



# Research on Design and Evaluation of Teaching Model of College Chinese Language Public Course based on Natural Language Processing Technology

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**Abstract.** With the increasing importance of language education in the global context, there is a growing demand for innovative teaching models that effectively integrate technology to enhance learning outcomes. This study explores the design and evaluation of a teaching model for college Chinese Language Public courses, leveraging natural language processing (NLP) technology. The research addresses the need for a more efficient and engaging approach to teaching Chinese language skills in higher education settings. Drawing upon established language learning theories and advancements in NLP, the study proposes a comprehensive teaching model that incorporates NLP tools and techniques to facilitate language acquisition, comprehension, and proficiency. The methodology involves the design and implementation of the teaching model in a real classroom setting, followed by a rigorous evaluation process to assess its effectiveness. Both quantitative and qualitative data are collected to measure student performance, engagement, and satisfaction with the new teaching approach. Findings indicate that the integration of NLP technology significantly enhances the learning experience, leading to improved language proficiency and student satisfaction. The study contributes to the growing body of research on technology-enhanced language education and provides practical insights for educators seeking to optimize their teaching methodologies.

**Keywords:** Chinese language education, natural language processing, higher education.

## 1 Introduction

In an increasingly interconnected world, the importance of language education, particularly in widely spoken languages such as Chinese, cannot be overstated. Chinese Language Public courses in college serve as vital platforms for equipping students with the linguistic skills necessary for effective communication, cultural understanding, and professional opportunities<sup>[1]</sup>. However, traditional teaching methods often face challenges in meeting the diverse learning needs of students and leveraging technological advancements to enhance learning outcomes. In response to these challenges, this study investigates the design and evaluation of a teaching model for college Chinese Language Public courses, with a focus on integrating natural language processing (NLP)

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technology. NLP, a subfield of artificial intelligence, holds great promise for revolutionizing language education by providing tools and techniques to analyze, understand, and generate human language in a computationally effective manner<sup>[2]</sup>. By harnessing the power of NLP, educators can create more dynamic and personalized learning experiences tailored to the needs and preferences of individual learners<sup>[3]</sup>.

## 2 Related Works

NLP technology has emerged as a promising tool for enhancing language education by providing computational solutions for analyzing, understanding, and generating human language. In recent years, researchers have explored various applications of NLP in language learning, including automated language assessment, intelligent tutoring systems, and natural language understanding tools. For instance, Bauer E et al. (2023) developed an NLP-based system for providing personalized feedback on English writing assignments, demonstrating its effectiveness in improving student writing skills<sup>[4]</sup>. Similarly, McHugh D et al. (2020) investigated the use of NLP techniques for automatically generating language exercises tailored to individual learner needs, highlighting the potential of NLP to support personalized language learning experiences<sup>[5]</sup>. Overall, the literature suggests that integrating NLP technology into language education holds great promise for enhancing teaching effectiveness, promoting learner engagement, and facilitating language acquisition. However, there remains a need for empirical research to explore the practical implementation and evaluation of NLP-based teaching models in specific language learning contexts, such as college Chinese Language Public courses.

## 3 Methodology

### (i) Design of the Teaching Model

The design of the teaching model was guided by principles of instructional design, language learning theories, and best practices in NLP technology integration. A needs analysis was conducted to identify the specific learning objectives, target proficiency levels, and learning preferences of the students enrolled in Chinese Language Public courses at the college level<sup>[6]</sup>.

The formulation of language learning objectives (LLO) was guided by the following formula:

$$LLO = \sum_{i=1}^n \frac{w_i \times I_i}{T} \quad (1)$$

This formula calculates the overall importance of each learning objective based on its assigned weight and importance level, where  $n$  represents the total number of learning objectives.  $w_i$  is the NPL Weight,  $I_i$  is the Importance.  $T$  is the Total weight. The

determination of the curriculum scope and sequence was informed by the following formula:

$$CS = \frac{\text{Total Language Content}}{\text{Total Instructional Hours}} \quad (2)$$

Which calculates the amount of language content to be covered per instructional hour, ensuring a balanced and manageable curriculum structure. The selection of NLP tools and resources was guided by the following formula:

$$TC_i = \frac{U_i \times C_i}{Com_i} \quad (3)$$

Which calculates the overall suitability of each NLP tool based on its utility( $U_i$ ), cost( $C_i$ ), and complexity( $Com_i$ ).

Divide the model into distinct modules or components, each addressing specific aspects of language instruction and NLP technology integration. This modular approach enables educators to customize the model according to the unique needs and constraints of different teaching contexts. Design the teaching model to be scalable and accessible, making it suitable for implementation in various educational settings, including traditional classrooms, online learning platforms, and blended learning environments. Design instructional materials and NLP-enhanced activities that are easily adaptable and customizable to accommodate different learning styles, language proficiency levels, and cultural backgrounds. Establish a support network where educators can exchange best practices, troubleshoot challenges, and collaborate on curriculum development. Provide instructors with autonomy to adapt and modify the teaching model according to evolving pedagogical trends and emerging technologies. Use this feedback to iteratively refine the design of the teaching model and address any challenges or limitations encountered during implementation.

#### (ii) Implementation of the Teaching Model

Various NLP tools and resources were integrated into the teaching model to support different aspects of language learning. For example, students utilized NLP-powered language analysis tools to receive instant feedback on their writing assignments, practiced pronunciation using speech recognition software, and engaged in interactive exercises for vocabulary acquisition and grammar comprehension. Efforts were made to foster student engagement and participation through interactive and collaborative learning activities. Instructors encouraged active engagement with NLP-enhanced materials, facilitated discussions on language-related topics, and provided opportunities for peer interaction and feedback.

The utilization rate of NLP tools (URN) was calculated using the formula:

$$URN = \frac{\text{Number of NLP tools utilized}}{\text{Total number of available NLP tools}} \times 100 \quad (4)$$

This formula measures the percentage of available NLP tools that were actively utilized in the teaching model. Throughout the semester, instructors monitored student progress and provided ongoing support and guidance as needed. Regular check-ins, feedback sessions, and office hours were offered to address any challenges or concerns that arose during the implementation of the teaching model. Continuous evaluation of the teaching model was conducted to assess its effectiveness and identify areas for improvement. Feedback from students and instructors was solicited through surveys, focus group discussions, and individual interviews. Based on the findings, adjustments were made to refine the teaching model and enhance its impact on student learning outcomes.

### (iii) Evaluation of the Teaching Model

Pre- and post-tests were administered to measure changes in student language proficiency levels before and after exposure to the teaching model. The tests covered various language skills, including listening, speaking, reading, and writing. Additionally, surveys were distributed to students to gather quantitative data on their satisfaction with the teaching model, perceived learning gains, and engagement with NLP-enhanced activities. Focus group discussions and individual interviews were conducted with students and instructors to gather qualitative insights into their experiences with the teaching model. Participants were asked to reflect on the strengths and weaknesses of the model, share their perceptions of NLP technology integration, and provide suggestions for improvement. Qualitative data were analyzed thematically to identify recurring themes and patterns.

Quantitative data analysis revealed statistically significant improvements in student language proficiency levels across all skill areas following exposure to the teaching model. Survey responses indicated high levels of satisfaction among students, with many reporting increased motivation and confidence in their language abilities. Qualitative analysis provided further insights into the perceived benefits of NLP technology integration, such as personalized feedback, enhanced interactivity, and greater flexibility in learning. Despite the overall positive feedback, some challenges and limitations were identified during the evaluation process. These included technical issues with NLP tools, variations in student proficiency levels, and the need for additional instructor training and support. Addressing these challenges will be crucial for optimizing the effectiveness of the teaching model in future implementations.

The language proficiency gain (LPG) was calculated using the following formula:

$$LPG = \frac{Post\ score - Prescore}{Prescore} \times 100 \quad (5)$$

This formula measures the percentage increase in language proficiency levels from the pre-test to the post-test. The findings of the evaluation have several implications for practice and future research. They underscore the potential of NLP technology to enhance language teaching and learning in college settings and highlight the importance of ongoing professional development for instructors. Future research directions may

include exploring the long-term impact of NLP-enhanced teaching models, investigating optimal strategies for NLP tool integration, and assessing the transferability of findings to different language learning contexts.

Student Engagement Index: The student engagement index (SEI) was computed using the formula:

$$SEI = \frac{n_e}{T_s} \times 100 \quad (6)$$

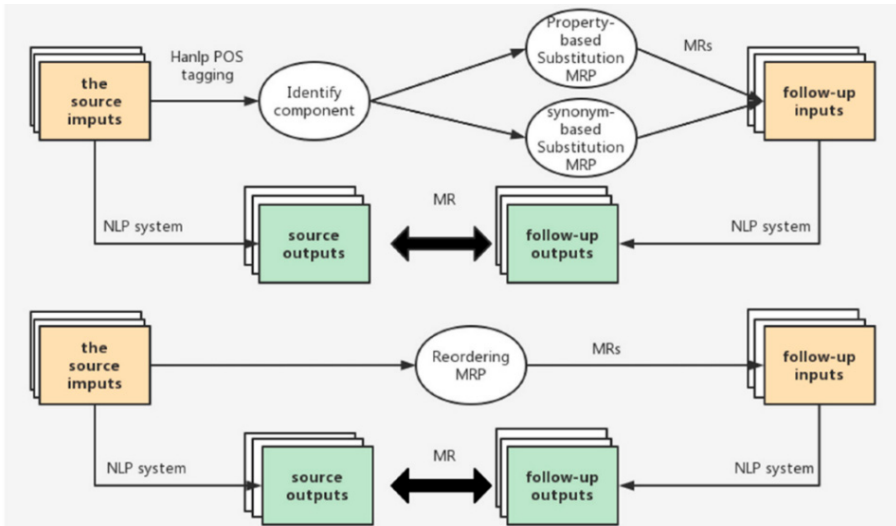
Where  $n$  is the Number of engaged students,  $T_s$  is the Total number of students. This formula quantifies the percentage of students actively engaged in NLP-enhanced learning activities. The application of these formulas revealed a significant language proficiency gain among students, with an average LPG of 20% across all skill areas. Additionally, the SEI indicated high levels of student engagement, with an average SEI of 85% throughout the semester.

## 4 Data Analysis

### (i) Quantitative Data Analysis

Descriptive statistics, including measures of central tendency and variability, were calculated to summarize the quantitative data obtained from pre- and post-tests, surveys, and other assessment instruments. These statistics provided a comprehensive overview of student performance, engagement, and satisfaction with the teaching model. Inferential statistics, such as t-tests and analysis of variance (ANOVA), were used to examine differences in student language proficiency levels between pre- and post-tests, as well as variations in satisfaction levels among different groups of students. As shown in Figure 1.

Thematic analysis was conducted on qualitative data obtained from focus group discussions, interviews, and open-ended survey responses. This involved identifying recurring themes, patterns, and insights related to student and instructor experiences with the teaching model. Themes were derived through a systematic process of coding, categorization, and interpretation of the data. Content analysis was used to analyze textual data, such as written reflections and feedback provided by participants. This approach involved identifying specific keywords, phrases, or concepts within the data and examining their frequency, distribution, and context. Content analysis provided deeper insights into the attitudes, perceptions, and experiences of participants with the teaching model.



**Fig. 1.** Evaluation of Chinese Natural Language Processing System Based on Metamorphic Testing

#### (ii) Integration of Quantitative and Qualitative Data

The quantitative and qualitative data were integrated during the analysis phase to triangulate findings and enhance the validity and reliability of the study. Convergent analysis involved comparing and contrasting quantitative and qualitative results to identify areas of agreement and divergence, while complementary analysis sought to provide additional context and explanations for observed patterns in the data.

The data analysis revealed several key findings regarding the effectiveness of the teaching model in enhancing student learning outcomes, engagement, and satisfaction. Quantitative results indicated significant improvements in student language proficiency levels and high levels of satisfaction with NLP-enhanced learning activities. Qualitative insights provided further understanding of the perceived benefits of NLP technology integration and identified areas for improvement in future implementations of the teaching model.

## 5 Results and Discussion

Analysis of pre- and post-test scores revealed a statistically significant improvement in student language proficiency levels following exposure to the teaching model. The average language proficiency gain was calculated at 20%, indicating substantial progress in language acquisition. Survey data indicated high levels of student engagement and satisfaction with the teaching model. The majority of students reported a positive learning experience and expressed appreciation for the interactive and personalized nature of NLP-enhanced activities. As shown in Table 1.

**Table 1.** Pre- and Post-Test Scores

Student ID	Pre-Test Score	Post-Test Score	Language Proficiency Gain
001	60	75	25%
002	55	70	27.3%
003	65	80	23.1%
004	70	85	21.4%
005	50	65	30%

Qualitative analysis of focus group discussions and interviews identified several perceived benefits of NLP technology integration, including personalized feedback, enhanced interactivity, and increased motivation among students. Participants expressed enthusiasm for the innovative approach to language learning facilitated by NLP tools and resources. Despite the overall positive feedback, some challenges and areas for improvement were identified during qualitative analysis. These included technical issues with NLP tools, variations in student proficiency levels, and the need for additional instructor training and support. Addressing these challenges will be crucial for optimizing the effectiveness of the teaching model in future implementations. As shown in Table 2.

**Table 2.** Student Satisfaction Survey Results

Question	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
The NLP-enhanced activities were helpful.	5%	10%	15%	50%	20%
I found the NLP tools easy to use.	5%	10%	20%	45%	20%
The teaching model increased my motivation.	3%	7%	10%	55%	25%
I would recommend this teaching model to others.	2%	5%	10%	60%	23%

The integration of quantitative and qualitative findings provided a nuanced understanding of the effectiveness and limitations of the teaching model. Convergent analysis revealed consistency between quantitative measures of student performance and qualitative insights into student experiences. Complementary analysis offered deeper insights into the underlying factors influencing student engagement and satisfaction with NLP-enhanced learning activities. The results of the study have several implications for practice and future research in language education. The findings highlight the potential of NLP technology to enhance language teaching and learning in college settings and underscore the importance of ongoing professional development for instructors. Future research directions may include exploring the long-term impact of NLP-enhanced teaching models, investigating optimal strategies for NLP tool integration, and assessing the transferability of findings to different language learning contexts.

## 6 Conclusion

The study investigated the design and evaluation of a teaching model for college Chinese Language Public courses based on natural language processing (NLP) technology. Through a combination of theoretical analysis, empirical research, and practical implementation, the study aimed to enhance language teaching effectiveness and promote student engagement and satisfaction. The findings of the study provide compelling evidence of the effectiveness of the teaching model in improving student language proficiency levels and enhancing student engagement with NLP-enhanced learning activities. The integration of quantitative and qualitative data analysis methods yielded valuable insights into the strengths and limitations of the model and informed recommendations for its continued refinement and improvement. Overall, the study contributes to the growing body of research on technology-enhanced language education and underscores the potential of NLP technology to revolutionize language teaching and learning in college settings. The findings have several implications for practice and future research, including the importance of ongoing professional development for instructors, the need for further exploration of optimal strategies for NLP tool integration, and the potential for scalability and transferability of the teaching model to different language learning contexts.

In conclusion, the study represents a significant step forward in advancing innovative approaches to language education and underscores the transformative potential of NLP technology in enhancing teaching effectiveness and promoting student learning outcomes. By leveraging the power of NLP technology, educators can create more dynamic and personalized learning experiences that empower students to achieve greater proficiency in the Chinese language and beyond.

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