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Exploring Chinese Learners' Chinese Learning Strategies in the Context of "Artificial Intelligence + Education". --Based on an embodied cognition theory perspective

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Abstract. The 2024 government work report clearly emphasizes the necessity of advancing research and development in big data, artificial intelligence, and related applications. It advocates for the implementation of the "Artificial Intelligence +" initiative, which establishes a clear direction for the development of "Artificial Intelligence + Education" and provides the necessary policy support. This paper focuses on the development of international Chinese language education in this context, analyzing in depth how AI technology can address the practical challenges faced in this field and exploring the potential for integrating artificial intelligence with international Chinese language education. Furthermore, it proposes specific strategies to enhance Chinese language learning among students, aiming to improve both the efficiency and effectiveness of the learning process. By offering new perspectives and ideas, this paper seeks to contribute to the advancement of Chinese language education.

Keywords: artificial intelligence; internaational Chinese language education; teaching Chinese as a foreign language; learning strategies; basic body cognition theory.

The Artificial Intelligence Index 2024 report released by Stanford University reveals that the number of new large-scale language models introduced globally in 2023 doubled compared to the previous year. This advancement in AI technology is significantly transforming the operational models of various industries, thanks to its powerful data processing, pattern recognition, and intelligent decision-making capabilities. As globalization accelerates and China's international status rises, an increasing number of foreigners are learning Chinese to facilitate economic and cultural exchanges with the country. This trend is driving the rapid development of teaching Chinese as a foreign language while simultaneously raising the standards for its implementation. However, traditional methods of teaching Chinese as a foreign language face numerous challenges, including a shortage of qualified teachers, limited curricula and content, and outdated teaching methods and resources. In the context of the rapid development of artificial intelligence (AI) technology, new solutions and possibilities are emerging for teaching Chinese as a foreign language. AI technologies such as machine learning, natural language processing, and intelligent recommender systems have already achieved remarkable results across various fields. These technologies can simulate human-like intelligence and facilitate automated processing and analysis, bringing revolutionary changes to the education sector.The application of AI in teaching Chinese as a foreign language can address the limitations of traditional methods, enhance teaching effectiveness and efficiency, and cater to the personalized needs of learners. In today's rapidly evolving technological landscape, AI is also poised to empower other technologies and foster innovative development. An article by futurist Bernard Marr, published on the Forbes website, predicts the top ten trends in the advancement of artificial intelligence, with one key insight being the growing prominence of AI entities. These AI systems, which leverage advancements in artificial intelligence, big data, machine learning, and other technologies, exhibit strong autonomy, interactivity, and adaptability. "RoBoHoN", a humanoid robot launched by Sharp in the first half of 2016, serves as a prime example of an AI entity. These highly intelligent humanoid robots have emerged as important platforms for large-scale model applications and represent a core focus in the development of terminal intelligence.

1. Status of the Implementation of International Chinese Language Education

1.1 Internationalization of Education

Currently, the demand for international Chinese language education is both strong and stable. The report from the 20th National Congress of the Communist Party of China emphasizes the importance of enhancing the global influence and dissemination of Chinese civilization. As the Belt and Road Initiative continues to advance, China has signed numerous cooperation agreements with countries and international organizations to facilitate its development. The deepening of the Belt and Road Initiative underscores the significance of international Chinese language education as a key channel for enhancing mutual understanding between China and other nations, while also overcoming language barriers. This role is crucial in supporting China's strategy to build a strong nation in the new era. With the rapid development of China's economy and its increasing international prominence, the global phenomenon of "Chinese language fever" is intensifying, and the popularity of the Chinese language is expanding worldwide. Furthermore, at the International Conference on Chinese Language Education held in December 2019, the term "International Chinese Language Education" was officially adopted. This marks a shift in the scope of Chinese language instruction, which is gradually extending beyond foreign students studying in China to include overseas Chinese and foreigners who wish to learn the language. As a result, the demographic of Chinese language learners is becoming increasingly diverse and multifaceted. With the continued growth in demand for educational resources, there are broadening opportunities for the advancement of international Chinese language education.

1.2 Digital Transformation in Education

The world is embracing the opportunities and challenges presented by the digital revolution, and digital transformation has become a prevailing trend across all sectors of society. The Action Plan for Education Informatization 2.0 emphasizes the need to develop high-quality digital educational resources and promote the deep integration of new technologies—such as cloud computing, artificial intelligence, and speech recognition technology—with education and teaching. In line with the national strategy to promote the Chinese language and fulfill the mission of building a community with a shared future for humanity, international Chinese language education urgently requires an innovative development model.

Currently, international Chinese language education faces new needs and challenges. As the field evolves and matures, numerous impactful teaching concepts and methods have emerged. However, there remains a significant gap between these theoretical innovations and actual teaching practices. Traditional classroom teaching is still dominated by a teacher-centered, textbook-driven, and classroom-bound approach, which often fosters an adversarial dynamic between teachers and students. This model leads to students disconnecting from their own learning processes, undermining their sense of agency and motivation. In Chinese language classrooms, students frequently encounter difficulties that are not addressed promptly, and the diverse needs related to students' native language backgrounds, learning abilities, and interests are often overlooked. As a result, the teaching content often lacks the specificity, differentiation, and relevance needed to engage students meaningfully. This situation underscores the urgent need for reform and innovation in teaching strategies. Moreover, the traditional teaching model no longer meets the demands of contemporary society. In the context of the new quality-driven productivity, the education sector is undergoing a transformation from conventional educational methods to modern, intelligent, and personalized teaching approaches. This shift is particularly evident in the growing popularity of the "Chinese + Vocational Skills" model, which has become a distinctive feature of international Chinese language education. This trend has led to the diversification of personalized and comprehensive teaching concepts, as well as the adoption of intelligent and digital teaching methods. The demand for reform and optimization of teaching strategies continues to increase, as personalized learning approaches evolve. Furthermore, in the post-pandemic era, "blended learning" (a combination of online and offline teaching) has

emerged as a key model for international Chinese language education. However, there is still a need for improvement in various areas, including teaching platforms, teacher-student interactions, learning environments, and assessment methods. To meet these demands, it is essential to establish and refine an intelligent teaching model for international Chinese language education, one that incorporates personalized learning profiles for students and integrates data-driven insights to enhance the learning experience.

2. The Logical Connection of Embodied Cognition Theory Applied to Teaching Chinese as a Foreign Language

For a long time, the dualistic notion of separating the mind and body dominated, leaving people unable to explain advanced cognitive activities and the underlying neural mechanisms. However, after the 1980s, influenced by cognitive linguistics, cultural anthropology, philosophy, robotics, artificial intelligence, and other disciplines, cognitive psychology underwent a significant transformation known as the central thesis of "embodied cognition" emerged. Since the inception of the embodied cognition theory, many prominent scholars, both domestically and internationally, such as Merleau-Ponty and Meng Wei, have extensively discussed their interpretations of the concept in detail. Although the elaborations of this theory by different scholars are not entirely consisent, they all acknowledge the crucial role of the body in the cognitive process and agree that the human mind results from the interaction between the brain, the body, and the environment.

2.1 Characterization of Embodied Cognition

Embodied Cognition Theory presents a new framework for understanding learning by emphasizing the deep interconnection between the human mind, body, and external environment. According to this theory, these elements are interdependent and inseparable, offering a more holistic and nuanced perspective on cognitive processes. In the context of education, embodied cognition holds significant potential as a guiding principle for both research and practice. Key concepts within this framework—such as embodiment, contextuality, generativity, subjective experience, the metaphorical mapping of emotional experiences, and a focus on the meaning of life—offer valuable insights into optimizing the teaching process. In particular, the integration of embodied cognition theory into international Chinese language education opens new pathways for enhancing pedagogical methods. This integration not only enriches and advances the development of teaching strategies but also facilitates curriculum reform, improves teaching practices, and elevates classroom instruction quality. Furthermore, it offers considerable potential for fostering innovation in Chinese language teaching culture, contributing to more engaging and effective learning experiences.

2.2 The Application of Embodied Cognition in Language Teaching and Learning

In his article "Principles of Linguistic Embodied Cognition and Its Theoretical Basis," Xu Xianwen explores the theoretical foundations of linguistic embodiment through the lenses of epistemology, psychology, and cognitive neuroscience. He examines the mind-brain mechanisms and cognitive neuroscience underpinnings of this theory, thereby reinforcing the scientific validity of Embodied Language Cognition (ELC). The theory of embodied language integrates cognitive science, linguistics, neuroscience, and brain science, acting as a bridge between philosophical cognitive theory, cognitive psychology, cognitive neuroscience, and applied linguistics. It posits that language production is inherently tied to bodily participation, asserting that external linguistic experiences are transformed into cognitive impressions through perceptual and neural processing. This theory emphasizes the critical roles of the body and environment in language acquisition, stating, "The body provides perceptual experiences for the occurrence and development of linguistic symbols, and it becomes the source of our knowledge of the world and a means of recognizing our existence." International Chinese language education, as a form of language instruction, often recognizes the importance of psychological perception in language acquisition. However, many educators overlook

the role of students' "bodies"—their physical engagement—which reflects a deeper issue of mind-body separation in education. This oversight can present challenges in the teaching and learning process. Specifically, language teaching activities grounded in this cognitive framework may face a threefold dilemma: the disconnection of teaching concepts, limitations in the teaching environment, and the predetermined nature of instructional design. The theory of Embodied Language Cognition (ELC) offers valuable theoretical support for integrating embodied cognition into international Chinese language education. This integration holds significant potential for improving the effectiveness of language instruction by exploring methods that foster synergistic gains in students' affective, cognitive, and intentional development.

3. "Artificial Intelligence + Education" Empowering the Advantages of International Chinese Language Education

3.1 Characteristics of Artificial Intelligence Applied to Chinese Language Teaching for Foreigners

1. Interactivity

Interactivity refers to the dynamic two-way communication and engagement that occurs not only between teachers and students but also among students themselves during the teaching and learning process. This interaction goes beyond verbal communication to include the exchange of emotions, culture, and ideas, all aimed at enhancing students' learning outcomes and active participation. Effective teaching that promotes such interaction can significantly boost students' interest and motivation to learn, while also encouraging the practical use of the language.Compared to traditional methods of teaching Chinese as a foreign language, AI offers remarkable enhancements in interactivity, reducing the burden on teachers and improving learning efficiency for students. For example, AI technologies such as affective computing and emotion recognition can monitor learners' emotional states in real time. When students face challenges or frustration, the system can detect changes in their facial expressions or voice intonation, offering timely encouragement and support. This immediate feedback helps learners overcome obstacles and stay motivated.By analyzing students' learning behaviors and emotional fluctuations, AI can also provide teachers with deeper insights into their students' progress and needs, enabling more personalized and targeted guidance. This emotional engagement, facilitated by AI, not only strengthens the teacher-student relationship but also enhances the overall effectiveness of the learning experience.

2. Personalized Learning

Since the 20th century, personalized learning has undergone significant evolution. It refers to the observation of students' individual characteristics in order to predict their future development and design a learning process tailored to their unique needs. The integration of artificial intelligence (AI) in education aligns perfectly with this trend. One of the major challenges faced by international Chinese language educators is adapting teaching methods to students' diverse cultural backgrounds, varying levels of language proficiency, and different learning abilities. This diversity demands a more relevant and customized approach to teaching. However, due to constraints in time, resources, and practical limitations, many teachers struggle to implement personalized and targeted strategies in the classroom. The advent of AI technology presents a solution to this issue. Through the use of big data analysis and machine learning algorithms, AI can accurately identify individual differences in learners' learning styles, interests, and language proficiency. This allows educators to effectively monitor each student's progress, preferences, and mastery levels, enabling them to offer customized content and teaching strategies. In turn, this helps students learn more efficiently. Moreover, AI can create personalized learning paths that address students' knowledge gaps or areas of difficulty. By identifying these gaps, educators can work to narrow the learning divide within the classroom, ensuring that every student receives the support they need. This personalized approach allows students to learn at their own pace, ultimately improving teaching effectiveness and learning outcomes.

3. Situational Learning

"The language environment is a determining factor in the acquisition of language skills." "The language environment plays a key role in the success or failure of second language acquisition." Although teachers of Chinese as a foreign language emphasize the importance of creating virtual teaching environments and integrating various traditional multimedia elements to improve students' learning efficiency, the diversity and complexity of Chinese cultural contexts limit the effectiveness of these methods. In teaching Chinese as a foreign language, students in a class may have different cultural environments and linguistic backgrounds, making it difficult for teachers to grasp the impact of negative language transfer. AI, on the other hand, can analyze the huge amount of existing data and generate specific language contexts to empower foreign teaching. For example, when learning vocabulary related to the Chinese New Year, AI can set up a virtual Chinese New Year celebration scenario and allow students to participate in it through dialogues and role-plays, thus enhancing their language use and cultural understanding. Language learning is not only about the accumulation of vocabulary and grammar but also about how to use language in a particular cultural context. Overall, AI can help students understand language usage habits and cultural differences by showing how to use appropriate expressions in specific contexts through examples.

3.2 Specific Ways and Means of Applying Artificial Intelligence to Foreign Language Teaching and Learning

The integration of artificial intelligence (AI) into Chinese language education offers significant potential. The diverse backgrounds of students, coupled with the need to develop linguistic communication skills, present challenges that require personalized, interactive, and contextualized teaching approaches. AI technology can precisely address these challenges. Through intelligent tutoring systems, virtual teachers, and other AI tools, it can interact with students in real time, answer their questions, and provide individualized guidance. Additionally, AI can simulate authentic Chinese language environments—such as virtual dialogues and role-playing activities—allowing students to practice Chinese in near-real-world contexts, thereby improving their language proficiency and cross-cultural communication skills. Research into the application of AI in international Chinese education has already begun. For example, the IBM Research Institute and Rensselaer Polytechnic Institute (RPI) have collaborated to develop the Cognitive Immersion Room (CIR), which combines advanced technologies like speech-to-text conversion, natural language understanding, and computer vision. This immersive environment, enriched with gaming elements, allows students to engage in natural, multi-modal conversations with AI chatbots in settings such as a Chinese restaurant, garden, or Tai Chi class. Such experiences help students practice Chinese in contexts that simulate real-life situations. Another example is Microsoft Learn Chinese, an app that uses AI to assist learners in mastering Chinese. The app features human-computer dialogue, combining machine learning models developed by native speakers with Microsoft’s speech recognition technology. It also includes a robust scoring system capable of evaluating and correcting spoken language. Furthermore, Microsoft Learn Chinese provides rich, context-based scenarios—such as greetings, shopping, and ordering food—creating immersive learning situations that enhance students' communicative skills. These examples highlight how AI can transform language learning by offering dynamic, interactive, and contextual experiences that closely mimic real-world language use.

4. Exploring the Application of AI-Assisted Chinese Teaching Based on Embodied Cognition

With the rapid advancement of AI technology, experts and scholars have increasingly recognized its vast potential in education. Significant progress has been made in areas such as intelligent tutoring systems, dual-teacher classrooms, and smart recording and broadcasting. The theory of embodied cognition underscores the central role of the body in the cognitive process, asserting that cognition, the body, and the environment are deeply interconnected. AI technology can enhance this process by

offering a multimodal learning experience. Through techniques such as speech recognition, image processing, and natural language processing, AI enables students to engage multiple senses during learning. Furthermore, AI can tailor learning paths to meet the personalized needs of each student, facilitating more individualized and effective education.

4.1 Phonics

Phonics is one of the most challenging aspects of learning Chinese for many learners. The pronunciation of Chinese tones, consonants and rhymes is particularly difficult for those from non-Chinese linguistic backgrounds. The theory of embodied cognition, which emphasizes the connection between perception and bodily actions, offers strong theoretical support for the application of artificial intelligence in speech instruction.

On one hand, modern speech recognition systems, such as those developed by Baidu and Google, possess high-precision capabilities in recognizing Chinese speech. These systems can detect subtle differences in pronunciation, helping learners identify and correct their mispronunciations. In speech teaching, educators can leverage speech recognition technology to provide real-time, accurate feedback by comparing learners' pronunciation with the standard. This aligns with the concept of "interactive learning" in embodied cognition theory, where learners continuously refine their language skills through repeated perceptual and motor interactions.

On the other hand, the integration of AI technologies, such as virtual reality (VR) and augmented reality (AR), into language learning can help create immersive environments that encourage the use of Chinese in realistic contexts. These technologies allow learners to engage their senses in dynamic language scenarios, activating motivation, enhancing contextual understanding, and improving the embodied experience of language acquisition.

4.2 Teaching of Grammar

The grammatical structure of Chinese differs significantly from that of many other languages, and aspects such as word order, the positioning of determiners and gerunds, and the use of quantifiers can present considerable challenges for non-native Chinese learners. According to the theory of embodied cognition, language learning is not just about memorizing abstract symbols but involves continuously optimizing language comprehension through actions, context, and practical interactions.

First, AI can aid learners in understanding abstract grammatical structures by visualizing complex grammar rules through images and animations. For instance, an AI system can demonstrate the order of sentence components in Chinese, showing how elements like the subject, predicate, and object are combined to form a sentence. This visualization process allows learners to better grasp grammatical structures in a more tangible and figurative context. Secondly, AI can enhance grammar practice by providing personalized feedback. Embodied cognition theory emphasizes that learners' perceptions of and responses to errors play a crucial role in the learning process. AI can offer real-time feedback based on learners' inputs, identify misunderstandings or errors, and provide targeted explanations and guidance. This enables learners to continuously improve their grammar skills through adaptive practice. Additionally, AI can facilitate the use of grammar in real-world contexts through grammar-based dialogue systems. In interactive conversations with AI, learners can apply the grammatical structures they have learned in practical communication scenarios. Such question-and-answer training helps learners not only master basic grammar but also effectively use it in both speaking and writing, ultimately achieving the goal of proficient verbal communication in Chinese.

4.3 Teaching Vocabulary

Learning vocabulary is a fundamental aspect of teaching Chinese as a foreign language, particularly when it comes to multi-syllabic characters and words with multiple meanings. These features present unique challenges for learners. In the process of learning Chinese, students often misuse vocabulary, a phenomenon that is sometimes more prevalent than the misuse of grammar.

This issue often arises because both teachers and students tend to overlook the importance of context when teaching and learning vocabulary.

According to the theory of embodied cognition, vocabulary learning should not rely solely on rote memorization but should involve multi-sensory experiences that deepen understanding and retention through the interaction of the body and the environment.

Artificial intelligence can offer a variety of sensory channels (e.g., visual, auditory, tactile) to enhance vocabulary learning. For instance, AI can provide images or videos to illustrate figurative vocabulary, helping students connect abstract words with concrete objects. By incorporating haptic devices (such as smart touchscreens or virtual reality equipment), AI can further engage learners through physical interaction. For example, when teaching the word "book," AI could display pictures or videos of books, allowing students to visualize the word in context. Additionally, it might simulate the action of turning a book's pages through a touchscreen, enabling students to experience the meaning of the word firsthand. This multimodal sensory input—encompassing visual, auditory, and tactile experiences—helps learners not only to access vocabulary sounds, shapes, and meanings, but also to deepen their understanding and memorization through interactive engagement.

4.4 The teaching of Chinese characters

The teaching of Chinese characters is a defining feature of teaching Chinese as a second language. Unlike Pinyin, which focuses on the memorization of sounds, Chinese characters are morphemic symbols with both form and meaning. The cognitive process involved in learning Chinese characters encompasses the interplay between sound, form, and meaning. Additionally, Chinese characters have complex structures involving strokes, stroke order, components, and frameworks. Embodied cognition emphasizes that learners acquire reading and writing skills for Chinese characters through physical movements and sensory engagement.

Firstly, teachers can help learners understand the structure of Chinese characters by utilizing image recognition and motion capture technologies. These tools enable learners to experience the construction and evolution of characters through actions such as touching, writing, and dragging. For example, through augmented reality (AR) technology, learners can observe the stroke order and historical evolution of Chinese characters in a virtual environment, enhancing their understanding of both the form and structure of the characters. Secondly, an AI-based system can support the teaching and evaluation of Chinese character writing. This system can assist students in practicing character writing while providing feedback on the accuracy of stroke order, structure, and even the aesthetic quality of the characters. Such AI-assisted feedback helps guide learners to correct their mistakes and continuously improve their skills. Finally, language learning is inherently linked to cultural context. Learning a language is not just about memorizing symbols，it involves connecting those symbols to the culture and context they represent. Teachers can leverage AI technology to design Chinese character learning tasks that incorporate cultural elements. For instance, when teaching the character "春" (spring), AI can integrate images, festivals, customs, and other relevant cultural knowledge, helping students form associations between the character and its cultural significance. This approach deepens learners' understanding of both the shape and meaning of the character.

5. Concluding remarks

With the acceleration of globalization and the rising international prominence of China, the demand for international Chinese language education is growing. However, traditional teaching methods face numerous challenges in the context of the new era. The rapid advancement of artificial intelligence (AI) technology presents new opportunities to address these developmental issues. By applying the theory of embodied cognition, we can re-examine and optimize the process of Chinese language teaching and learning, placing greater emphasis on students' bodily participation and contextual experience. This approach also proposes specific strategies for incorporating AI into foreign language teaching. Currently, the integration of AI technology into international Chinese

language education remains in the exploratory phase. Moving forward, it is essential to continue exploring innovative applications of AI in this field, while continuously refining teaching strategies and learning pathways.

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