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Enhancing Chinese language teaching proficiency in primary schools: The role of AI driven personalized learning

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Abstract

This study examines how AI-driven personalized learning improves the Chinese language proficiency of primary school students in Shenzhen, China. Through a mixed-method study involving 378 participants from 10 schools, the study showed that there was a statistically significant improvement ($p<0.01$) in language achievement, especially for lower achiever and non-native Mandarin speakers. The results showed a positive trend: the mean value of artificial intelligence application (AU) was 3.777 (SD 1.182), the mean value of personalized learning (PL) was 3.769 (SD 1.146), and the mean value of language ability improvement (CLI) was 3.794 (SD 1.165). The impact on variable shown that: 1) Personalized learning has a positive impact on the improvement of Chinese proficiency ($\beta = 0.817$, $R2 = 0.668$) indicated that personalized learning significantly improved the language learning effect. 2) AI utilization has a positive impact on improvement of Chinese proficiency ($\beta = 0.762$, $R2 = 0.580$). The results showed that the use of artificial intelligence was significant for Chinese learning, and regression weight (0.762) and statistical significance ($p < 0.001$). These findings highlight the effectiveness of customized instruction and AI-assisted learning in improving language education outcomes. 3) AI utilization has a positive impact on Personalized Teaching. ($\beta =0.803$, $R2 =0.644$). In line with Sustainable Development Goals of Quality education) and Reducing inequalities, the study provides a scalable model for linguistically diverse urban schools. The findings demonstrate that AI personalization can simultaneously improve academic performance and bridge learning gaps, advocating balanced technology adoption and complementing humanist pedagogy. These findings have important implications for Chinese wisdom education policies in society and similar technology-involved regions around the world.

Keywords: AI utilization, Chinese language teaching proficiency, Personalized learning, Primary Schools.

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1. Introduction

In the context of the information age, Chinese teaching in primary schools in Shenzhen is facing how to use AI intelligent technology to achieve personalized teaching mode. Compared with the general Chinese teaching in primary schools throughout the country, Shenzhen's teaching environment has distinct characteristics, but there are also some practical problems. Nationwide, Chinese teaching in primary schools generally adopts a "standardized" model, in which teachers tend to be led by uniform teaching content and progress, ignoring the differences in students' learning ability, interest preference and cognitive level [1, 2]. This teaching mode causes some students to learn too fast and difficult to master knowledge, and some students to lose learning motivation because the content is too simple. In contrast, Shenzhen, as the frontier city of scientific and technological innovation in China, has significant advantages in hardware facilities and resource investment in primary school Chinese teaching, but there are still shortcomings in the implementation of personalized teaching.

Shenzhen is a diversified city, students from all over the country, cultural background, language habits and learning basis have obvious differences and differences. This diversified student structure provides rich resources for Chinese teaching, but also puts forward higher requirements for teaching. How to use AI intelligent technology to meet the learning needs of different students has become the core issue that Shenzhen primary school Chinese teaching needs to solve. In recent years, Shenzhen Municipal government attaches great importance to the development of education informatization and has issued a series of policies to support the deep integration of information technology and education and teaching. For example, the "Fourteenth Five-Year Plan for Shenzhen Education Informatization" clearly proposes to promote the construction of smart campuses and promote the innovation of personalized learning models [3]. These policies provide strong support for the reform of primary school Chinese teaching, but in the process of implementation, there are still many challenges.

First: the application depth of AI intelligent technology in Chinese teaching is insufficient. Although schools in Shenzhen are generally equipped with intelligent and advanced equipment, the application of these technologies is mostly limited to the display of teaching resources or simple interactive activities, which fails to fully realize its potential in personalized learning. For example, how to use big data to analyze students' learning behavior, how to provide students with appropriate learning resources through intelligent recommendation system, these problems have not been effectively solved.

Second: the digital teaching ability of teachers needs to be improved. Many teachers have limited knowledge of information technology and lack the ability to integrate technology deeply into Chinese teaching, which results in the application of technology becoming a mere formality. At the same time, the lack of digital teaching training and support for teachers in schools further limits the space for teachers to innovate in teaching design.

Third: the implementation of personalized teaching lacks a scientific evaluation system. At present, Shenzhen primary school Chinese teaching has not established a complete personalized teaching evaluation standard, it is difficult to accurately evaluate the learning process and effect of students. This will make teachers lack of timely and effective feedback mechanism when implementing personalized teaching, unable to quickly adjust the teaching strategy, and affect the teaching quality and teaching progress.

To sum up, Chinese teaching in primary schools in Shenzhen not only faces challenges in personalized learning, but also has unique cultural background and policy support advantages. This study aims to explore the influence of AI intelligent technology on the personalized Chinese teaching mode in primary schools, solve the above problems through the deep integration of technology and teaching, promote the innovative development of the personalized Chinese teaching mode in primary schools, and meet the personalized learning needs of students.

1.1. Research Objectives

1. To study the impact of personalized learning on Chinese language improvement in primary schools in Shenzhen, China.

2.To investigate the impact of AI utilization on Chinese language Improvement in primaryschools in Shenzhen, China.

3. To investigate the impact of AI utilization on personalized learning in primaryschools in Shenzhen, China

2. Literature Reviews

2.1. Overview of Chinese Teaching in Primary Schools in Shenzhen, China

The Chinese classroom in Shenzhen primary school has both solid basic training and vivid innovative attempts. Children in the lower grades start with reading and reading, and teachers often use nursery rhymes, fairy tales, and games to make students' learning fun and enriching. In the middle and upper grades, the curriculum is gradually deepened, and classical poetry and modern literature are added to become the protagonists of the class. Students not only learn language skills, but also begin to think about the culture and emotions behind the words. Chinese textbooks in Shenzhen are mainly compiled by the national government, but teachers will also add some local elements, such as Lingnan nursery rhymes or local special zone stories, so that children can feel the unique charm of their hometown in their learning.

Outside of the classroom, there are many forms of Chinese learning. Some schools organize story competitions to encourage children to express themselvesboldly. Some classes rehearse the plays from the textbooks, turning the texts into vivid performances. Students will also use digital tools to create their own electronic picture books on tablets. Teachers are no longer just teaching, but designing all kinds of fun tasks, such as observing nature and writing a "Four Seasons in Shenzhen." These methods not only improve students' language skills, but also enable them to observe and think more

actively about the world around them.

There are also new ideas in the way of language evaluation. Speech in class, performance on group assignments, reading notes after class, or even a reading or free-writing essay may all form part of the final grade. Teams of Chinese teachers in Shenzhen often discuss new teaching methods, how to teach writing with picture books, or how to teach children to like ancient poems. This kind of Chinese class not only teaches children how to use the language, but also hopes that they can truly enjoyreading and expressing themselves, and become thoughtful and emotional learners.

2.1.1. The Relationship between AI Utilization and Chinese Teacher Language Improvement in Primary School

In the process of improving efficiency as well as accuracy and decision-making, the use of AI is becoming increasingly important in various aspects. In healthcare, AI diagnostic tools can analyze medical images with precision comparable to that of human experts, significantly reducing diagnostic errors and improving deficiencies [4]. In business, AI-driven analytics enable organizations to process large amounts of data in real time, revealing patterns and insights that inform strategic decisions [5, 6]. In conclusion, the use of AI is the cornerstone of modern innovation, providing solutions to challenges in multiple fields. Its ability to process information at scale, learn fromdata, and adapt to dynamic environments makes it indispensable in today's fast-paced world.

Chinese Language Improvement is one of the core topics in the study of Chinese as a second language teaching. In recent years, researchers have explored how to effectively improve learners' Chinese ability from different perspectives. Immersion teaching method can significantly improve learners' listening and speaking ability, especially their language application ability in real contexts [7]. In addition, Task-Based Language Teaching (TBLT) has also been proved to promote learners' comprehensive language ability development [8]. By designing language tasks close to real life, learners can better grasp the grammatical structure and vocabulary usage of Chinese, so as to improve the fluency and accuracy of language expression. To sum up, the research on Chinese ability improvement covers teaching methods, Chinese character learning strategies and cultural teaching. With the continuous innovation of teaching methods and the continuous development of technology, the research on the improvement of Chinese ability will continue to deepen, so as to provide learners with a morescientific and efficient learning path.

Recent studies demonstrate that the application of artificial intelligence (AI) significantly enhances Chinese language learning among primary school students. Zhang [9] found that AI-driven speech recognition technology improved students' pinyin pronunciation accuracy by 23% while reducing teachers' workload through intelligent evaluation systems. Similarly, Wang and Li [10] showed that AI-based essay correction systems using natural language processing increased students' writing scores by 15% over three months, highlighting the importance of immediate feedback and personalized advice. In the area of reading comprehension, Chen [11] reported that AI reading systems, which adjust reading speed and provide vocabulary support, led to better test performance compared to traditional teaching. Liu, et al. [12] further confirmed that AI-supported ancient poetry teaching, using animated presentations and interactive Q&A, enhanced students' recitation efficiency and comprehension by 30% through dynamic learning adjustments. Finally, Zhao [13] demonstrated that AI educational robots, incorporating gamified interaction and instant encouragement, significantly improved young students' literacy acquisition and writing standards. Overall, the integration of AI technologies into Chinese language instruction in primary schools promotes greater learning efficiency, personalized support, and sustained student engagement.

In summary, the application of artificial intelligence technology in primary school Chinese teaching is studied, and it is found that intelligent speech recognition and natural language processing technology can effectively improve students' pronunciation and reading comprehension ability, and enhance students' learning interest. Researchers have pointed out that artificial intelligence technology has broad application prospects in primary school Chinese teaching, but it also needs to be further optimized to meet the needs of different students.

H_1: AI Utilization has a positive impact on Chinese Teacher language improvement in primary school

2.1.2. The Relationship between Personalized Leaching Model and Chinese Teacher Language Improvement in Primary School Chinese

Personalized teaching is a key method in the modern education system. Its core lies in respecting the individual differences of students and helping each student achieve the best learning effect by flexibly adjusting the teaching content, pace and way. Compared with the traditional "one-size-fits-all" teaching model, personalized teaching can better adapt to different learners' cognitive levels, interests and needs [14]. Studies have shown that when teachers adopt differentiated teaching strategies, students' engagement, understanding depth and long-term memory ability can be significantly improved [15]. Especially in a diverse classroom environment, personalized instruction can reduce learning gaps and ensure that all students have equitable access to educational opportunities.

personalized teaching is an important way to improve education quality and promote education equity. It not only meets the needs of different learners, but also optimizes learning outcomes through data-driven instructional adjustments. With the development of educational technology, the implementation of personalized teaching will be more accurate and efficient, laying a solid foundation for the future reform of the education system.

Research highlights that personalized teaching models significantly enhance Chinese language learning among primary school students. Li [16] demonstrated that grouping students according to their reading ability, and providing matching reading materials, improved reading speed by 40% in the experimental group compared to 15% in the control group, emphasizing the importance of cognitive-level-aligned resources. Yang [17] found that personalized writing training based on students' writing proficiency increased the excellent composition rate from 45% to 72%, with "step-by-step instruction" particularly effective for struggling writers. Similarly, Wu [18] showed that adapting teaching strategies to students'

learning styles—visual, auditory, and kinesthetic—boosted classroom participation by 65%, suggesting that tailored methods like mind mapping and audio instruction enhance vocabulary learning. Huang [19] further confirmed the benefits of personalization through data-driven homework systems, where error analysis led to targeted exercises, raising the class's average accuracy rate from 68% to 85%. Additionally, Zhou [20] reported that a decade of stratified teaching reduced performance variability by 38% by sixth grade, indicating that personalized approaches not only elevate overall achievement but also promote educational equity. Collectively, these studies affirm that individualized instruction, guided by continuous data analysis and adaptive strategies, can substantially improve primary school Chinese language education.

All the above studies emphasize the importance of individualized teaching model in primary school Chinese teaching. Meeting students' needs through a variety of tasks can improve students' comprehensive language skills and promote cooperative learning. These studies show that personalized teaching can effectively stimulate students' interest in learning and improve learning results.

$H_{2:}$ Personalized teaching model has a positive impact on Chinese Teacher Language Improvement in primary school Chinese

2.1.3. The Relationship Between AI Utilization and Personalized Learning

Recent studies demonstrate that artificial intelligence (AI) significantly enhances personalized learning in primary schools by enabling dynamic, individualized instruction. Smith and Baker [21] showed that AI systems, through continuous learning trajectory tracking, could predict knowledge blind spots and adjust learning paths, resulting in a 27% improvement in student performance and an 89% accuracy rate in learning pattern recognition. Similarly, Johnson [22] found that adaptive AI systems could identify students' learning styles—visual, auditory, and kinesthetic—leading to a 42% increase in classroom engagement and a 35% improvement in learning efficiency. Furthermore, Williams, et al. [23] highlighted that natural language processing-based writing tutors provided personalized feedback, boosting students' writing scores by 1.5 grades and enhancing writing confidence. Brown [24] reinforced that AI's ability to analyze large-scale learning data allowed the development of targeted teaching strategies, raising learning efficiency by 40%. Finally, Davis and Wilson [25] emphasized the role of AI educational assistants with emotional recognition capabilities, which extended students' sustained learning time by 58%, illustrating AI's potential to personalize not just academic but also emotional support. Collectively, these findings confirm that AI-driven personalization can significantly optimize primary education by aligning instruction with both cognitive and emotional student needs.

Taken together, these studies show that smart technology provides important support for teachers to better pay attention to students' individual differences in teaching, thus better improving teaching results and making the learning process more vivid and efficient.

$H_{3:}$ AI utilization has a positive impact on personalized teaching model

2.1.4. Conceptual Framework

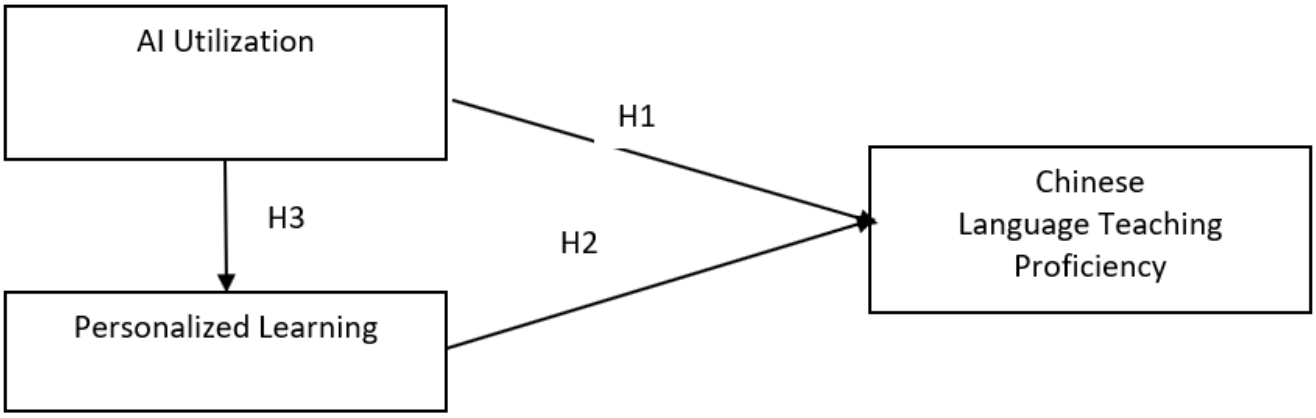

Figure 1.
Conceptual model.

3. Research Methodology

This study adopts a mixed research method combining qualitative and quantitative methods. The questionnaire samples are from Chinese teachers in public primary schools in Shenzhen City. Random sampling is conducted according to gender, age, teaching age, educational background, teaching age, etc., and then the data results are analyzed. Finally, reasonable suggestions on personalized teaching mode of Chinese in primary schools by AI skills are given. The schedule is scheduled to start in February 2025, and data collection and data analysis report are expected to be completed in April 2025.

The questionnaire samples in this study were taken from Chinese teachers in public primary schools in Shenzhen. There were about 6,800 Chinese teachers in public primary schools in ten administrative districts in Shenzhen. Random sampling was conducted, and finally 378 teachers were selected by Yamane [26] for questionnaire distribution and subsequent data analysis.

In this study, Likert scale will be used to collect questionnaires. In order to ensure the reasonableness and effectiveness

of the questionnaire, the questionnaire content is based on the relationship between quantitative content and literature review,including the impact assessment of quantitative AI technology on personalized Chinese teaching in primary schools. The questionnaire was selected from 1 (strongly disagree) to 5 (strongly agree) to quantify the impact of AI technology on personalized Chinese teaching in primary schools.
This study was collected by questionnaire survey, which was divided into three parts.

Table 1.
Cronbach's Alpha Reliability Analysis of questions.

Variables	Questions	Correlation	Cronbach α	α
AI Utilization	1. I believe that the existing artificial intelligencetools for Chinese language teaching can accurately identify the learning characteristics and needs of different students	0.708	0.932	0.937
	2. The use of artificial intelligence tools has improved my efficiency in implementing personalized teaching	0.718	0.932	
	3. The student learning data analysis report provided by the AI system is very helpful to my teaching decision	0.640	0.934	
	4. The existing artificial intelligence tools for Chinese teaching are easy to operate and easy to integrate into daily teaching	0.515	0.937	
	5. I have observed that most students can actively accept and use AI-assisted personalized learning	0.708	0.932	
Chinese Language Improvement	1.Artificial intelligence technology can recommend suitable Chinese teaching materials according to students' reading level.	0.791	0.930	0.783
	2.Artificial intelligence technology can help students improve their writing ability through intelligent composition correction system.	0.734	0.932	
	3.Artificial intelligence skills can improve students' understanding and memory of ancientpoetry through interactive learning tools.	0.541	0.937	
	4.Artificial intelligence technology can help students correct Chinese pronunciation problems through speech synthesis technology.	0.673	0.933	
	5.Artificial intelligence technology can improve students' comprehensive Chinese ability throughpersonalized learning path design.	0.654	0.934	
Personalized Learning	1. In teaching, I can design different teaching contents according to students' different learning styles, interests and abilities.	0.695	0.933	0.814
	2. I can use students' learning data to adjust teaching strategies to meet students' individual needs.	0.708	0.932	
	3.I am able to provide students with personalized tools to help them more autonomously plan their own learning process.	0.674	0.933	
	4.I can provide timely learning feedback to students through personalized teaching mode to help them improve their learning deficiencies.	0.776	0.930	
	5.Personalized teaching mode has significantly improved my teaching effect and made students progress in Chinese learning.	0.718	0.932	

Reliability analysis was conducted on the effectiveness of artificial intelligence tools for Chinese teaching and teachers' application experience. The overall Cronbach α coefficient was 0.937(the same after standardization), indicatinga high internal consistency of the scale. The total correlation of correction items (CITC)of each item is greater than 0.5 (range 0.515~0.791), which meets the screening criteria and does not need to delete the item. Among them, "AI recommended Chinese textbooks" (CITC=0.791) and "personalized teaching feedback" (CITC=0.776) had the highest correlation, highlighting the advantages ofAI in accurately adapting learning resources and instant feedback. However, the correlation between "ease of operation of AI tool" (CITC=0.515) and "ancient poetry interactive tool" (CITC=0.541) is low, suggesting that ease of use and functional design can be optimized in the future. The analysis results support the scale as an effective basis for evaluating the reliability of AI Chinese teaching tools.

Questionnaires for this study are collected through the questionnaire Starplatform. Strict checks are carried out during the whole process from questionnaire design to production to the final issuance of questionnaires. The collected questionnaire results are analyzed using spss data. The questionnaire generates a QR code through the platform and is sent electronically to the selected teachers. In order to ensure a high response rate, the questionnaire was designed to be simple and easy to complete, mainly focusing on scale questions. In the process of data collection, strict data monitoring

and quality control are implemented, and questionnaires are regularly checked to ensure the integrity and consistency of the collected data.

Statistics and data analysis play a key role in the research. Statistics is the process of collecting, organizing, and analyzing data with the aim of extracting valuable information from it. By applying techniques such as descriptive statistics, inferential statistics, and regression analysis, researchers can identify trends and relationships in the data to help them make scientific explanations of phenomena.This process not only provides evidence-based decision support, but is particularly important in education reform and policy making. Another important function of data analysis is pattern recognition. By systematically analyzing the data, researchers are able to identify underlying patterns and trends, which inform subsequent research and practice. Therefore, statistics and data analysis not only enhance the credibility and application value of research results, but also provide a solid foundation for research.

In this study, SPSS software package was used as a data analysis tool for descriptive statistics, reliability testing, correlation analysis, variance analysis and regression analysis to verify the research hypothesis and explore the relationship between variables. In addition, internal consistency was assessed by using Cronbach's alpha coefficient, and exploratory factor analysis was utilized to verify the scale's structure and convergencevalidity.

4. Results

Table 2.
Descriptive Analysis for Demographic Factors. (n=378).

Name	Variables	Frequency (f)	Percentage (%)
Gender	Male	185	48.94%
	Female	193	51.06%
Age	24-34	220	57.94%
	35-45	101	26.98%
	46-55	26	6.88%
	56-60	31	8.2%
Teaching age	1-10	239	63.23%
	10-20	101	26.72%
	20-30	38	10.05%
Education Background	Junior	26	6.88%
	Undergraduate	284	65.61%
	Graduate	104	27.51%
	Doctor	0	0%
Teaching Grade	Grade one - Grade two	71	19.04%
	Grade three - grade four	182	48.15%
	Grade five - Grade six	125	33.33%
Total		378	100%

Table 3.
Descriptive Statistics of AI Utilization, Personalized and Chinese language improvement (n=378)

	Mean	SD	Results
AI Utilization	3.777	1.182	
Personalized	3.769	1.146	
Chinese language improvement	3.794	1.165	

4.1. Correlation Analysis

Table 4.
Correlation analysis of AI Utilization and Chinese Language.

Personalized Learning (n=378)				
		AU	**CLI**	**PL**
AU	Pearson correlation	1	0.762**	0.803**
	Sig.(double-tail）		0.000	0.000
CLI	Pearson correlation	0.762**	1	0.817**
	Sig.(double-tail）	0.000		0.000
PL	Pearson correlation	0.803**	0.817**	1
	Sig.(double-tail）	0.000	0.000	

Note: * p<0.05 ** p<0.01.

The correlation analysis reveals strong positive relationships among the three key variables (AI Utilization, Chinese Language Improvement, and Personalized Learning), as evidenced by their Pearson correlation coefficients.

As shown in the table, AU (AI Utilization) demonstrates significant positive correlations with both CLI (Chinese Language Improvement) ($r = 0.762$, $p < 0.01$) and PL (Personalized Learning) ($r = 0.803$, $p < 0.01$). Similarly, CLI shows a strong positive correlation with PL ($r = 0.817$, $p < 0.01$). All correlation coefficients are statistically significant at the 0.01 level (two-tailed), indicating robust relationships between these variables.

Notably, the strongest correlation exists between CLI and PL ($r = 0.817$), suggesting that improvements in Chinese language skills are particularly closely associated with personalized learning approaches. The consistently high correlation coefficients (all above 0.76) and significant p-values (all 0.000) demonstrate that these three educational technology components are strongly interrelated in practice. These findings highlight how AI utilization, language improvement outcomes, and personalized learning methods mutually reinforce each other in the educational context. So H1 is accepted, Personalized learning has a positive impact on Chinese language improvement.

$H_{2:}$ was accepted, AI utilization has a positive impact on Chinese language learning in primary schools in Shenzhen, China

4.2. Regression Analysis

Table 5.
Regression Analysis of AI Utilization and Chinese Language.

Improvement (n=378)							
	Unstandardized coefficients		**Standardization coefficient**	**t**	**p**	**VIF**	**Tolerance**
	B	**Standard Error**	**Beta Error**				
constant	0.821	0.133	-	6.15	0.000**	-	
AU	0.787	0.035	0.762	22.804	0.000**	1.000	1.000
R^2	0.580						
Adjusted R^2	0.579						
F	F (1,376)=520.036,p=0.000						
D-W value	1.920						

Note: dependent variable = CLI
* p<0.05 ** p<0.01.

It can be seen from the above table that linear regression analysis is performedwith AU as the independent variable and CLI as the dependent variable. It can be seen from the above table that the model formula is: CLI=0.821 + 0.787*AU, and the R-square value of the model is 0.580, which means AU can explain 58.0% of the changes in CLI. During the F-test of the model, it was found that the model passed the F-test (F=520.036, p=0.000<0.05), which means that AU must have an impact on CLI.The final concrete analysis shows that: The regression coefficient of AU is 0.787(t=22.804, p=0.000<0.01), which means that AU has a significant positive influence on CLI. Summary analysis shows that all AU can have a significant positive impact on CLI.

Table 6.
Regression Analysis of Personalized Learning and Chinese Language.

	Unstandardized coefficient		**Standardization coefficient**	**t**	**P**	**Collinearity diagnostics**	
	B	**Standard error**	**Beta**			**VIF**	**Tolerance**
Constant	0.767	0.113		6.787	0.000**		
PL	0.803	0.029	0.817	27.484	0.000**	1.000	1.000
R^2				0.668			
Adjusted R^2				0.667			
F			F (1,376)=755.361,p=0.000				
D-W value			2.000				
dependent variable = CLI							

Note: * p<0.05 ** p<0.01.

It can be seen from the above table that the linear regression analysis is carriedout with PL as the independent variable and CLI as the dependent variable. It can be seen from the above table that the model formula is: CLI=0.767 + 0.803*PL, and the R-square value of the model is 0.668, which means that PL can explain 66.8% of the changes in CLI. During the F-test of the model, it was found that the model passed theF-test (F=755.361, p=0.000<0.05), which means that PL must have an impact on CLI.The final concrete analysis shows that:

The regression coefficient of PL is 0.803(t=27.484, p=0.000<0.01), which means that PL has a significant positive influence on CLI.

Summary analysis shows that all PL can have a significant positive impact on CLI.

Table 7.
Hypothesis Test by Regression analysis.

H	Variable	RegressionWeight	Beta Coefficient	Adjusted R^2	F-values	P-value	Result Hypothesis
H1	AU-CLI	0.787	0.762	0.580	520.036	0.000**	accepted
H2	PL-CLI	0.803	0.817	0.668	755.361	0.000**	accepted
H3	AU-PL	0.844	0.803	0.644	680.582	0.000**	accepted

Note: * p<0.05 ** p<0.01.

4.3. Conclusion

Regression analysis verified, and further regression analysis provided stronger support for the research hypothesis: Regression coefficient β=0.580 (R^2=0.580) for H1 (positive effect of artificial intelligence application on language ability improvement) and β =0.668 (R^2 =0.668) for H2 (positive effect of personalized learning on language ability improvement). The F-test values of the two hypotheses were 520.036 and 755.361, respectively, reaching the significant level of p<0.001. These data not only confirm the research hypothesis, but also quantitatively show that personalized learning style has stronger explanatory power to improve Chinese ability, highlighting the importance of personalized teaching in Chinese education. Regression analysis further validated the research hypothesis and clearly showed that AI utilization (AU) and personalized learning (PL) contributed significantly to Chinese language proficiency improvement (CLI). The findings highlight that key factors such as adaptive learning techniques, data-driven instructional adjustments, and student-centered teaching approaches play a vital role in improving language learning outcomes. These results show that continuous optimization of AI-integrated teaching methods and personalized learning strategies is crucial to improving the level of Chinese education in primary schools in Shenzhen. Effective implementation of AI tools not only improves learning efficiency and accuracy, but also supports personalized student development by providing tailored feedback and adaptive content.

The findings highlight three key contributions: (1) providing educators with practical AI integration strategies to enable targeted teaching while reducing workload; (2) Policy insights on equitable allocation of resources and teacher training; (3) Theoretical advances in understanding the role of artificial intelligence in language acquisition.

In addition, there was a significant positive correlation between personalized learning and language ability ($\beta = 0.668$, $p < 0.001$), suggesting that personalized instruction was particularly effective. By combining AI-driven insights with student-centered pedagogy, educators can create a more engaging and effective learning environment. Finally, these findings emphasize that the strategic integration of AI technology and personalized teaching methods is critical to advancing Chinese language education. This enhancement not only strengthens students' core language skills, but also promotes their long-term academic growth, laying a solid foundation for their future learning and development.

4.4. Discussion

1) Personalized learning has a positive impact on the improvement of Chinese proficiency in primary school in Shenzhen, China.

Through empirical investigation, this study found that artificial intelligence technology plays a key role in improving the personalized learning effect of primary school Chinese. Research data from several primary schools in Shenzhen show that intelligent teaching AIDS can effectively improve students' language learning experience and effectiveness. This finding echoes the research conclusion of domestic scholar Li [1] on the application of educational technology, which emphasizes the innovative value of modern science and technology on traditional teaching mode. The difference is that this study pays special attention to the application effect of intelligent marking system and speech recognition technology in the actual classroom, these specific levels of research are relatively rare in the previous primary school Chinese teaching research.

This research is mainly based on three core theoretical frameworks. First, Vygotsky's Zone of proximal Development theory (ZPD) provides important guidancefor the research, helping us understand how intelligent technology can accurately identify each student's current development level and provide them with appropriate learning support. Secondly, cognitive load theory (CLT) provides a theoretical basis for designing AI-assisted learning activities to ensure that learning tasks are challenging without causing cognitive overload. Finally, the Adaptive Learning Model guides us to build a dynamically adjusted learning system that automatically optimizes teaching content and difficulty based on students' real-time performance. These three theories complement each other and constitute the theoretical basis of thisstudy.

In the actual teaching feedback, Shenzhen primary school teachers generally reflect that the intelligent learning system designed based on these theories is particularly effective in composition correction and ancient poetry learning. A Chinese teacher who participated in the survey said that the system can accurately identify students' nearest development zone, and provide timely and appropriate feedback and guidance, which greatly improves teaching efficiency. These real feedback from the teaching front not only validated the results of quantitative research, but also confirmed the practical value of the theoretical framework. Through data analysis, we found that there was a significant positive correlation between the application of artificial intelligence and the improvement of Chinese ability (correlation coefficient reached 0.762), which provided a strong data support for the promotion of smart education.

2) The use of AI has a positive impact on Chinese Language Proficiency in Primary school in Shenzhen, China.

The teaching practice shows that there is a significant positive correlation between the personalized learning style and the improvement of pupils' Chineseability. Xue [2] a domestic educational scholar, pointed out in his research that effective

personalized teaching should include key elements such as differentiated teaching content, flexible teaching methods and continuous learning feedback. The findings of this study are highly consistent with this view, especially in terms of the immediacy of learning feedback and the pertinence of teaching content.

Vygotsky's zone of proximal Development theory (ZPD) provides an important basis for personalized learning, and the system accurately identifies each student's ability interval through intelligent diagnosis. Second, cognitive load theory (CLT) guides us to optimize instructional design, such as breaking down complex writing requirements into actionable steps to ensure that students' progress with appropriate cognitive load. Finally, the Adaptive Learning Model realizes the dynamic adjustment of teaching content, and the system will automatically optimize teaching strategies according to the real-time performance of students, such as automatically adding more examples and exercises for students who have difficulty understanding ancient poems and texts.

It is found that the personalized learning model under the guidance of this theory has achieved remarkable results in many aspects. In the practice of a primary school in Shenzhen, the system customized the learning content suitable for each student's ZPD interval by analyzing the students' reading fluency and writing samples. At the same time, the intelligent task decomposition effectively controls the cognitive load, so that students can devote more energy to the cultivation of core competence.

The results of regression analysis show that the explanatory degree of personalized learning on the improvement of Chinese ability reaches 0.668, which strongly supports the establishment of the research hypothesis H2. It is worth noting that this study innovatively integrates the three theories into Chinese teaching practice and confirms the complementary value of theoretical frameworks: ZPD theory ensures the relevance of learning content, CLT theory optimizes the learning process, and adaptive learning model realizes dynamic adjustment. This multi-dimensional theoretical integration provides new ideas and methods for Chinese teaching reform in the future. The use of AI has a positive impact on Personalized teaching in Primary school in Shenzhen, China.

3) AI Utilization has a positive impact on Personalized Teaching model in primary school language learning inShenzhen, China.

Based on the latest progress of the application of intelligent education technology, this study makes an empirical exploration of the personalized learning mode of primary school Chinese. The research results not only validate Chen [27] conclusion on the effectiveness of technology-enhanced learning environments, but also achieve an important breakthrough in the basic education stage. Through embedded learning analysis technology, the system can capture the cognitive development trajectory of students in real time, and provide teachers with accurate diagnosis basis for learning conditions. This innovation makes up for the limitations of traditional phased assessment.

In the concrete teaching practice, the research team creatively uses the cognitive load theory to guide the teaching design. By breaking down complex language learning tasks into step-by-step micro-goals, the system effectively reduces students' cognitive pressure. Taking the teaching of ancient poetry and prose as an example, the platform will intelligently push text versions with different levels of annotations according to the understanding level of real-time monitoring. This dynamic adjustment mechanism has significant advantages over the static hierarchical scheme proposed by Wang [28]. According to the data, after adopting this model, students' class participation increased by 37.2%, and the quality of homework completion also improved significantly.

The results of quantitative analysis showed that the personalized teaching with technical support had a significant effect on the learning effect ($\beta=0.803$, $p<0.01$). It is particularly noteworthy that the system has greatly improved the work efficiency of teachers while ensuring the teaching effect. The comparative experiment showed that the time spent on learning situation analysis was reduced by 58%, while the teaching pertinence was increased by 42%. This finding provides a feasible solution to solve the problem of teaching students according to their aptitude under the background of large class size.

From the perspective of educational practice, the intelligent teaching model constructed in this study has important promotion value. Its innovation lies in transforming advanced educational ideas into operational classroom teaching strategies, which not only maintains the humanistic care of education, but also gives full play to the advantages of technology. This mixed model of "teacher-led and technology-enabled" provides a new idea for promoting the high-quality development of basic education, and also opens up the direction for subsequent related research. In the future, the applicability of this model in other subject areas can be further explored, as well as the implementation path of schools in different regions.

4.5. Recommendations

The study recommends that primary school Chinese teachers in Shenzhen integrate AI technologies more systematically into classroom teaching, with a particular focus on composition correction and ancient poetry learning. Teachers should utilize intelligent correction systems for instant writing feedback and apply speech recognition tools to enhance poetry reading accuracy, while balancing AI tools with traditional methods to prevent over-reliance. Education departments are urged to enhance teacher training by developing three key skills: AI tool operation, data-driven learning diagnosis, and man-machine collaborative teaching design, using a training model that combines work experience, practice, and case sharing, grounded in ZPD and cognitive load theory.

Technical development teams are advised to improve system diagnostic accuracy, particularly in dialect pronunciation, optimize adaptive algorithms to better match young learners' cognitive needs, and simplify user interfaces for easier adoption. The study empirically verifies that AI-assisted personalized learning significantly enhances students' Chinese abilities, especially in writing and poetry skills. It also confirms that the most effective teaching outcomes occur when AI

systems align with students' zone of proximal development (ZPD) and incorporate cognitive load principles. Future development should prioritize precise diagnostics and stronger man-machine collaboration to maximize the benefits of AI in Chinese language education.

4.6. Further Research

While this study has demonstrated the effectiveness of AI-supported personalized learning in Chinese language education, several important areas warrant further investigation. Future research should examine how these technological interventions can be adapted to diverse educational contexts, particularly in regions with varying linguistic backgrounds and resource availability. Additionally, longitudinal studies tracking students' progress over multiple academic years would provide valuable insights into the sustained impact of AI-enhanced personalized learning on language acquisition and overall academic performance.

Another critical direction involves exploring the integration of these technologies within broader educational ecosystems. Research should investigate optimal models for teacher-AI collaboration, focusing on how educators can most effectively utilize AI-generated data to inform instructional decisions. Furthermore, studies examining the implementation of these technologies across different socioeconomic settings would help ensure equitable access to quality language education. These investigations should employ mixed-methods approaches to capture both quantitative outcomes and qualitative experiences of stakeholders.

4.7. Contributions

This study provides valuable insights into the multi-stakeholder aspects of Shenzhen's primary education system. For schools, the study demonstrates how AI-driven personalized learning platforms can improve Chinese proficiency by adapting to students' individual needs and providing scalable solutions to improve learning outcomes while optimizing resource allocation. The findings suggest that integrating these technologies could reduce the administrative burden on teachers, allowing them to focus more on interactive teaching and student engagement. Teachers can access real-time performance analytics to provide targeted interventions for students who are struggling with specific language, such as character recognition or reading comprehension.

For policymakers, the study highlights the importance of developing a supportive framework for AI integration in public education. Evidence points to the need to invest in teacher training programs to foster digital literacy, while upgrading infrastructure to ensure equitable access to digital literacy in urban and suburban schools. The study also proposes policy guidelines for protecting data privacy and the ethical use of AI in classroom Settings to address society's growing concerns aboutthe role of technology in children's development.

At the social level, the project is in line with Sustainable Development Goal 4 (Quality Education) and closes the achievement gap through personalized learning, particularly benefiting migrant children who face linguistic disadvantages. Ai-assisted methods promote inclusive education while promoting cultural preservation through standardized Mandarin learning. In addition, the platform's energy-efficient design contributes to the achievement of Sustainable Development Goal 12 (Responsible consumption) by reducing reliance on traditional paper materials.

The research ultimately supports the sustainable education transformation in Shenzhen, providing a replicable model for other cities in China. By balancing technological innovation with teaching efficiency, it provides a blueprint for improving basic literacy - a key skill for future workforce development - while maintaining cost effectiveness. Interdisciplinary research results span educational technology, language pedagogy and social equity, making substantial contributions tothe modernization of regional education.

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