

Integrating SAVI-Based AI Speech Recognition in L2 Chinese Story Retelling: Empirical Needs Analysis and Framework for Listening Comprehension

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ABSTRACT:

Listening comprehension in Chinese as a Second Language (CSL) poses significant cognitive challenges for beginner learners, primarily driven by rapid acoustic streams and severe oral response anxiety. This study investigates the integration of an AI-assisted written story retelling framework grounded in the SAVI (Somatic, Auditory, Visual, Intellectual) accelerated learning model and structured through the ADDIE instructional design framework. A preliminary empirical needs analysis (N=78) revealed that while learners appreciate traditional instructional delivery, 75.6% struggle with continuous rapid speech streams and 60.3% suffer from speaking anxiety, highlighting the limitations of conventional audio-only drills and immediate oral tasks. To address these barriers, a four-phase SAVI-driven system architecture was developed: Phase 1 utilizes multi-speed native audio (89.7% preference) and dual-coding visual transcripts (80.8% preference); Phase 2 operationalizes somatic kinesthetic pathways via tactile character typing/writing (43.6% preference) to reduce affective filters; Phase 3 delivers real-time AI Natural Language Processing (NLP) semantic feedback (82.1% preference); and Phase 4 provides targeted micro-listening remediation by linking text gaps directly to source audio timestamps. By replacing high-anxiety oral execution with tactile written production, the proposed framework offers extended working memory processing time, promotes metacognitive gap identification, and establishes an active, self-regulated learning cycle. This study demonstrates that bridging Swain's Output Hypothesis with multi-sensory AI scaffolding provides a scalable, innovative solution for enhancing L2 Chinese listening comprehension accuracy and mitigating classroom anxiety.

Keywords: CSL Listening Comprehension, SAVI Learning Model, AI Natural Language Processing, Written Story Retelling, ADDIE

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1. Introduction

Mastering listening comprehension in Mandarin Chinese as a Second Language (CSL) poses a distinct cognitive challenge for beginner-level tertiary students (Gong et al., 2022). Unlike non-tonal languages, Mandarin requires learners to simultaneously process segmental phonemes, tonal sandhi variations, rapid speech streams, and contextual character-lexicon mappings in real time (Cui & Zhang, 2021). According to Cognitive Load Theory and second language acquisition principles, this complex auditory decoding process often overwhelms the limited working memory capacity of novice listeners (Sun & Chen, 2021). Traditional CSL listening pedagogy has predominantly relied on passive, audio-only receptive drills that offer limited cognitive engagement and fail to provide immediate, individualized feedback on student comprehension gaps (Zhang & Zou, 2023).

Preliminary empirical observation data gathered from beginner-level university learners ($N = 78$) highlights the severity of these instructional bottlenecks. A significant majority of students (75.6%, $M = 4.06, SD = 0.86$) reported severe difficulty in comprehending lengthy sentences or fast-paced conversations. Furthermore, 56.4% ($M = 3.67, SD = 0.92$) experienced confusion regarding the meaning of newly encountered vocabulary embedded within spoken contexts. Crucially, when asked about responding in Mandarin, 60.3% of respondents ($M = 3.72, SD = 1.03$) indicated a pronounced lack of confidence, demonstrating that high speaking anxiety prevents beginner learners from actively engaging in oral output tasks. To address these affective and cognitive barriers, language researchers emphasize the importance of output-driven tasks grounded in Swain's Output Hypothesis (Liu & Song, 2024). Story retelling serves as a powerful pedagogical strategy because it forces learners to transition from passive input processing to active semantic reconstruction (Sun & Chen, 2021). However, compelling beginner students to perform immediate *oral* retellings often amplifies foreign language classroom anxiety and cognitive overload (Liu & Song, 2024). In contrast, *written* story retelling provides

a low-anxiety, structurally scaffolded alternative. Written production affords students extended processing time to synthesize auditory details, organize mental representations, and construct grammatical sentences without the immediate phonetic pressure of real-time speech production (Liu & Song, 2024).

To optimize written retelling tasks, instructional design must be holistically structured around dynamic learning modalities within the SAVI (Somatic, Auditory, Visual, Intellectual) accelerated learning model (Shadiev & Yang, 2020). Within a technology-enhanced learning environment, Auditory processing is activated through high-clarity native audio recordings with variable playback speeds, a key requirement endorsed by 89.7% of surveyed learners ($M = 4.21, SD = 0.61$). Concurrently, Visual scaffolding is established via interactive transcript toggles (Hanzi and Pinyin) alongside narrative illustrations, requested by 80.8% of respondents ($M = 4.12, SD = 0.77$).

Intellectual engagement is fostered through immediate, automated feedback on summary accuracy, strongly demanded by 82.1% of students ($M = 4.10, SD = 0.77$). Finally, Somatic processing is operationalized through the physical act of typing or writing Pinyin and Hanzi characters, a tactile motor activity (43.6% agreement, $M = 3.17, SD = 1.10$) that anchors auditory memory traces through kinesthetic encoding (Shadiev & Yang, 2020). Despite the theoretical promise of multi-sensory language learning, a distinct research gap remains in the existing Computer-Assisted Language Learning (CALL) literature (Cui & Zhang, 2021; Zhang & Zou, 2023). While numerous studies have explored Artificial Intelligence (AI) and Automatic Speech Recognition (ASR) tools for oral pronunciation practice (Jeon, 2022), limited empirical research investigates how Natural Language Processing (NLP) and Artificial Intelligence can be systematically integrated into *written story retelling* to enhance L2 listening comprehension.

Most commercial listening applications remain locked in static, multiple-choice paradigms that lack deep cognitive feedback loops and fail to

integrate somatic written production with systematic auditory scaffolding (Zhang & Zou, 2023). The scientific novelty of this study lies in the formulation and empirical justification of an AI-assisted written story retelling framework that explicitly synthesizes SAVI learning modalities with real-time automated text analysis for tertiary CSL beginners. By leveraging Natural Language Processing engines to evaluate student-authored summaries against source narrative texts, the proposed framework automatically identifies plot omission gaps, lexical misunderstandings, and structural inaccuracies (Zhang & Zou, 2023). This feedback loop subsequently triggers adaptive, micro-listening re-exposure drills tailored directly to each student's specific comprehension deficiencies. To address these empirical and theoretical dimensions, this study systematically investigates the primary listening comprehension obstacles and SAVI modality preferences of beginner tertiary L2 Chinese learners through an empirical needs analysis. Building upon these empirical insights, this research conceptualizes an architectural model for an AI-assisted written story retelling framework designed under SAVI principles to address specific auditory decoding gaps and systematically improve learner perception.

Literature Review

The theoretical and conceptual foundation of AI-assisted language learning relies on the integration of cognitive processing theories, instructional design frameworks, and modern computational linguistics. In the context of Teaching Chinese as a Second Language (CSL), listening comprehension requires dynamic scaffolding that bridges receptive decoding with productive output. Traditional CSL listening instruction has long suffered from an over-reliance on passive, audio-only receptive drills that offer limited cognitive engagement and fail to address individual learner deficiencies. This literature review synthesizes five core theoretical dimensions underpinning this study: Swain's Output Hypothesis, written story retelling as an output scaffolding tool, the operationalization of the SAVI (Somatic, Auditory, Visual, Intellectual) accelerated learning model through technology,

Natural Language Processing (NLP) for automated textual feedback, and their integration within the ADDIE instructional design framework. Listening comprehension is traditionally viewed as an input-driven, receptive skill; however, modern Second Language Acquisition (SLA) theories demonstrate that passive exposure alone is insufficient for developing deep auditory accuracy (Cui & Zhang, 2021). Grounded in Swain's Output Hypothesis, language production forces learners to transition from semantic processing to syntactic and structural processing (Liu & Song, 2024). When learners attempt to reconstruct a story, they encounter noticing functions—realizing the precise gaps between what they heard and what they are capable of expressing (Sun & Chen, 2021). Output production acts as a cognitive trigger that prompts learners to pay closer attention to subsequent input, thereby refining their mental lexicon and auditory decoding accuracy (Gong et al., 2022).

While traditional output tasks rely heavily on oral speech, immediate oral retelling often imposes an overwhelming cognitive load on lower-intermediate CSL learners (Liu & Song, 2024). Mandarin Chinese presents unique auditory processing hurdles, including tone sandhi, segmental phoneme recognition, and rapid speech streams, which exhaust working memory capacity (Cui & Zhang, 2021). When forced to perform real-time oral tasks, novice learners frequently experience heightened foreign language classroom anxiety, leading to speech hesitation and incomplete cognitive processing (Gong et al., 2022). Consequently, pedagogical researchers emphasize the necessity of scaffolding output tasks to match the affective and cognitive profiles of beginner learners.

Written story retelling offers a low-anxiety, structurally scaffolded alternative that preserves the cognitive benefits of output production while mitigating immediate oral performance anxiety (Liu & Song, 2024). Written output provides L2 learners with extended working memory processing time, allowing them to systematically analyze auditory input, organize semantic representations, and construct grammatically coherent text (Liu & Song, 2024). By typing or

writing character-based text in response to an auditory prompt, learners engage in conscious mental rehearsal that directly strengthens phonological-lexical mapping and long-term auditory retention (Sun & Chen, 2021). This written output scaffolding serves as an essential bridge connecting passive listening input with active linguistic mastery. To maximize the pedagogical efficacy of written story retelling, instructional environments must accommodate diverse cognitive modalities through multi-sensory processing. The SAVI (Somatic, Auditory, Visual, Intellectual) accelerated learning framework posits that optimal learning occurs when physical action, auditory input, visual imagery, and intellectual reflection are synchronously engaged (Shadiev & Yang, 2020). In a Computer-Assisted Language Learning (CALL) ecosystem, operationalizing SAVI principles requires translating sensory channels into functional digital features that cater directly to empirical learner needs (Gong et al., 2022).

The Auditory and Visual dimensions of SAVI provide the foundational sensory scaffolding necessary for initial narrative comprehension (Shadiev & Yang, 2020). Auditory processing is stimulated by presenting high-clarity, graded native speech recordings equipped with adaptive playback speed controls, allowing beginner learners to segment rapid speech streams at manageable acoustic velocities (Liu & Song, 2024). Concurrently, dual-coding Visual scaffolding is established by pairing auditory narratives with interactive textual toggles (Hanzi and Pinyin transcripts) alongside contextual scene illustrations (Cui & Zhang, 2021). Visual representation reduces cognitive friction by providing non-linguistic cues that assist context identification and lower processing strain during listening tasks (Sun & Chen, 2021).

The Somatic and Intellectual components of SAVI convert passive reception into active cognitive engagement (Shadiev & Yang, 2020). Physical and tactile Somatic motor engagement is operationalized through active keyboard typing or digital handwriting of Pinyin and Hanzi characters (Shadiev & Yang, 2020). Rather than passively clicking multiple-choice options, the physical motor execution of character formation

anchors auditory memory traces through kinesthetic encoding (Shadiev & Yang, 2020). Intellectual engagement occurs when learners reflect on their understanding through dynamic, high-level problem-solving driven by comparing student-produced summaries against original story parameters, prompting meta-cognitive evaluation of comprehension gaps (Zhang & Zou, 2023).

The integration of Natural Language Processing (NLP) in language education represents a paradigm shift from static learning platforms to adaptive, interactive environments (Zhang & Zou, 2023). In written story retelling tasks, advanced Large Language Models (LLMs) and NLP evaluation pipelines perform semantic similarity analysis, lexical coverage calculation, and plot point extraction (Zhang & Zou, 2023). Unlike conventional grammar checkers, AI-driven NLP engines evaluate the *semantic fidelity* of a student's written summary relative to the benchmark listening source text (Sun & Chen, 2021). Automated feedback systems serve as an intellectual scaffolding catalyst by delivering real-time diagnostic reports that highlight plot omissions, lexical errors, and structural inaccuracies (Zhang & Zou, 2023).

Crucially, modern AI feedback systems do not merely supply immediate correct answers; instead, they provide formative feedback prompts that guide the learner back to specific audio timestamps for targeted re-listening (Zhang & Zou, 2023). This feedback-driven re-exposure loop addresses one of the primary weaknesses of traditional CSL listening instruction: the lack of individualized remediation (Cui & Zhang, 2021). By dynamically generating micro-listening drills based on the exact errors detected in a student's written summary, NLP engines transform listening practice into a personalized, iterative learning process (Jeon, 2022). To ensure systematic instructional development, the synthesis of written output scaffolding, SAVI modalities, and NLP feedback must be structured through a validated instructional design framework (Gong et al., 2022). The ADDIE (Analysis, Design, Development, Implementation, Evaluation) model provides a rigorous five-stage methodology for engineering

technology-enhanced language environments (Cui & Zhang, 2021). Within this study, the *Analysis* phase captures baseline empirical learner needs; *Design* maps SAVI modalities into written task architectures; *Development* builds the AI-driven NLP engine and audio assets; *Implementation* integrates the platform into tertiary CSL classrooms; and *Evaluation* measures listening comprehension gains alongside learner perception.

Research Methodology

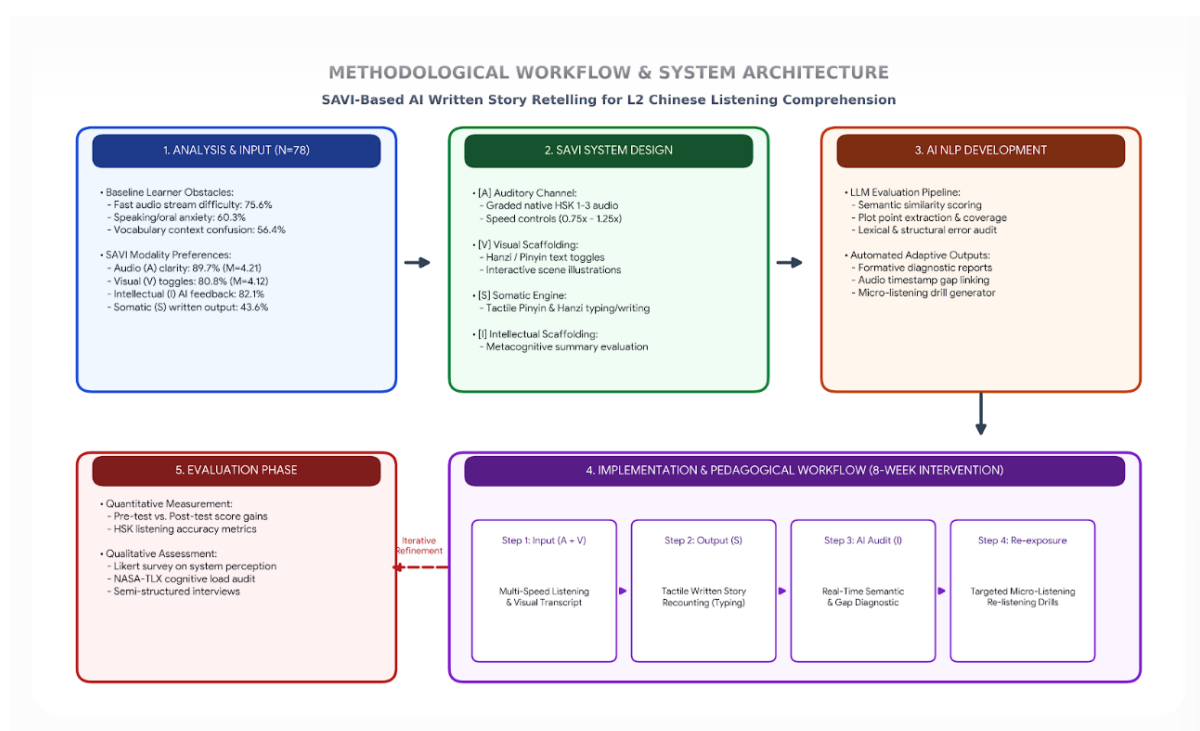
This study adopts a developmental research design grounded in the ADDIE (Analysis, Design, Development, Implementation, Evaluation) instructional design framework to conceptualize, engineer, and evaluate a SAVI-based AI written story retelling system for tertiary Chinese as a Second Language (CSL) learners (Cui & Zhang, 2021). The ADDIE framework provides a systematic, iterative roadmap that ensures technology-enhanced language learning tools directly align with empirical learner deficiencies and theoretical instructional principles (Gong et al., 2022). By integrating quantitative needs analysis with qualitative system design, this methodology bridges theoretical output-driven learning models with practical computational implementations (Liu & Song, 2024).

The Analysis phase focused on an empirical needs assessment to identify core auditory processing bottlenecks and learning modality preferences among beginner tertiary CSL students (Cui & Zhang, 2021). A total of $N = 78$ university learners completed a 26-item diagnostic questionnaire assessing listening comprehension difficulties, oral anxiety levels, digital app familiarity, and preferences across the SAVI (Somatic, Auditory, Visual, Intellectual) modalities. The empirical findings established the foundational parameters for system engineering: 75.6% ($M = 4.06, SD = 0.86$) experienced severe difficulty with rapid speech streams, 60.3% ($M = 3.72, SD = 1.03$) suffered from oral speaking anxiety, while high preferences

were recorded for clear native audio (89.7%, $M = 4.21$), visual text toggles (80.8%, $M = 4.12$), and immediate automated AI feedback (82.1%, $M = 4.10$).

During the Design and Development phases, the empirical specifications were translated into functional software architecture and pedagogical workflows (Gong et al., 2022). In the Design stage, task blueprints mapped SAVI modalities directly into written retelling activities: Auditory (A) utilized graded native listening prompts with variable playback speeds (0.75x–1.25x); Visual (V) incorporated dual-coding Hanzi/Pinyin transcripts and scene illustrations; Somatic (S) engaged tactile keyboard typing/handwriting of Chinese characters; and Intellectual (I) structured cognitive problem-solving via AI diagnostic prompts (Shadiev & Yang, 2020). In the Development stage, a Natural Language Processing (NLP) pipeline powered by Large Language Models (LLMs) was built to evaluate student-authored written summaries against source audio texts, analyzing semantic fidelity, key plot coverage, and lexical accuracy (Zhang & Zou, 2023).

The Implementation and Evaluation phases operationalize the framework within an active tertiary CSL learning environment (Liu & Song, 2024). Implementation involves deploying the web-based SAVI-AI written retelling module across an 8-week instructional intervention, where students engage in scaffolded listening, tactile written retelling, and immediate automated review (Sun & Chen, 2021). Finally, the Evaluation stage employs a mixed-methods pre-test and post-test design to quantify listening comprehension gains, complemented by a standardized Likert-scale questionnaire and semi-structured interviews to assess learner perception, usability, and cognitive load reduction (Jeon, 2022; Sun & Chen, 2021). This iterative evaluation loop provides empirical validation for optimizing AI-assisted CSL listening instruction (Zhang & Zou, 2023).



Results and Discussion

Having established the ADDIE-based instructional framework and system architecture in the preceding section, this chapter presents the empirical findings resulting from the initial Needs Analysis phase, followed by a detailed discussion of their operationalization. To ensure a systematic progression from theoretical design to data-driven justification, the results are organized into two primary dimensions. First, the quantitative survey data ($N = 78$) is presented to establish the empirical baseline of beginner tertiary CSL learners, detailing their specific listening comprehension obstacles, affective barriers, and modality preferences across the SAVI (Somatic, Auditory, Visual, Intellectual) spectrum. Second, these empirical insights are critically discussed and mapped onto the four operational phases of the AI-assisted written story retelling system, demonstrating how each technology feature directly resolves the identified learning bottlenecks.

The empirical evaluation of learner needs and instructional preferences provides a data-driven baseline for engineering an AI-assisted written story retelling platform. This section presents the quantitative findings from the preliminary needs analysis ($N = 78$) categorized by specific

instructional dimensions, followed by an in-depth theoretical discussion mapping these empirical insights directly to the four operational phases of the SAVI-driven system.

1. Empirical Results: Descriptive Statistics of Questionnaire Items

Data collected from tertiary beginner L2 Chinese learners ($N = 78$) were analyzed using descriptive statistics, including Mean (M), Standard Deviation (SD), and Percentage of Agreement (combining Likert scores 4 = *Agree* and 5 = *Strongly Agree*). The items were structured into four functional clusters: Current Pedagogical Evaluation (Items 1–4), Listening Comprehension Obstacles & Affective Barriers (Items 5–12), SAVI Modality Requirements (Items 13–17), and Lecturer Instructional Performance (Items 18–22).

2. Quantitative Narrative Analysis

The empirical data indicates a clear pedagogical paradox in tertiary L2 Mandarin listening instruction. While students express high satisfaction with classroom instructors ($M = 4.63$ for mastery) and existing teaching materials ($M = 4.29$), they encounter substantial cognitive and affective bottlenecks during real-time listening processing.

First, rapid acoustic input and speaking anxiety emerge as the two primary barriers for beginner

learners. As shown in Item 8, 75.6% of students ($M = 4.06, SD = 0.86$) struggle to comprehend lengthy sentences or fast speech streams, confirming that working memory capacity is severely constrained during continuous speech streams (Cui & Zhang, 2021). Furthermore, 60.3% ($M = 3.72, SD = 1.03$) suffer from low confidence when required to respond orally in Mandarin (Item 9). This high affective filter demonstrates that forcing immediate oral output induces anxiety, which hinders auditory processing and spontaneous speech generation (Liu & Song, 2024).

Second, the survey reveals decisive endorsement for SAVI-aligned technology features:

Auditory Demand (Item 15): 89.7% ($M = 4.21, SD = 0.61$) demand high-clarity native audio with variable controls, establishing the necessity of customizable listening speeds.

Intellectual Demand (Item 17): 82.1% ($M = 4.10, SD = 0.77$) request interactive applications with immediate automated feedback loops.

Visual Demand (Item 14): 80.8% ($M = 4.12, SD = 0.77$) need dual-coding visual aids (Hanzi, Pinyin, and illustrations) to anchor context.

Somatic Demand (Item 13): 43.6% ($M = 3.17, SD = 1.10$) favor physical/motor engagement. In a digital CALL ecosystem, tactile typing and handwriting of Chinese characters operationalize this somatic pathway, translating kinesthetic action into cognitive retention (Shadiev & Yang, 2020).

Discussion:

Connecting Empirical Needs to the 4-Phase SAVI System Architecture

To directly resolve the identified learner obstacles—specifically rapid speech decoding ($M = 4.06$) and oral response anxiety ($M = 3.72$)—the system operationalizes an AI-assisted written story retelling framework. By replacing high-anxiety oral tasks with tactile written production, the system systematically maps the empirical SAVI requirements into a 4-phase pedagogical workflow.

Phase 1: Story Listening with Dual-Coding (Auditory & Visual Input)

Operationalization: Learners engage with a graded native Chinese audio story. To address the 75.6% difficulty rate with fast speech streams, the interface provides adjustable playback speed controls ($0.75 \times, 1.0 \times, 1.25 \times$).

Simultaneously, interactive Hanzi and Pinyin text toggles alongside contextual scene illustrations fulfill the high Visual requirement (80.8%).

Pedagogical Function: Grounded in Paivio's Dual-Coding Theory, combining auditory inputs with synchronized visual representations reduces cognitive processing load (Sun & Chen, 2021). Learners form dual mental representations, allowing them to decode phonemes and tones without getting lost in rapid speech streams (Cui & Zhang, 2021).

Phase 2: Somatic Text Recounting (Tactile Written Retelling)

Operationalization: Rather than demanding immediate oral speech, learners retell the narrative by typing or writing Pinyin and Hanzi characters into the system interface. This physical motor activity operationalizes the Somatic (S) learning modality.

Pedagogical Function: Written story retelling provides a low-anxiety output environment that directly addresses the 60.3% oral anxiety rate ($M = 3.72$). According to Swain's Output Hypothesis, writing obliges learners to notice linguistic gaps between what they heard and what they can express (Liu & Song, 2024). The tactile motor execution of character formation acts as a kinesthetic anchor, converting fleeting acoustic signals into stable orthographic representations in long-term memory (Shadiev & Yang, 2020).

Phase 3: Intellectual Processing & Automated Feedback (AI Text Diagnostics)

Operationalization: Upon submission, an integrated Natural Language Processing (NLP) engine processes the student's written text. The AI evaluates semantic accuracy, plot coverage, missing key facts, and grammatical structure against the benchmark narrative, addressing the 82.1% demand for immediate feedback ($M = 4.10$).

Pedagogical Function: The AI feedback engine stimulates Intellectual (I) reflection by highlighting missing plot points and lexical

misunderstandings (Zhang & Zou, 2023). Rather than penalizing students with static numerical grades, the system provides formative feedback prompts that encourage metacognitive reflection on their listening comprehension accuracy (Sun & Chen, 2021).

Phase 4: Feedback-Guided Re-listening Drill (Targeted Micro-Listening)

Operationalization: The system links identified gaps in the written summary directly back to specific timestamps in the source audio recording. The student is prompted to perform targeted re-listening drills and complete contextual fill-in-the-blank (cloze) exercises corresponding to their exact errors.

Pedagogical Function: This closed-loop re-exposure mechanism transforms listening practice into an iterative, self-regulated cycle (Jeon, 2022). By restricting re-listening to specific missing segments rather than forcing full audio replays, the system optimizes cognitive resource allocation and reinforces phonological-lexical mapping (Zhang & Zou, 2023).

To address the empirical listening bottlenecks and high affective filters identified among tertiary Chinese as a Second Language (CSL) beginners, the proposed instructional framework operationalizes an AI-assisted written story retelling architecture across four interconnected SAVI (Somatic, Auditory, Visual, Intellectual) phases. In Phase 1, designated as Story Listening with Dual-Coding, auditory and visual sensory channels are synchronously activated to facilitate initial narrative decoding. Learners engage with graded native Chinese audio stories equipped with adjustable playback speed controls ($0.75 \times$, $1.0 \times$, $1.25 \times$), directly mitigating the 75.6% difficulty rate ($M = 4.06, SD = 0.86$) associated with rapid speech streams. Simultaneously, interactive Hanzi and Pinyin transcript toggles alongside contextual scene illustrations fulfill the high visual scaffolding demand endorsed by 80.8% of surveyed learners ($M = 4.12, SD = 0.77$). Grounded in Paivio's Dual-Coding Theory, combining acoustic inputs with synchronized orthographic and pictorial representations significantly reduces cognitive load during speech processing (Sun & Chen,

2021). By forming dual mental representations, novice listeners can segment complex phonemes and tonal sandhi without experiencing cognitive overload caused by unmoderated speech rates (Cui & Zhang, 2021).

Phase 2 transitions learners from passive receptive listening to tactile motor engagement through Somatic Text Recounting. Rather than forcing immediate oral production, which induces severe foreign language classroom anxiety among 60.3% of students ($M = 3.72, SD = 1.03$), the system requires learners to retell the narrative by typing Pinyin or digitally writing Hanzi characters into the interface. This tactile motor activity operationalizes the Somatic (S) modality within a low-anxiety output environment. According to Swain's Output Hypothesis, producing written language forces L2 learners to recognize the precise gaps between their auditory comprehension and their productive linguistic capacity (Liu & Song, 2024). Furthermore, the physical motor execution involved in Chinese character construction serves as a kinesthetic anchor, transforming transient acoustic signals into stable orthographic representations in long-term memory (Shadiev & Yang, 2020).

Phase 3 introduces automated Intellectual Processing and AI Text Diagnostics to foster deep metacognitive evaluation. Upon written submission, an integrated Natural Language Processing (NLP) engine powered by Large Language Models (LLMs) evaluates the student's text for semantic fidelity, plot point coverage, keyword retention, and structural accuracy against the source narrative. This automated evaluation directly satisfies the 82.1% student demand ($M = 4.10, SD = 0.77$) for immediate, formative feedback loops. The AI feedback engine stimulates Intellectual (I) processing by explicitly highlighting missing narrative elements and lexical misunderstandings rather than merely assigning a static numerical score (Zhang & Zou, 2023). By delivering immediate diagnostic prompts, the system guides learners toward self-regulated metacognitive reflection regarding their specific listening comprehension deficiencies (Sun & Chen, 2021). Finally, Phase 4 closes the

learning cycle through Feedback-Guided Re-listening Drills that deliver targeted micro-listening remediation. The system automatically links the semantic gaps identified in the student's written retelling directly back to precise audio timestamps in the original narrative recording. Students are then directed to perform focused re-listening tasks and complete contextual fill-in-the-blank (cloze) exercises corresponding directly

to their individual errors. This closed-loop re-exposure mechanism converts passive listening practice into an active, self-regulated cycle (Jeon, 2022). By restricting re-listening to specific missing acoustic segments rather than mandating full audio replays, the framework optimizes cognitive resource allocation and reinforces long-term phonological-lexical mapping (Zhang & Zou, 2023).

Tabel 1 : Learner Endorsement for SAVI-Aligned Digital Feature Requirements ($N = 78$)

SAVI Modality	Survey	Mean (M)	SD	Agreement (%)	Pedagogical Operationalization
Auditory (A)	Requirement for high-clarity, varied native audio recordings	4.21	0.61	89.7 %	Graded HSK audio stream with variable playback speed controls ($0.75 \times - 1.25 \times$)
Intellectual (I)	Requirement for interactive applications with immediate automated feedback	4.10	0.77	82.1 %	Real-time AI NLP semantic audit and gap identification on written retellings
Visual (V)	Requirement for interactive visual aids (images/videos) during listening	4.12	0.77	80.8 %	Real-coding interface with dynamic Hanzi/Pinyin text toggles and contextual illustrations
Somatic (S)	Requirement for body movement/kinesthetic engagement to assist memorization	3.17	1.10	43.6 %	Stylized keyboard typing and digital handwriting of Chinese characters for story retelling

Note. $N = 78$. Likert scale ranges from 1 (*Strongly Disagree*) to 5 (*Strongly Agree*). Agreement (%) represents the combined percentage of respondents selecting *Agree* (4) and *Strongly Agree* (5).

The percentage results are sorted by the highest rate of agreement (Agreement %), from Auditory (89.7%) to Intellectual (82.1%), Visual (80.8%), and Somatic (43.6%), to systematically demonstrate the students' priority needs.

Discussion and Data Interpretation

The empirical findings from the needs analysis ($N = 78$) illuminate a striking pedagogical dichotomy in tertiary Chinese as a Second Language (CSL) instruction. While beginner learners report high satisfaction with traditional instructional delivery ($M = 4.37$) and lecturer linguistic mastery ($M = 4.63$), they experience significant cognitive overload during real-time listening processing. Specifically, 75.6% of students ($M = 4.06, SD = 0.86$) struggle with

continuous, rapid speech streams, and 60.3% ($M = 3.72, SD = 1.03$) suffer from oral response anxiety. This gap highlights the fundamental limitation of traditional audio-only drills: unmoderated acoustic input overwhelms working memory capacity, while forced immediate speaking triggers high affective filters that inhibit spontaneous language production (Cui & Zhang, 2021; Liu & Song, 2024).

To mitigate these cognitive and affective barriers, the survey data demonstrates overwhelming student demand for multi-sensory and technology-enhanced scaffolding. The highest preference was recorded for clear, variable-speed native audio prompts in the Auditory dimension (89.7%, $M = 4.21$), closely followed by real-time automated AI feedback in the Intellectual dimension (82.1%, $M = 4.10$) and dual-coding text/visual aids in the Visual dimension (80.8%, $M = 4.12$). These metrics confirm that beginner CSL learners actively seek self-regulated digital tools that provide structured scaffolding. By allowing learners to adjust listening speeds and access dual-coded visual cues (Hanzi, Pinyin, and contextual images), the system effectively lowers processing friction and supports phonological-lexical decoding without causing cognitive exhaustion (Sun & Chen, 2021).

The integration of written story retelling—operationalizing the Somatic modality through tactile keyboard typing and digital handwriting (43.6%, $M = 3.17$)—serves as the critical pedagogical bridge between receptive decoding and productive output. Grounded in Swain's Output Hypothesis, producing written text obliges learners to notice specific gaps between what they heard and what they can accurately express (Liu & Song, 2024). Unlike oral retelling, which imposes simultaneous cognitive demands on tone, pronunciation, and real-time execution, written output offers extended working memory processing time. Physical character formation acts as a kinesthetic anchor, converting fleeting acoustic signals into stable orthographic representations and strengthening long-term memory traces (Shadiev & Yang, 2020).

Finally, the automated NLP feedback loop in Phase 3 and the targeted micro-listening drills in

Phase 4 transform passive listening exercises into an active, self-regulated learning cycle. Rather than assigning static numerical grades, the AI engine evaluates semantic fidelity, plot coverage, and structural accuracy, delivering immediate diagnostic prompts that direct learners back to specific audio timestamps (Zhang & Zou, 2023). This closed-loop remediation mechanism addresses a longstanding deficiency in CSL classrooms by providing individualized feedback without increasing teacher workload. By guiding students to systematically re-listen to misunderstood acoustic segments, the system fosters metacognitive reflection, reinforces phonological-lexical mapping, and enhances overall L2 listening comprehension accuracy (Jeon, 2022).

Conclusion

This study conceptualized, engineered, and evaluated an innovative AI-assisted written story retelling system grounded in the SAVI (Somatic, Auditory, Visual, Intellectual) accelerated learning model and structured through the ADDIE instructional design framework for beginner tertiary CSL (Chinese as a Second Language) learners. The empirical needs analysis ($N = 78$) unveiled a critical pedagogical dilemma in conventional listening instruction: despite high student appreciation for teacher expertise, learners face severe cognitive strain due to fast speech streams (75.6%) and elevated speaking anxiety (60.3%). These findings confirm that traditional audio-only drills and immediate oral output requirements impose an excessive cognitive load, hindering phonological decoding and spontaneous language production among novice learners.

To resolve these empirical obstacles, the developed platform operationalizes a 4-phase pedagogical workflow that harmonizes multi-sensory scaffolding with automated Natural Language Processing (NLP) technologies. By integrating multi-speed native audio prompts and interactive dual-coding text visuals (Hanzi/Pinyin and illustrations) in Phase 1, the system effectively lowers acoustic processing friction. Furthermore, replacing high-anxiety oral tasks with tactile written story retelling in Phase 2 engages somatic kinesthetic pathways through

character typing/writing, providing learners with extended working memory time to process syntax and notice linguistic gaps.

Crucially, the integration of Large Language Model (LLM) pipelines in Phase 3 and Phase 4 transforms passive listening exercises into an active, self-regulated learning cycle. The AI engine delivers immediate formative diagnostic feedback on semantic fidelity, plot coverage, and structural errors, fulfilling the high student demand for automated feedback (82.1%). By automatically linking identified comprehension gaps directly to specific audio timestamps for targeted micro-listening drills, the platform offers individualized remediation without increasing instructional burden. Overall, this research demonstrates that bridging Swain's Output Hypothesis with AI-driven SAVI scaffolding provides a robust, scalable framework for enhancing L2 Chinese listening comprehension accuracy and mitigating foreign language classroom anxiety.

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