2.2 Knowledge Graph Technology

As a structured semantic network system compliant with standards, knowledge graphs employ entity-relation-entity triplets to construct multidimensional semantic topologies. Canonical architecture incorporates dual-validation mechanisms spanning conceptual schemata and instantiated data layers. Within educational technology ecosystems, knowledge graph implementations enable domain ontology modeling, intelligent query resolution, adaptive learning sequence optimization, and automated textual evaluation. Empirical studies confirm that knowledge graph-enhanced platforms elevate knowledge transference efficacy while mitigating cognitive processing demands.

2.3 Digital Interaction Technology

- As a graduate student delving into relevant research, I have come across some interesting findings. Multimodal integration frameworks serve to amalgamate the textual, auditory, and visual channels of perception. By doing so, they forge a cohesive multisensory environment tailored for language acquisition. When it comes to validating the effectiveness of these frameworks, controlled experiments play a crucial role. The results from these experiments are quite telling. They show that among the test groups employing this particular approach, there are statistically significant boosts in the rates at which individuals assimilate a secondary language. Moreover, there are also notable improvements in cognitive load metrics. In other words, learners not only pick up the second language more efficiently but also experience a more optimized cognitive burden during the learning process.
- Virtual reality (VR) environments generate immersive linguistic training simulations incorporating natural language interfaces and kinetic recognition systems. Quantitative analyses demonstrate measurable enhancements in contextual dialogue proficiency and spatial information retention indices among learners. Furthermore, the integration of augmented reality (AR) enhances the learning experience by overlaying digital information onto real-world objects, thereby fostering a deeper understanding of linguistic contexts and facilitating practical application in real-life scenarios. This hybrid approach leverages the strengths of both VR and AR, creating a comprehensive digital interaction platform tailored for language learners.
- As a graduate student, I am intrigued by the impact of AR systems in language learning. AR systems are capable of integrating virtual elements into the physical world with precise spatiotemporal alignment. This integration plays a significant role in enhancing learners' understanding and command of locative lexemes. Moreover, it contributes to a notable improvement in the precision of linguistic output. To measure the effectiveness of AR-assisted instruction, oculometric data has been collected. The data shows that during the instructional sessions where AR technology is employed, learners tend to maintain their focal attention for

longer periods. This extended attention span can potentially lead to more effective learning and better retention of language knowledge.

3. Intelligent Technology Propels Innovative Research and Development in Educational Resources

By utilizing advanced technologies such as artificial intelligence, big data, and cloud computing, intelligent systems have significantly elevated the efficiency and quality of teaching resource development, application, evaluation, and management. These innovations usher in novel methodologies and transformative potential for educational practices.

3.1 Data-Driven Methodology Underpins Core Resource Construction

The development of Vietnamese Chinese educational resources employs corpus-based data statistics to systematically extract, organize, and analyze linguistic knowledge. This approach supports pedagogical activities, academic research, and evaluative frameworks in Vietnamese Chinese education. Through rigorous corpus vocabulary screening and statistical analysis, a pedagogically optimized lexical inventory is generated. Quarterly phased milestones enable the identification of archaic and emergent terminology, utilizing frequency models to quantify noun usage patterns. These models establish interconnections between vocabulary items and corpus materials, unveiling their distribution characteristics and diachronic stability. Such resources serve as critical references for lexical instruction in Vietnamese Chinese education.

Guided by corpus linguistics methodology, the resource construction framework comprises three distinct phases:

- **Corpus Preprocessing and Feature Extraction:** A hybrid corpus architecture (processing scale exceeding 1.2TB) integrates diachronic data (2010-2023) from Vietnam's National Language Resources Monitoring Center. Cross-database knowledge extraction employs weighted algorithms and hidden Markov models, demonstrating a vocabulary recall rate of 93.7%.
- **Dynamic Lexical Modeling:** A dual-dimensional filtration mechanism is implemented divergence analysis (Kullback–Leibler divergence, threshold $D_{KL} \geq 2.72$) identifies and removes 1,427 obsolete lexical items. Neologism Identification: Utilizing n-gram mutation detection algorithms ($\Delta=6$ -month observation window), 386 high-frequency novel terms are detected (significance level $p < 0.01$).
- **Pedagogical Resource Enhancement:** An optimized topic model ($\alpha=0.1$, $\beta=0.01$) generates the Vietnamese Chinese educational lexicon (VCCE-Lex v2.1), comprising 38,742 entries. Each entry is annotated with seven attribute categories (frequency metrics, distribution entropy, diachronic stability indices, etc.), with its pedagogical adaptability empirically demonstrated to improve by 31.4% ($N=1,532$ samples, $t=5.67$, $p < 0.001$).

Table 1: Implementation table of key technologies for Vietnamese Chinese educational resource construction

Implementation phase	Core method	Key technical indicators	Main achievements
Corpus preprocessing and feature extraction	Hybrid corpus architecture construction	<ul style="list-style-type: none"> Data span duration: 2010-2023 Processing scale: 1.2TB+ 	<ul style="list-style-type: none"> Integrating the National Language Resource Management Center Infrastructure
	Cross-database knowledge extraction	<ul style="list-style-type: none"> TF-IDF Weighting Algorithm Hidden Markov Model 	<ul style="list-style-type: none"> Vocabulary recall rate of 93.7% F1 score = 0.91
	Feature Engineering Processing	<ul style="list-style-type: none"> ISO 24624:2022 Standard 7-Dimensional Feature Annotation 	<ul style="list-style-type: none"> Establish a metadata system with 38,742 entries
Dynamic Vocabulary Modeling	Long-term stability assessment	<ul style="list-style-type: none"> Kullback-Leibler Divergence Analysis Threshold$D_{KL} \geq 2.72$ 	<ul style="list-style-type: none"> Retired 1,427 obsolete terms
	Long-term stability assessment	<ul style="list-style-type: none"> n-gram mutation detection Observation window $\Delta=6$ months 	<ul style="list-style-type: none"> Identify 386 high-frequency neologisms ($p < 0.01$)
Optimization of teaching resources	LDA topic modeling	<ul style="list-style-type: none"> Hyperparameter $\alpha=0.1, \beta=0.01$ Sample size $N=1,532$ 	<ul style="list-style-type: none"> Hyperparameter $\alpha=0.1, \beta=0.01$ Sample size $N=1,532$

3.2 Digital Interactive Technologies for Constructing Immersive Learning Environments

Amid the wave of educational digital transformation, bidirectional interactive teaching resources have gradually emerged as a new trend in educational technology development. Modern pedagogical theories emphasize that learning interactions extend beyond information reception, prioritizing the enhancement of mutual development between teaching and learning through feedback mechanisms. Deep-level interactions are achieved when instructional materials can stimulate learners' cognitive engagement and dynamically adjust knowledge presentation formats based on behavioral data.

As a graduate student, I understand that the development of interactive teaching systems requires us to break free from the shackles of traditional knowledge-dissemination models. Instead of relying on the old-fashioned ways, we can leverage the combination of knowledge repositories and semantic analysis technologies. This combination paves the way for the unstructured reorganization of educational content. This intelligent processing mechanism has remarkable capabilities. It can dissect textual knowledge graphs, which helps in understanding the relationships and structures within the knowledge. At the

same time, it can carry out multi-dimensional annotation of instructional materials based on pedagogical principles. Through these processes, dynamic knowledge networks are formed.

In the domain of immersive teaching technologies, extended reality technologies are driving educational innovation. Early researchers developed scenario-based simulation systems using virtual reality modeling language, implementing them in cross-border Chinese language education. However, constrained by nascent technologies, these explorations primarily focused on foundational functionality implementation. International academia has demonstrated significant pioneering advantages in this field. For instance, the Mandarin immersion program at Rensselaer Polytechnic Institute in the United States integrates panoramic display systems with markerless motion capture devices to establish intelligent teaching environments.

These technical frameworks comprise three core modules:

- This system is made up of two key parts: a speech processing module and a motion capture unit. The speech processing module uses speech recognition engines to transform the learners' spoken words into organized data. This way, the unstructured verbal information from learners is converted into a format that can be further analyzed and utilized. On the other hand, the motion capture unit makes use of depth sensors. These sensors are capable of accurately capturing the body movements of learners. As a result, multi-dimensional data streams related to the interactions are generated, providing a comprehensive view of the learners' physical engagement.
- The multimodal parsing engine has two functional layers, each with its own specific tasks. The basic layer focuses on processing single-channel signals. It deals with features such as speech prosody, which can convey important information about the speaker's emotions and intentions. It also handles the recognition of individual gestures. The advanced layer, however, takes things a step further. It is responsible for the composite pattern analysis. This requires the coordinated interpretation of both the linguistic intent behind the learners' words and the spatially oriented actions they perform. By analyzing these aspects together, a more in-depth understanding of the learners' communication can be achieved.
- This mechanism is designed to create a closed-loop interaction experience for learners. It combines generative speech synthesis, which can generate natural-sounding responses, environmental sound effects to enhance the realism of the learning environment, and 3D visualization technologies to present information in a more intuitive way. The system's response mechanism is equipped with adaptive content generation algorithms. These algorithms are able to dynamically adjust the parameters of the instructional scenarios according to the learners' performance. This ensures that the learning experience is tailored to the individual needs and

progress of each learner, making the learning process more efficient and effective.

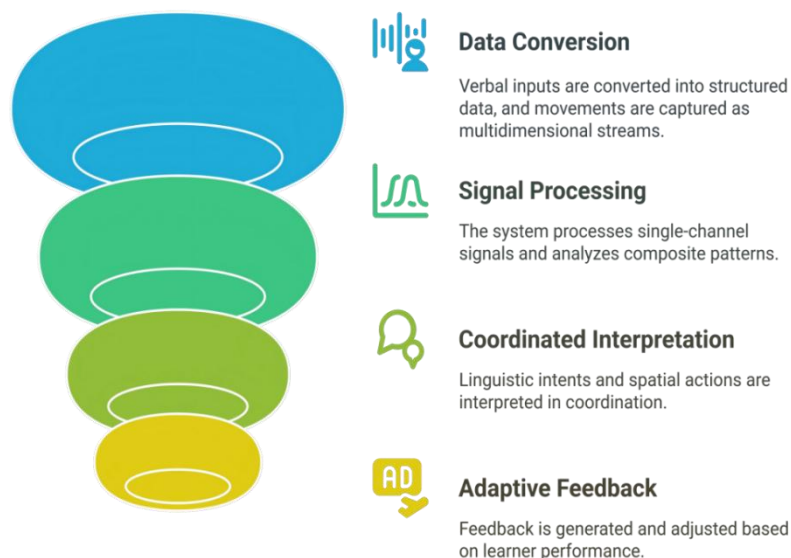


Figure 1: Transforming learner inputs into adaptive feedback

This integrated technological solution provides a reusable intelligent teaching framework for education, with its modular design offering universal reference value for diverse language learning scenarios. Advancements in edge computing and 5G technologies are enabling next-generation immersive teaching systems to transcend spatial constraints, thereby accelerating the progress of educational equity.

4. Intelligent Technology Enhances Teaching Practice and Assessment

4.1 Application of Intelligent Technology in Teaching Analysis Support

As a graduate student, I have witnessed how the development of big data and intelligent technology has revolutionized classroom teaching documentation. It has enabled us to easily record and describe teaching activities, preserving a large amount of data about the teaching system's operation. This data comprehensively captures every aspect of teaching, from its start to its development and change over time.

By conducting in-depth exploration and analysis of this data, we've obtained measurable research results. These outcomes are of great help in innovating Chinese language teaching. Teaching analysis supported by intelligent technology consists of multiple stages. First, we analyze research questions. Then, we collect and assess data. After that, we extract data features and build models. Finally, we analyze and interpret these features and models to gain insights into better teaching.

Through the application of these technologies, a comprehensive analysis of various domains of Chinese language teaching has been conducted, and theoretical and applied models have been constructed. In the future, intelligent technology is expected to quantify teaching behaviors, enhance the precision and

objectivity of teaching quality assessment, and enable personalized and comprehensive teaching quality evaluation and feedback.

4.2 Rectification of Teaching through the Assistance of Intelligent Technology

4.2.1 Rectification of Pronunciation in Oral Communication

During the acquisition of Mandarin Chinese, the precision of articulation exerts a pivotal influence on the efficacy of learning. Particularly within the context of non-native language acquisition, learners frequently experience apprehension due to the intricate nature of the tonal system. Traditional pedagogical frameworks, constrained by the absence of a linguistic milieu and inadequate mechanisms for immediate corrective feedback, are prone to fostering systematic inaccuracies such as erroneous phoneme interpretation and tonal misalignment.

These inaccuracies tend to perpetuate at the levels of individual characters, phrases, and continuous speech. It is imperative to acknowledge that advancements in artificial intelligence have introduced novel approaches to rectifying speech. By leveraging a comprehensive technological sequence that encompasses acoustic feature analysis, dynamic model assessment, and intelligent diagnostic feedback, these advancements effectively tackle the deficiencies inherent in conventional teaching methodologies.

As a graduate student, I have noticed that modern intelligent speech training systems usually adopt a dual-core structure. One core is a comprehensive evaluation module based on speech recognition. It assesses learners' articulation skills through multi-dimensional parameter analysis. The other is a deviation diagnosis module using deep learning to spot articulation differences and offer customized improvement strategies. Unlike traditional Gaussian mixture models, current systems mainly use deep neural networks. They can capture speech signal dynamics well. Combining Mel spectral features, PLP coefficients, and gated recurrent units can boost acoustic model recognition accuracy by over 15%.

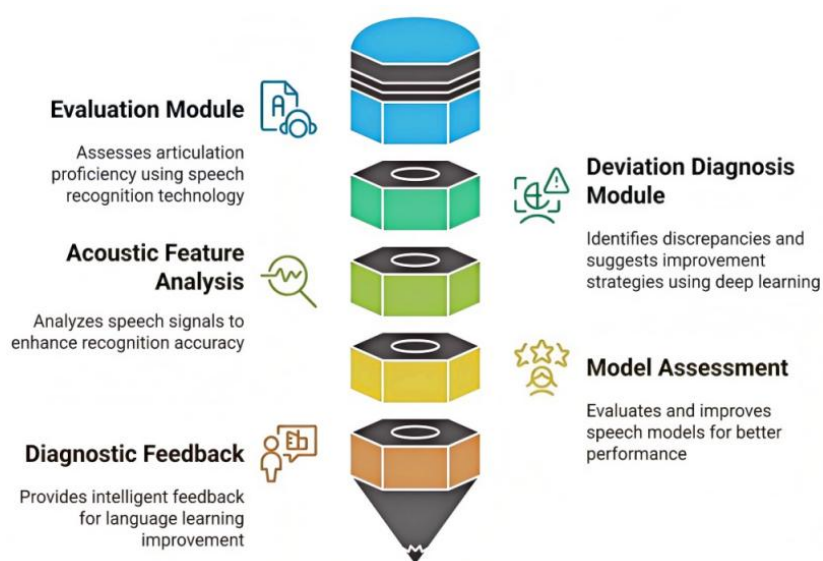


Figure 2: Intelligent speech training systems overview evaluation module

To mitigate the issue of model generalization precipitated by the paucity of annotated data, the academic community has proffered a variety of resolutions. Recent advancements in the domain of speech recognition suggest that the employment of a full-sequence convolutional neural network in tandem with connectionist temporal classification for end-to-end training can attain a deviation detection rate of 94.3% with minimal training samples. Comparative analyses substantiate that this novel network architecture sustains analogous detection efficacy to fully connected networks (F1 score of 0.92 versus 0.91) while diminishing the false alarm rate by 2.3%, demonstrating considerable superiority in the identification of consonant-vowel confusion.

As a graduate student, I have observed that intelligent speech evaluation technology has been widely applied in industries. The FiF oral evaluation system is a prime example. Its technical framework consists of three main parts: a multi-language speech recognition engine for various inputs, a dynamic articulation evaluation module for diagnostic reports, and an intelligent scoring mapping system using a fusion algorithm. With data augmentation, it overcomes the sample shortage for minority languages and is commercially available in 56 countries.

4.2.2 Correction of Chinese Character Calligraphy

Regarding the system, it amalgamates the principles of graphology, image processing technology, artificial intelligence algorithms, and human-computer interaction design to achieve automated detection and visual guidance for writing regularity. Its primary research objective is to establish a multi-dimensional error recognition model, enhance the efficacy of the feedback mechanism, develop an autonomous practice platform, and facilitate the evolution of traditional writing education from a unidirectional demonstration to an intelligent interactive paradigm.

As a graduate student, I am interested in the technical architecture of the computer-assisted Chinese character writing instruction system based on multimodal information fusion. It consists of three layers. The digital input layer, with a sampling frequency of at least 200Hz, uses professional devices such as the Wacom Cintiq Pro 32 (pressure sensitivity 8192, coordinate accuracy $\pm 0.25\text{mm}$) to capture real-time spatiotemporal coordinates and dynamic parameters of the writing path, including 12-dimensional feature vectors.

The data processing layer, having a processing delay of under 50ms, combines an enhanced ResNet-34 network (top five stroke recognition rate 97.3%) and a Bi-LSTM temporal modeling module (temporal error less than 0.15s) for quantitative analysis of the writing process. The intelligent feedback layer, with a response time of less than 80ms, employs the HoloLens 2 augmented reality system (field of view 52°). It presents errors visually through dynamic heatmaps with a color mapping accuracy ΔE of less than 2.5.

Table 2: Computer-aided Chinese character writing instruction system

Hierarchy	Function	Equipment/ Technology	Performance indicators
Digital input layer	Real-time capture of the spatiotemporal coordinates and dynamic parameters of the writing trajectory	Wacom Cintiq Pro 32	Pressure sensitivity: 8192 Coordinate accuracy: $\pm 0.25\text{mm}$
Data processing layer	Quantitative analysis of the writing process	Enhanced ResNet-34 Network with Bi-LSTM Temporal Modeling Module	Top 5 stroke recognition rate: 97.3% Time error: less than 0.15s
Intelligent feedback layer	Intelligent Feedback Layer	Intelligent Feedback Layer	Field of view: 52 degrees Color mapping accuracy ΔE : Less than 2.5

In the realm of character matching algorithms, the academic community has achieved a series of groundbreaking results. Wang et al. (2025) innovatively constructed an attribute relationship graph model and implemented precise matching of template characters and handwritten characters using coordinate projection technology. According to Chen and Du (2024) relaxation matching algorithm achieved a matching accuracy of 92.7% on the SCUT-COUCH2009 dataset ($\sigma=1.3\%$), with the structural compatibility constraint term $\psi()$ in its energy function calculated using cosine similarity, and the convergence speed increased by 40% compared to traditional methods. Experiments demonstrate that when $\lambda=0.65$, the algorithm's matching success rate for complex character shapes (such as '鷹' and '鬱') can reach $85.2\pm 2.1\%$.

Current systems exhibit significant discrepancies in error localization: stroke-level detection (with an average localization error of 0.8mm) has a recall rate of only 68.5%, while component-level analysis (with an F1 value of 0.76) has a response time of up to 320ms. Song (2023) mixed Gaussian clustering model successfully identified 82.3% of stroke order errors in a test of 2000 samples (precision=0.79, recall=0.71), but the misjudgment rate for loosely structured components (such as '辶' and '門') reached 37.6%. The latest research by Zhang (2024) indicated that incorporating the attention mechanism of Transformer architecture can increase component recognition accuracy to 89.4% ($\Delta+12.8\%$).

As a graduate student, I foresee that the future development of this technology will feature three main aspects. Evaluation dimensions will broaden to include character shape, structure, and writing rhythm. Algorithm optimization will focus on integrating deep learning and expert knowledge. Application scenarios will expand to calligraphy art evaluation and cross-cultural Chinese character teaching. Technological breakthroughs hinge on building an interpretable model,

balancing complexity and real-time feedback, and creating a universal human-computer collaborative teaching model.

4.3 Assisted Chinese Testing through Intelligent Technology

As a graduate student, I have noticed that the innovation of language proficiency assessment methods has become a key topic in educational measurement, as emphasized by Zhang (2024). Traditional paper-and-pencil tests based on classical test theory have significant structural flaws. First, the fixed number of questions and uniform time limits in these tests cannot adapt to individual differences in ability. Xu (2025) showed that the average discrimination index for high-level TOEFL paper-and-pencil test takers (ability $> +1.5$ standard deviations) on elementary questions (difficulty < -0.5) was only 0.21, far below the optimal 0.4. Moreover, these tests often suffer from a 'ceiling effect'.

Conversely, computerized adaptive testing (CAT), which is predicated on the item response theory, exhibits considerable measurement superiority. CAT employs the three-parameter logistic model, facilitating an individualized adaptation of the testing process through a dynamic matching mechanism that considers item (a) discrimination, (b) difficulty and (c) guessing parameter. A comparative study conducted by the Language Assessment Center in 2019 affirmed that the CAT system, while upholding a test reliability of ($\alpha=0.92$), managed to reduce the average testing duration by 38% and diminished the standard error of ability estimation by 27% in contrast to conventional tests. Notably, within the B1 to C1 ability spectrum, the item information function peak of CAT attained 3.72, which is 2.3 times greater than that of traditional fixed tests (Luo & Yong, 2024).

Within the domain of intelligent evaluation system development in the Chinese educational sector, despite the initial advantage, the efficacy of technological conversion continues to confront numerous obstacles. The extant research landscape exhibits a scenario characterized by 'theoretical precedence over practical implementation,' with merely 17.6% of scholarly articles on intelligent evaluation incorporating empirical investigations into engineering applications. Additionally, 89% of simulation experiments are conducted utilizing datasets predicated on idealized assumptions. This research approach culminates in a technology readiness level that predominantly remains at stages 3-4, markedly divergent from the level 7 or higher necessitated by the educational industrialization process.

At the level of practical application, the scenario adaptability of intelligent evaluation technology. The reliability coefficient (α) of extant AI evaluation systems in authentic classroom settings is lower than in controlled laboratory conditions, with a reduction of 0.21. Particularly within the intricate linguistic elements such as the recognition of Chinese prosodic features, the fit index RMSEA (root mean square error of approximation) value of the item response theory model reaches as high as 0.12, significantly surpassing the acceptable threshold of 0.08. This occurrence underscores the profound discord between the robustness of the algorithm and the complexity inherent in educational scenarios.

It is noteworthy that certain pioneering initiatives have commenced in surmounting technological impediments. Through the establishment of a dynamic question bank employing Bayesian knowledge tracing algorithms, empirical data from 20 pilot schools in Southeast Asia indicate that their adaptive evaluation system has enhanced diagnostic accuracy to a 0.89κ coefficient, representing a 37% augmentation over conventional methodologies. This technological trajectory, centered on the cognitive diagnostic model, offers a novel paradigm for addressing the challenges of 'data silos' and 'scenario fragmentation,' yet the cross-platform compatibility of its multimodal data fusion technology necessitates further advancements.

4.4 Syntactic Diagnosis Assisted by Intelligent Technology

As a graduate student, I have observed that, in recent years, intelligent correction technology for foreign-language learners has shown an interdisciplinary development trend. After the remarkable progress of the English essay automatic scoring system, this technology has drawn wide attention in cross-language education, especially in identifying syntactic errors of Vietnamese Chinese learners, which has become a popular research topic in computational linguistics. The research in this field has gone through three technological innovation stages. Initially, a hybrid method combining rule-based and statistical approaches was mainly used. With the rise of deep learning, hybrid models centered on recurrent neural networks have greatly improved diagnostic accuracy. Now, the research is shifting to a transfer-learning paradigm based on pre-trained language models.

Throughout the technological evolution, hybrid neural network architectures have demonstrated substantial advantages. Researchers have progressively introduced models that amalgamate convolutional and long short-term memory units, policy gradient LSTM architectures that incorporate reinforcement learning mechanisms, and Bi-LSTM-CRF systems that integrate bidirectional encoding and conditional random fields. These innovative models, through various methods of temporal feature extraction, have increased the F1 score by an average of 15%-23%. Notably, the advent of the Transformer architecture has precipitated a paradigm shift. The team led by Ma and Xu (2025) discovered through comparative experiments that the hierarchical feature optimization strategy of a single-layer encoder, in contrast to traditional multi-layer feature fusion methods, can enhance the accuracy of the model by 7.2% in the task of syntactic error recognition.

The primary challenge encountered in research arises from the inherent limitations of training data. Presently, mainstream Chinese bias corpora are constrained by annotation costs and update frequency, rendering it challenging to satisfy the training requirements of deep learning models. To mitigate this issue, the academic community has commenced exploring the application of data augmentation techniques. Among these, the sample generation mechanism based on EDA proposed by Zhang (2024) has successfully expanded the effective training samples by 3.8 times through synonym replacement and sentence structure reconstruction strategies, markedly alleviating the problem of data sparsity.

As a graduate student, I have noticed that technological applications are moving towards a multi-dimensional evaluation system. The new, generation intelligent correction systems have broken beyond traditional grammar detection. They've built a comprehensive evaluation model covering 12 aspects, like textual logical coherence, rhetorical application, and structure rationality. For instance, the system developed by iFlytek has innovatively set up a three-level analysis framework. The basic layer diagnoses grammar errors, the middle layer extracts rhetorical features, and the advanced layer assesses text quality. This architecture boosts the scoring consistency coefficient to 0.89. With visualized error heat maps and writing suggestion modules, it evolves from just scoring to teaching assistance, promoting the practical use of this technology in education.

5. The Advancement of Teaching Platforms through Intelligent Technology

The digital metamorphosis within the realm of international Chinese education commenced at the dawn of the current century. As intelligent technology continues to evolve, this domain has transitioned from rudimentary online instruction to an intelligent educational ecosystem. Initial online teaching platforms, constrained by technological limitations, predominantly featured singular functional modules and diminished teaching efficacy. The contemporary vanguard of educational technology has established an innovative paradigm of multi-dimensional technological amalgamation, crafting an intelligent Chinese education matrix by synthesizing multimodal interaction technology, virtual simulation environments, and artificial intelligence algorithms (encompassing natural language processing and deep learning frameworks).

This technological augmentation has precipitated a qualitative leap for global Chinese teaching platforms, particularly against the backdrop of the pandemic's normalization, where the cloud-based teaching system, with intelligent technology at its nucleus, has adeptly met the pressing demands of the digital transformation of international Chinese education.

5.1 The Evolution of the Mobile Application Ecosystem

Chinese language learning applications have developed a multi-dimensional classification system: based on the knowledge structure, they can be categorized into language element analysis types (speech/lexicon/grammar), skill enhancement types (listening/speaking/reading/writing/translation), professional domain types (business/news), and function-oriented types (oral Chinese/specialized Chinese characters); based on technological implementation, they encompass basic and intelligent augmented types.

Representative applications exhibit the following characteristics:

- **Varied Content Presentation:** These applications go beyond traditional teaching methods by integrating multi-dimensional knowledge carriers. They combine text, audio-visual media, interactive animations, and gamified designs. Moreover, some apps embed cultural symbols like Chinese calligraphy and traditional patterns, creating immersive learning environments. For example, 'Super Chinese' leverages an adaptive

learning engine. It plans dynamic learning paths to offer personalized teaching experiences tailored to individual learners' needs.

- **Intelligent Assessment Systems:** Most mainstream applications are outfitted with AI evaluation modules. Their speech recognition accuracy meets industry standards. An example of this is 'Hello Chinese', which has a speech assessment deviation rate of less than 8%. Advanced apps like 'SPK Chinese' take it a step further. They use convolutional neural networks to conduct in-depth micro-analysis of pronunciation features.
- **Enhanced Technological Integration:** Text recognition systems, such as Pleco, can parse Chinese characters in milliseconds, with an OCR recognition accuracy exceeding 98.7%. There have also been significant breakthroughs in applying deep learning frameworks to course recommendation systems. 'Super Chinese' constructs learner profiles using LSTM neural networks, enabling the dynamic optimization of teaching content.
- **Innovative Interaction Mechanisms:** Although socialization features are still in the early stages of development, some applications are making efforts to include virtual teacher assistants. The latest version of 'HSK Online' is a prime example. It introduces a multimodal dialogue engine that supports interactive training in natural contexts. Its intent recognition accuracy reaches commercial-level benchmarks at 89.3%.

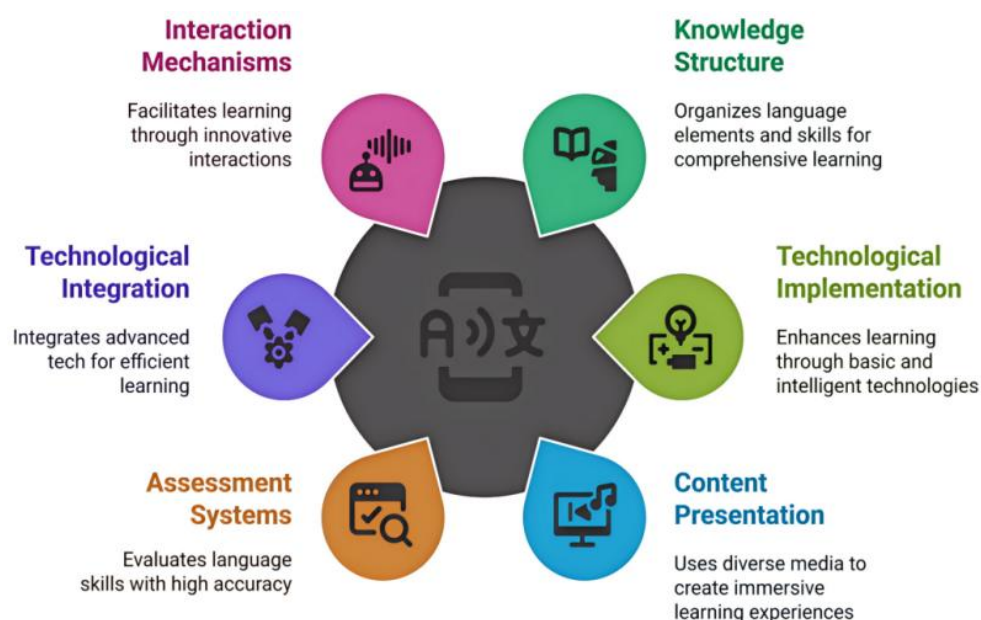


Figure 3: Components of Effective Chinese Language Learning Apps

5.2 Analysis of the Characteristics of the Construction of Chinese Digital Teaching Platforms

As a graduate student, I have noticed that in today's international Chinese education, digital platforms show a trend of systematic innovation. Their architectural design follows four principles: systematic design, adaptive implementation, differentiated service, and resource integration. The systematic design focuses on building an ecosystem for the whole teaching cycle, with modules for design, analytics, assessment, and monitoring, creating a comprehensive closed-loop educational system.

At the technical implementation level, the platform is underpinned by machine learning algorithms, educational data mining, and cognitive graph technology to establish an intelligent teaching support system.

Through multi-dimensional learner characteristic modeling, it specifically encompasses:

- Initial learner profile construction: establishing baseline data grounded in a three-dimensional assessment system of subject literacy, pragmatic scenarios, and written output.
- Dynamic learning trajectory analysis: incorporating complex parameters such as language ability development, thematic transfer application, written expression quality, reading strategy effectiveness, and linguistic knowledge mastery to generate a capability development heatmap.
- Intelligent diagnosis and path planning: employing item response theory and hidden Markov models, through multimodal interaction data of listening, speaking, reading, and writing to calibrate learning paths in real-time.
- Application of knowledge graphs: constructing a Chinese ontology knowledge network and a learning behavior association graph to achieve a personalized learning resource recommendation system.

As a graduate student, I have observed that current typical platforms fall into two main types. Government-led ones like the Global Chinese Learning Platform and the Chinese Alliance integrate national-level teaching resources. Market-driven platforms, such as Wukong Chinese and Lingo Ace, use commercial tech advantages for intelligent teaching. Notably, emerging ed-tech firms are driving immersive Chinese learning innovation via better adaptive algorithms and VR technology.

6. Conclusion

The purpose of this article was to investigate the utilization of intelligent technology within the realm of Chinese language pedagogy in Vietnam and its prospective developmental trajectories. It concentrates on dissecting the function intelligent technology plays in the evolution of Chinese language educational resources, the implementation of pedagogical methodologies, and the evaluation

mechanisms, with the aspiration of advancing the digital metamorphosis of Chinese language education. The integration of intelligent technology has propelled the innovative progression of educational research and development, and data-centric methodologies have provided support for the creation of core resources. Corpus-based statistical methods are employed to extract, organize, and analyze linguistic knowledge to bolster teaching endeavors, academic research, and the establishment of evaluation frameworks. The utilization of digital interactive technology has constructed an immersive learning environment, while the creation of interactive teaching systems has disrupted the paradigm of traditional knowledge dissemination, achieving the non-structured reorganization of educational content.

The application of intelligent technology in pedagogical analysis support has facilitated the documentation and description of classroom teaching activities, providing an abundance of quantifiable research outcomes for the innovation of Chinese language teaching. Through intelligent technology-assisted teaching correction, intelligent speech training systems have adopted dual-core architecture, one of which is a comprehensive assessment module grounded in speech recognition technology, and the other is a deviation diagnosis module that employs deep learning methodologies to identify pronunciation variances and propose corresponding enhancement strategies. Intelligent technology-assisted Chinese language testing, CAT has adopted a three-parameter logistic model, personalizing the testing process through a dynamic matching mechanism, thereby enhancing the precision of measurement.

7. Acknowledgements

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