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Integration and Effect Analysis of Artificial Intelligence in Intercultural Communication English Teaching

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Traditional English teaching methods are often limited to the imparting of language knowledge, and neglect the cultivation of students' intercultural communication skills. In recent years, the rapid development of artificial intelligence (AI) technology has brought new opportunities to the field of education. In language teaching, the application of AI technology can support the cultivation of cross-cultural communication competence. This study aims to explore the effect of applying AI to intercultural communication English teaching, and combine AI technology with intercultural communication teaching to improve students' intercultural understanding and communication ability. Using experimental research methods, an experimental group and a control group were set up to compare the differences between AI-assisted teaching and traditional teaching methods in improving intercultural communication ability. The application of specific AI tools in the classroom, the improvement of students' intercultural communication ability after using AI tools, and the evaluation of teachers regarding the teaching effect of AI are studied. By means of both quantitative and qualitative analysis, the outcome of using AI for intercultural communication English teaching is evaluated. According to the results, the students in the experimental group showed significant improvement in cross-cultural communication ability, and were better than the students in the control group in terms of cultural adaptability, cross-cultural understanding and communication confidence. Generally, teachers believed that AI tools can increase classroom interaction and increase students' motivation to learn and participate, confirming the effectiveness and potential of using AI for the teaching of English. This study provides a new perspective and methodology for intercultural communication English teaching, and proposes a teaching model that combines AI technology with traditional teaching methods. This study can provide a valuable reference for the future application of AI in the field of education.

Keywords: artificial intelligence; cross-cultural communication; English teaching; teaching mode; cultural adaptability

1. INTRODUCTION

1.1 Background Information of the Research Field

With the acceleration of globalization, intercultural communication competence has become an important goal of language learning. Intercultural communication English teaching and language learning help students understand and adapt to different ways of communicating and thinking when interacting with people from different cultural backgrounds. As an international language, English is being used worldwide, and English learners are faced with the obstacles of language expression and the challenges of cultural differences in cross-cultural communication. How to improve students' intercultural communication ability, especially in non-English speaking countries, has become an important subject of educational research.

At the same time, the rapid development of information technology and the maturity of AI technology have brought

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new opportunities for language education [1]. The application of AI in language teaching has made steady but remarkable progress, and the introduction of technologies such as intelligent speech recognition, natural language processing, and personalized learning systems has provided English learners with a more flexible and efficient learning environment [2]. AI-generated intelligent learning systems can assist students in language learning, and can also give feedback on students' learning progress and performance in real time, providing more accurate data support for teaching.

The traditional language teaching model focuses on the teaching of grammar and vocabulary, but neglects cultural background knowledge and communicative strategies. AI technology, language learning platforms based on big data, and intelligent voice assistants, are able to provide tailored teaching content based on students' language ability and cultural understanding. Through virtual dialogues and simulated scenarios, AI can help students exercise their communication skills in simulated cross-cultural situations and enhance their cultural adaptability and confidence in cross-cultural communication. Although the application of AI technology in English teaching is gradually increasing, systematic and in-depth research on its effect in in terms of intercultural communication teaching is still lacking. At present, most of the research focuses on the general application of AI in language teaching, and the analysis of the integration and effect of AI in intercultural communication teaching is still in the preliminary stage. Hence, it is necessary to explore ways to effectively combine AI technology with intercultural communication teaching and determine whether it can improve students' intercultural communication competence.

1.2 Research Status

The existing research provides theoretical and application support for both the integrated application of AI in intercultural communication English teaching and in criminal case trials. Kleinova and Straka studied the application of artificial intelligence in allocation route optimization, and proposed that a language model can simplify complex allocation path planning [3]. This language processing ability of the AI model can be applied in intercultural communication English teaching, which can help teachers optimize teaching content under multi-language and multi-cultural backgrounds. Moreover, it can assist with the management of criminal cases and improve processing efficiency in criminal trials.

Zhang et al. studied the application of neurobiological evidence in criminal responsibility and found that the behavior of suspects can be comprehensively analyzed through scientific evidence, and the neural mechanism underlying their behavior can be revealed [4]. This capability of AI to analyse evidence contributes to the efficiency of criminal case trial proceedings and provides scientific support for the trial. In intercultural communication English teaching, similar AI techniques can be used to understand students' cognitive patterns and then adjust teaching strategies accordingly. Chen et al. pointed out that the application of AI in service-oriented manufacturing significantly improved production efficiency and service quality [5]. The AI-driven service model in intercultural communication English teaching means that teachers can use AI tools to provide customized teaching experiences and improve students' participation and learning outcomes. In criminal cases, AI-assisted process-optimization can effectively reduce case backlog.

In his study on the efficiency of judicial license review, Kanazawa emphasized the importance of simplifying legal procedures to improve judicial efficiency [6]. In criminal trials, AI technology can simplify review procedures, reduce duplication of labor, and improve the speed of case processing. In cross-cultural English teaching, AI can also optimize the teaching process through automated testing and real-time feedback. Gao and Feng pointed out that the introduction of AI has improved the production efficiency of enterprises, especially in processing large amounts of data and automating decision-making [7]. In criminal cases, AI can quickly analyze evidence and generate reports to speed up the trial process. In cross-cultural English teaching, AI can automate the processing of teaching data, provide real-time feedback to teachers, and optimize classroom results.

Aronin and Yelenevskaya reviewed English teaching models in multilingual environments, arguing that different cultural and linguistic backgrounds require differentiated teaching methods [8]. AI can help teachers achieve personalized teaching support in intercultural communication teaching and improve teaching and learning outcomes.

Moorhouse and Kohnke analyzed the responses of the English teaching community during the Covid-19 pandemic and found a surge in the demand for distance education [9]. AI-supported online education tools play an important role in intercultural communication English teaching and can support long-distance teaching by means of intelligent teaching platforms. In criminal trials, the AI remote hearing platform provided a solution for the difficulties of appearing in court due to distance or the pandemic.

Dang et al. systematically reviewed the professional learning of English teaching in higher education and pointed out that teachers' ability to adapt to new technologies is the key to improving teaching quality [10]. AI tools can provide continuous professional development support for teachers in intercultural communication English teaching. In criminal cases, the successful application of AI depends on the technical adaptability of judicial personnel, which affects the improvement of trial efficiency.

Birhan studied autonomy and learner identity in English teaching and proposed that AI can enhance students' learning autonomy [11]. In cross-cultural communication, AI-supported personalized learning path can stimulate students' learning interest and motivation; In criminal trials, AI can assist in data analysis to help judges make their final judgments. Erciyas et al. pointed out that an individual's attitude towards AI affects his acceptance of this technology [12]. Teachers' acceptance of AI technology determines its success in intercultural communication English teaching, and in criminal cases, judicial personnel's acceptance of AI determines the extent of its application and its efficiency in trials.

Byrne pointed out that the next generation of generative AI has subversive capabilities in regard to data processing and

prediction [13]. This technology can generate more intelligent teaching materials and real-time data analysis support for cross-cultural English teaching, and help achieve the rapid analysis and prediction of complex cases in criminal cases, and improve processing efficiency. Hwang et al. summarized the application trend of AI in nursing, emphasizing the advantages of AI in task allocation and resource management [14]. In cross-cultural English teaching, AI can optimize course scheduling and student resource management. In criminal cases, AI can support the reasonable allocation of case tasks and improve the efficiency of resource utilization. El-Sherif et al. studied the application of AI in telemedicine during the pandemic and found that it could significantly improve medical efficiency [15]. This finding applies to the remote scenario of cross-cultural teaching and criminal trial, and the AI remote platform facilitates the global reach of cross-cultural teaching and the online trial of cross-regional criminal cases. However, Challen et al. and Macrae pointed out that AI needs to guard against bias in decision-making to ensure security [16, 17]. In intercultural communication English teaching, AI should avoid cultural bias and provide fair learning support. In criminal trials, AI needs to avoid data bias and ensure fairness.

1.3 Problems to be Solved

In intercultural communication English teaching, there have been some attempts to combine artificial intelligence technology with teaching content, but there are still some problems to be solved. How to effectively apply artificial intelligence to teaching design and classroom practice has not yet translated into a systematic and feasible implementation plan. The existing AI-assisted teaching method often focuses on the learning of grammar and vocabulary, and lacks the comprehensive improvement of cross-cultural communication ability. In terms of understanding cultural differences and cultivating cross-cultural communication skills, there is still insufficient application of AI technology. Hence, an important issue in current research is how to simulate and provide feedback on complex cross-cultural communication via AI technology, so as to improve students' acculturation ability and communication skills.

How AI technology can accurately provide personalized cross-cultural learning support for students from different backgrounds and different language abilities is still a challenge. At present, most AI applications have not fully taken into account cultural background differences in language learning. In multicultural communication scenarios, how to avoid cultural bias and ensure that AI can provide fair and effective learning support for all students?

There has been little integration of AI with traditional English teaching methods, and the existing teaching model is still predominantly the traditional classroom model. There is a lack of effective practical experience and theoretical guidance on how to use AI tools to give full play to their advantages in intercultural communication teaching and how teachers can effectively interact with AI in their teaching practice. Further research and experiments are needed to establish refined and innovative teaching objectives, the selection of teaching content, and the design of teaching evaluation.

The evaluation system of intercultural communication English teaching is not yet mature. When evaluating the effect of AI-assisted teaching, there is still a lack of scientific and standardized evaluation tools that can accurately measure students' progress and intercultural communication competence. How to design an effective evaluation mechanism to ensure the measurability and reliability of teaching outcomes is the problem that this research needs to focus on.

1.4 Purpose of the Study

This study explores the outcomes of integrating and applying AI technology in intercultural communication English teaching. The main goal of this study is to investigate, through theoretical and empirical analysis, how AI technology can improve students' intercultural communication ability, and determine the effectiveness of its application in actual classrooms by combining specific teaching design and practice. The research focuses on how artificial intelligence can play a role in intercultural communication education, explores how it can make up for the shortcomings of traditional teaching models, improves students' sensitivity and understanding of cultural differences, and strengthens cross-cultural communication skills.

The study analyzes and evaluates the advantages and limitations of AI-assisted teaching, explores how to effectively integrate AI with teachers' traditional teaching methods and ensure that AI tools can play a value-added role in teaching, rather than being merely auxiliary tools. Through the experimental analysis of different teaching scenarios, the practical application and effect of AI technology in intercultural communication teaching are evaluated, and the improvement plan of intercultural communication teaching strategy and teaching model based on AI is proposed, which provides a theoretical basis and practical guidance for future intercultural English teaching.

It will also focus on how AI can help teachers better identify students' difficulties and problems in cross-cultural communication in order to provide customized teaching programs according to individual needs. An exploration of the application of AI technology can help teachers to design cross-cultural education courses more accurately, and also provides students with more learning resources and practical opportunities, and promote the holistic development of students.

1.5 Main Technologies and Methods Adopted

The main technologies used in this research are natural language processing in AI, speech recognition technology and an intelligent feedback system based on deep learning. For the purpose of language teaching, these technologies can provide real-time cross-cultural communication learning support for students together with an awareness of cultural background differences. Natural language processing technology will be used to analyze students' language output and help identify students' misunderstandings and shortcomings in cross-cultural communication. Speech recognition

technology can assess language expression skills and cultural adaptability evident in students' spoken interactions within the classroom. An intelligent feedback system based on deep learning will provide personalized, targeted learning suggestions and practice tasks based on students' language learning progress and cultural understanding.

This study adopted a comprehensive research method combining quantitative and qualitative approaches. The quantitative analysis of survey data, experimental data and teaching evaluation results, indicated the extent to which AI-assisted teaching has improved students' intercultural communicative competence. The experimental group and the control group were designed to compare the influence of AI-assisted teaching and traditional teaching mode on students' learning outcomes when exposed to different teaching modes, and to determine whether there were any changes in students' language expression ability, cultural understanding ability and cross-cultural adaptability in cross-cultural communication.

Qualitative analysis was conducted of data collected via classroom observation, teacher interviews and student feedback, yielding a better understanding of the application of artificial intelligence technology in intercultural communication English teaching, and its effect on teaching practices and learning outcomes. The subjective experience of teachers and students provided first-hand information enabling the researcher to identify the problems and shortcomings of using AI in the classroom, and informing the subsequent adjustment of teaching mode.

SPSS statistical software was used for data processing and analysis, and methods such as descriptive statistical analysis, correlation analysis and variance analysis were adopted to ensure the rigor and reliability of the research results. Through multi-angle and multi-dimensional analysis, this study comprehensively evaluated the application effect of artificial intelligence in intercultural communication English teaching, revealed its potential advantages and shortcomings, thereby informing future teaching practice.

In order to verify the effect of using AI technology in cross-cultural education, the researcher also designed cross-cultural communication teaching activities based on AI and conducted specific teaching experiments as well as a review of actual teaching cases. Through the implementation of teaching activities, the researcher collected and analyze students' learning outcomes, and evaluated the impact that AI technology has on students' cross-cultural understanding and cultural adaptability.

1.6 Research Significance

With the acceleration of globalization, cross-cultural communication has become an important part of modern English education. Traditional intercultural communication teaching methods often have limitations and fail to make full use of modern scientific and technological means to improve learning outcomes. Hence, an investigation of the AI technology that is applied in this field can provide new perspectives and solutions for educational practice.

At the theoretical level, this study combines cross-cultural communication theory, AI-assisted learning theory and constructivism learning theory to build a multi-dimensional teaching framework. It is helpful to promote the deep integration of AI technology and foreign language teaching, as it provides theoretical support for the development of intercultural communication education. In this study, the researcher explored the ways that AI can cultivate students' cross-cultural awareness in the context of language teaching, and help students improve their ability to engage in cross-cultural communication in real situations through intelligent feedback mechanism, so as to provide a new theoretical perspective for relevant academic research.

At the practical level, the study explores the teaching mode and experimental design, and verifies the feasibility and effect of AI in intercultural communication teaching. It provides practical teaching strategies for educators and specific suggestions for teachers in different educational environments that will enable them to improve course content and teaching methods. By incorporating personalized learning and real-time feedback, the AI-assisted teaching model proposed in this paper is expected to overcome the inadequacies of the traditional teaching mode that appears to neglect students' cultural adaptability, and help students better understand and use language in a multicultural environment.

This research also has strong social and educational practical significance. With the rapid development of educational technology, the cognition and application of artificial intelligence by teachers and students has gradually become a new educational demand. Through this study, educational decision makers can better understand the impact of AI on the teaching process, promote the rational allocation of educational resources and the wide application of technology, and encourage the development of educational informatization. The study provides a valuable reference for teaching practices and implementation plans for higher education institutions and language education institutions, and helps to strengthen students' future competitiveness in the global market by ensuring that they have competent intercultural communication skills.

1.7 Theoretical Basis

1.7.1 Cross-Cultural Communication Theory

Cross-cultural communication theory aims to explain the interaction patterns of people with different cultural backgrounds when engaging in communication, the causes of misunderstanding and conflict, and how to effectively promote cross-cultural communication. Essentially, this theory posits that language is not only a tool for transmitting information; it also carries cultural connotations. Therefore, language learners should not only master grammar and vocabulary, but also possess cultural awareness and the ability to adapt to different cultural norms in cross-cultural communication. The cultural dimension theory proposed by Hofstede (1980) has exerted a profound influence on the theory of intercultural communication. This theory uses six dimensions (power distance, individualism and collectivism, masculinity and femininity, uncertainty avoidance, long-term orientation and

short-term orientation, tolerance and restraint) to determine the differences between different cultures, assisting language learners to understand and cope with potential challenges in cross-cultural communication. In the teaching of intercultural communication, in addition to learning the language characteristics of people from different cultural backgrounds, students can improve their intercultural adaptability and communication skills through situation simulation and intercultural communication practice. With the advancement of globalization, intercultural communication competence is regarded as one of the core objectives of modern foreign language education. This theory also provides theoretical support for ways to integrate cultural elements into teaching practices and enhance students' intercultural awareness.

1.7.2 Constructivism Learning Theory

Constructivism learning theory, proposed by Piaget (1973), Vygotsky (1978) and other scholars, posits that learners actively construct a knowledge system through interaction and social communication with the environment. According to constructivism theory, learning is a process of continuous development, reconstruction and revision of cognitive structure, in which learners do not passively accept knowledge, but connect new information with existing knowledge through experience and reflection to form personalized understanding. In foreign language teaching, constructivist learning theory emphasizes situational learning, cooperative learning and problem solving to stimulate students' learning motivation and improve their ability to solve practical problems. Especially in the study of cross-cultural communication, constructivism provides students with a strong interactive learning platform. Students not only need to understand the grammatical structure of languages, but also need to expand their understanding of cultural differences through communication and cooperation with others, and from feedback; this enables them to establish effective cross-cultural communication strategies. This theory provides important guidance for modern language teaching and promotes the in-depth development of cross-cultural education through the student-centered teaching method.

1.7.3 AI-Assisted Learning Theory

AI-assisted learning theory has emerged following the development of AI technology in recent years. This theory advocates that AI technology can provide learners with personalized learning paths and real-time feedback, so as to promote the improvement of learning outcomes. In language learning, AI technologies such as natural language processing, speech recognition, intelligent recommendation etc. can help students adjust their learning content according to their learning progress and mastery level. AI-assisted learning theory comprises the analysis of students' learning behavior through machine learning algorithms, so as identify the weak links in learning, and then provide targeted learning resources and feedback. This intelligent learning method can improve learning efficiency and increase students' interest in learning. When applied to language learning, this method can significantly improve students' oral communication skills including language fluency, and their cultural acquisition. For English teaching in intercultural communication, AI can simulate dialogue scenes between entities from different cultural backgrounds, help students understand and cope with linguistic expression, tone differences and cultural symbols in non-verbal communication in various cultures, and improve their intercultural communication ability more effectively. With the continuous progress of AI technology, AI-assisted learning theory will have a more profound impact on foreign language education, especially on intercultural communication English teaching.

2. MATERIALS AND METHODS

2.1 Data Collection and Sample Selection

2.1.1 Sample Selection

The sample collected for this study was based on the need for a systematic evaluation of the effect of using AI for intercultural communication English teaching. In order to ensure the broadness and representativeness of the research results, the sample group comprised students and teachers from different backgrounds and cultures. Participants were divided into two groups: experimental and control. Members of the experimental group received AI-based cross-cultural communication English teaching, while the control group received traditional cross-cultural English teaching.

The student sample comprised Grade 10–12 learners with a documented intermediate proficiency verified by the school's standardized placement exam (cut-off: 60–80th percentile) and at least six years of formal English instruction. Pretest results indicated similar baseline scores in listening, speaking, reading, and writing for the experimental and control classes. The teacher sample comprised teachers of English who had at least five years of teaching experience, together with a cross-cultural education background. Students in the experimental and control groups ranged in age from 16 to 18, and all were selected from the same school to reduce the influence of other external variables. The sample size of the experimental group and the control group was balanced as far as possible to ensure the comparability and reliability of data.

In order to ensure the scientific selection of samples, the cultural background and language ability of participants were also considered to ensure that the selected samples could reflect the diversity and extensiveness of intercultural communication teaching. The number of students, age range, teaching experience, and background (variables) of both the experimental and control groups are shown in Table 1 below.

2.1.2 Data Collection Methods

The data was collected via a questionnaire survey, interviews, and classroom observation. The purpose of the questionnaire survey was to understand students' cognition, attitude towards AI-assisted teaching, and the improvement of cross-cultural communication ability. The questionnaire items related to students' learning experience, understanding of course content, satisfaction with classroom interaction, and mastery

Table 1 Sample distribution and basic information.

êGroup	Number of Students	Age Range	Number of Teachers	Teacher Experience (Years)	Teacher Background	Teaching Type
Experimental	50	16–18	5	5	Experience in Cross-Cultural Education	AI-assisted Teaching
Control	50	16–18	5	5	Experience in Cross-Cultural Education	Traditional Teaching

Table 2 Data collection methods and implementation.

Data Collection Method	Participants	Content	Implementation Time	Data Volume
Questionnaire	Students	Learning Experience, Satisfaction	Before and After Teaching	100 Questionnaires
Interviews	Students, Teachers	Teaching Feedback	Multiple Times During the Teaching Period	10 Interviews
Classroom Observation	Students, Teachers	Classroom Interaction	Every Class	12 Observations

Table 3 Data analysis methods.

Data Type	Analysis Method	Software Tools	Main Analysis Content
Questionnaire Data	Descriptive Statistics, Paired Sample t-test	SPSS	Learning Attitudes, Satisfaction, Improvement in Cross-Cultural Ability
Interview Data	Content Analysis	NVivo	Teaching Feedback, Students and Teachers Views on AI Tools
Classroom Observation Data	Coding Analysis	Manual Coding	Student Interaction, Effectiveness of AI Tools

of cross-cultural knowledge. A Likert five-point scale was used to ensure the quantification and objectivity of the results. All questionnaires were distributed before and after the experiment, and the changes before and after AI-assisted teaching were compared and analyzed.

The semi-structured interviews were conducted to obtain the opinions and attitudes of teachers and students in regard to teaching methods, the use of AI tools, and students' participation in cross-cultural discussions in the classroom. The semi-structured format ensured that, for consistency, interviewees were asked the same questions, and also had the freedom to expand on their answers and give in-depth insights into relevant issues not covered by the pre-established questions. After the interview recordings were organized, the core ideas related to the research topic were extracted.

Classroom observation involved observing the interaction between teachers and students during the lesson, and noting students' participation in cross-cultural communication activities, language use, and the actual role of AI tools. Observers record key events according to a pre-designed observation framework, ensuring data objectivity and consistency. The specific implementation of each data collection method, including participants, collection content, implementation time and data volume are shown in Table 2 below.

2.1.3 Data Analysis Methods

In order to ensure the accuracy and scientific rigor of the research results, quantitative analysis and qualitative analysis were combined. For the quantitative analysis, SPSS was used for data processing. For the questionnaire survey data, descriptive statistical analysis was used to obtain students' overall evaluation of AI-assisted teaching, including the distribution of satisfaction and learning outcomes. The paired sample t test was used to compare the changes in intercultural communication ability and language ability between the experimental group and the control group, and to test whether the effect of teaching mode was statistically significant. In order to explore the influence of different variables on students' learning outcomes, analysis of variance (ANOVA) was used to determine the influence of different background factors (such as gender, grade, English level) on students' learning outcomes.

For the qualitative analysis, through the content analysis of the transcript of the interview recording, the feedback of teachers and students on the key problems and outcomes of the teaching process were extracted. It is necessary to have an in-depth understanding of the application of AI tools in intercultural communication teaching and students' acceptance of this teaching method. Classroom observations were coded so as to systematically record the performance of AI when applied to teaching activities, and its impact on students' participation and interaction. The data analysis methods, tools used and main analysis contents are shown in Table 3 below.

2.2 Model Construction

2.2.1 Model Selection

Given that cross-cultural communication teaching requires efficient language understanding and language generation, this study chose natural language processing (NLP) and the

speech recognition model as the core technologies. Natural language processing (NLP) technology can conduct semantic analysis of students' language expression, identify their language errors in communication and provide immediate feedback. The speech recognition model can accurately identify students' spoken language, evaluate pronunciation, intonation and speech fluency, and improve the learners' cross-cultural communication ability.

A pre-trained language model based on transformer architecture, such as BERT or GPT, was chosen for the development of the natural language processing model. This model has strong contextual understanding and generation ability, can cope with the diversity and complexity of language in cross-cultural context, and support the immediate analysis and feedback of students' spoken or written language. When using the BERT model, the clarity and accuracy of student expression are assessed by calculating the similarity between sentences through Eq. (1).

$$sim = \frac{A \cdot B}{|A| \cdot |B|} \tag{1}$$

Where A and B represent the language expression vectors of students and teachers respectively, and their similarity is measured by calculating the cosine similarity between the two vectors.

The speech recognition model adopts the architectures of the convolutional neural network (CNN) and the recurrent neural network (RNN) under the deep learning framework to improve the accuracy and speech recognition in real time. The voice signal is first extracted by CNN, modeled by RNN, and finally outputs the recognition result through the full connection layer. This method can effectively improve the accuracy of cross-cultural speech recognition in terms of accent, speech speed and other factors. In order to evaluate the performance of the AI model, Eq. (2) is designed to calculate the recognition accuracy of the model in the actual teaching scenario.

$$accuracy = \frac{TP + TN}{TP + TN + FP + FN} \tag{2}$$

where TP represents true cases, TN represents true negative cases, FP represents false positive cases, and FN represents false negative cases. This equation is used to evaluate the accuracy of the model in recognizing students' speech; subsequently, the feedback mechanism of the AI tool can be adjusted to improve the teaching outcome.

2.2.2 Model Architecture Design

In this study, an AI application architecture was built based on the cloud platform, combining natural language processing and speech recognition technology to achieve comprehensive support for intercultural communication English teaching. The whole system consists of three main modules: a data processing module, an AI model module, and a user interaction module. The data processing module is responsible for the acquisition and pre-processing of students' language input, including the cleaning and standardization of text and speech data. The AI model module contains the NLP and speech recognition models selected above for analyzing students' speech and speech data. The user interaction module provides the interactive interface between teachers and students and the system, including intelligent feedback and personalized learning suggestions.

In the architecture design, the transmission and processing of data are carried out through the cloud computing platform, which ensures the efficiency and scalability of the system. Students' voice and text input is uploaded to the cloud platform through the front-end device, and after initial processing by the data processing module, it is passed to the AI model for in-depth analysis. The analysis results returned by the AI model are displayed to teachers and students through user interaction modules. Teachers can adjust their teaching strategies based on feedback, and students can improve their learning methods also based on feedback. The model architecture design is shown in Eq. (3). A complete AI processing flow is created through three hierarchical structures: input layer, processing layer and output layer.

$$y = f(x) = W_2 (W_1 x + b_1) + b_2 \tag{3}$$

where, x represents the input data (the student's language input), W_1 and W_2 are the weight matrix of the model, b_1 and b_2 are the bias items, and y is the output result of the model (that is, the feedback on the students' learning performance). This architecture ensures that the system can provide personalized feedback in real time in response to students' input, and promote the improvement of students' language ability and cultural understanding in cross-cultural communication. When designing the model architecture, this study also considered data privacy and security to ensure that students' personal information is fully protected during processing and meets the requirements of relevant laws and regulations.

2.2.3 Training Process and Data

In order to ensure the effectiveness of the artificial intelligence model in intercultural communication English teaching, this study conducted systematic training of the model, and the data selection and training process design followed scientific and rigorous methods. The training data was selected based on students' language input and phonetic performance, covering diverse cultural backgrounds, language habits, phonetic features and expressions related to cross-cultural communication. Students' oral recordings and written language texts were included to ensure that the model could comprehensively assess students' intercultural communication competence.

The training data comprised actual teaching data from multiple schools and an open cross-cultural communication corpus. Specifically, the dataset contained both speech and text data on English expressions made by students from different cultural backgrounds. The data included students' immediate reactions in class, self-expression after class, and several simulated cross-cultural dialogues. When processing data, special attention was paid to removing noisy data and irrelevant content to ensure the quality of the training set.

The supervised learning method is adopted for model training, as a large amount of labeled data is involved. For speech recognition, marked pronunciation data is used to train the model for more accurate pronunciation recognition by

Table 4 Basic information on training dataset.

Data Type	Data Source	Data Volume	Included Languages	Applicable Scenario
Speech Data	School Classroom, Public Corpus	500 hours	English (US, UK Accents)	Cross-Cultural Communication Dialogue
Text Data	School Classroom, Cross-Cultural Communication Corpus	20,000 Sentences	English (Multi-cultural Background)	Cross-Cultural Writing, Dialogue Generation
Speech-Text Matched Data	School Recording Studio, Online Corpus	300 hours	English (Various Accents)	Speech Recognition Training

comparing speech input with correct speech text labels. The natural language processing section uses annotated text data to compare students' language expression with the correct expression in standard grammar and context. The training process optimizes the parameters of the model through batch gradient descent, which can optimistically adapt to the data in the actual teaching scenario.

For the training process, the cross-validation method is used to evaluate the model, ensure the generalization ability, and prevent overfitting. The data is divided into training sets and validation sets to better monitor the training progress of the model and evaluate its performance in real scenarios. For the training, various hyperparameters (such as learning rate, batch size, etc.) are optimized to ensure the efficiency and accuracy of the model. The basic information regarding the training data is shown in Table 4 below.

A meticulous manual review of data labeling and processing ensures that each piece of data provides valuable information to help models better understand students' linguistic performance in cross-cultural communication. Throughout the training process, privacy protection regulations are applied to ensure that students' personal data is not leaked. By means of carefully designed training data and a scientific training process, the model can effectively identify and analyze students' language ability in cross-cultural communication, and provide personalized feedback and suggestions. The evaluation of the effectiveness of the training process is measured by the performance of the model on the verification set. By calculating the loss function (such as cross entropy loss), the learning effect of the model in different scenarios can be accurately evaluated, and it can be continuously adjusted in actual teaching scenarios to ensure that it can provide relevant help to students.

2.2.4 Performance Evaluation

After the training of the artificial intelligence model is completed, its actual performance in cross-cultural English teaching must be strictly evaluated. In order to ensure that the model could effectively improve students' intercultural communication competence, this study used several indicators to measure its performance, including accuracy rate, accuracy rate, recall rate and F1 score. The loss function of the model is also one of the important means of evaluating its effect. By comparing and analyzing the performance of the model on the training set and the verification set, we can systematically understand the performance of the model and its application effect in different teaching scenarios.

When evaluating the performance of a model, the accuracy rate of the speech recognition model is a fundamental factor to be considered. By calculating the recognition accuracy of the model on the validation set, students' fluency in oral expression can be measured. The evaluation of the text generation focuses on the understanding and feedback of students' written expression, and evaluates their language writing ability by comparing the generated text with the students' actual performance. The assessment of intercultural communicative competence is based on students' performance in simulated cross-cultural situations, and through the combination of students' feedback and teachers' evaluation, the model's success in improving students' language competence is evaluated. The function of the loss function equation is to help evaluate the error level of the model during training, as shown in Eq. (4).

$$\mathcal{L} = -\frac{1}{N}\sum_{i=1}^{N}\sum_{c=1}^{C} y_{i,c}\log \hat{y}_{i,c} \tag{4}$$

Where $y_{i,c} \in \{0, 1\}$ is the ground-truth indicator that sample; i belongs to class; $\hat{y}_{i,c} \in \{0, 1\}$ is the model-predicted probability for class; c is the number of classes; N is the number of samples; and $\mathcal{L}$ is the loss value. For binary classification ($C = 2$), Eq. (4) reduces to the binary cross-entropy.

Model parameter settings and evaluation results are shown in Figure 1 below. The data shows the optimization effect and the final performance of the trained model.

As shown in Figure 1, the integrated model (voice + text) performed the best, with high scores for accuracy, recall, and F1. In terms of the value of the loss function, the loss of the speech recognition model is low, which indicates that the processing of speech input is excellent. On the whole, the actual performance of the model in intercultural communication English teaching has reached the expected goal and is highly applicable.

2.3 Teaching Design and Experiment Implementation

2.3.1 Design of Teaching Activities

In this study, the design of teaching activities takes artificial intelligence as a support tool and combines it with the actual needs of intercultural communication to in order develop an AI-assisted intercultural communication teaching activity

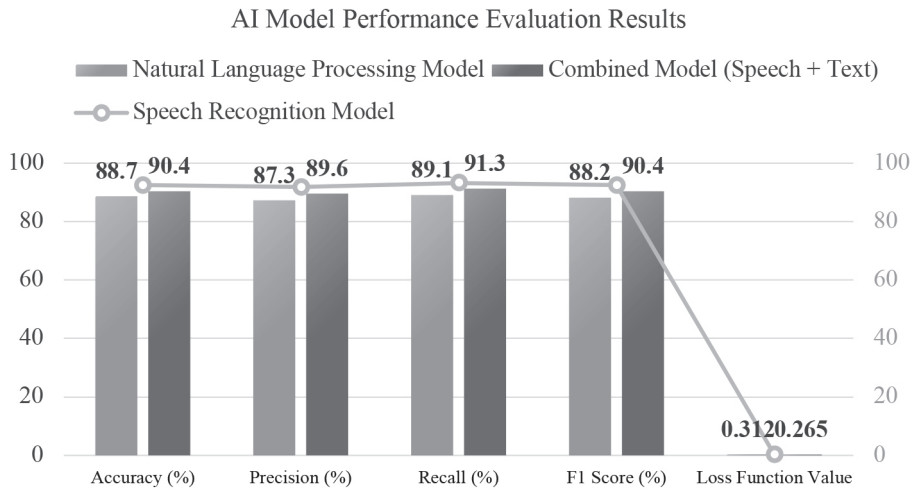

Figure 1 Performance evaluation results of AI model.

plan for middle-school students. The core objective of the program is to apply modern technology to enhance students' intercultural understanding and language skills. The design of teaching activities takes into account the learning characteristics and cultural background of students to ensure that the teaching process is both challenging and practical.

In activity design, AI technology is used for two purposes: AI-assisted speech recognition and natural language processing models to help students understand and analyze language expressions in different cultures and their cultural connotations; and through the simulated cross-cultural situation generated by AI, students can role-play in the virtual environment, experience the communication rules of different cultures, and learn and master cross-cultural communication skills in practice. For example, students engage in a dialogue with a virtual character in a scenario that simulates an international conference or a transnational communication, and AI gives immediate feedback and corrective suggestions based on the students' responses, helping students improve their self-confidence and expression skills in the interaction.

In order to ensure the smooth progress of teaching activities, the content and schedule of activities gradually become more complex, and the content of activities is differentiated according to the students' language ability and level of cultural background knowledge. The content of each activity includes basic cross-cultural theory explanation and specific language operation training to ensure that students can improve in terms of theory knowledge and practical application. Every link of the teaching activities provides students with sufficient practice and feedback opportunities to help them improve their cross-cultural communication skills through consistent practice.

2.3.2 Implementation of Teaching Experiments

The implementation of the teaching experiment involved teaching activities, the setting of a teaching environment, and the organization of the experiment cycle. In order to ensure the scientific rigor and validity of the experiment, the research team selected a representative group of schools and students for the experiment. The experiment comprised four phases: teaching preparation, evaluation before the experiment, teaching implementation, and evaluation after the experiment.

The setting of the teaching environment was based on intelligent classrooms and AI-based teaching platforms, which integrate a variety of AI tools such as speech recognition, natural language processing, and virtual role playing, providing a learning environment with strong interaction and timely information feedback. During the experiment, the teacher divided the students into groups, and each group was given an independent task and learning goal. After each teaching activity, teachers commented on the students' performance and provided targeted improvement suggestions using AI tools for data analysis.

The experiment lasted for a total of four weeks, with two teaching activities per week, each lasting about 90 minutes. At the end of the experiment period, the research team assessed the improvement of students' intercultural communication ability through questionnaires and student performance data. Teachers adjusted the content of the teaching activities according to the students' feedback so as to improve the teaching outcomes. The schedule and content of teaching activities are shown in Table 5 below.

2.4 Research Paths and Suggestions

2.4.1 AI-Based Teaching Content Customization Path

The application of AI technology enables the customization of teaching content to adapt to the needs and learning progress of individual students more accurately. In order to customize the teaching content based on AI, it is necessary to comprehensively analyze the students through the AI system according to the cultural background, language ability, interests and other factors, and obtain the personalized learning data of the students. The collection and analysis of this data provide the basis for the accurate customization of the subsequent teaching content.

AI technology can tailor course content to students' needs based on their learning data. For example, by analyzing

Table 5 Schedule and content of teaching activities.

Time	Activity Content	Teaching Goals	AI Tools Used
Week 1, Session 1	Basic Theories of Cross-Cultural Communication	Help students understand fundamental concepts and skills of cross-cultural communication	AI Speech Recognition, Virtual Character Role-play
Week 1, Session 2	Cross-Cultural Differences and Language Habit Comparison	Deepen students understanding of cultural language habits through case analysis	Natural Language Processing, Cultural Background Analysis
Week 2, Session 1	International Communication Simulation Role-play and Feedback	Improve students' language flexibility and expression in simulated international communication	AI Speech Interaction, Scenario Feedback System
Week 2, Session 2	Cultural Adaptability and Communication Skills Practical Training	Help students apply language strategies effectively in cross-cultural communication	Virtual Scenario Simulation, Real-Time Feedback System
Week 3, Session 1	Non-verbal Communication Training in Cross-Cultural Communication	Enhance students' sensitivity to non-verbal communication in cross-cultural contexts	AI Visual Analysis, Facial Expression Recognition
Week 3, Session 2	Etiquette and Communication Methods in International Business	Strengthen students understanding of language and behavior norms in international business settings	AI Virtual Business Simulation, Speech and Text Generation
Week 4, Session 1	Comprehensive Simulation of Cross-Cultural Communication Scenarios	Apply all learned cross-cultural communication skills in real-life simulated dialogues	AI Speech Interaction, Scenario Feedback and Scoring
Week 4, Session 2	Course Summary and Evaluation, Individual Performance Analysis	Summarize learning achievements and assess improvement in students' cross-cultural communication abilities	Data Analysis and AI Evaluation Report

students' learning progress and expression ability in cross-cultural communication, the AI system can automatically adjust the difficulty and depth of the content of the textbook to ensure that each student receives training at the appropriate learning level. Such personalized and customized teaching content can improve learning efficiency, stimulate students' learning interest, and enable them to make better use of language skills and cultural background knowledge in actual cross-cultural communication. AI can dynamically adjust the learning content according to the real-time feedback of students, and provide students with timely language support and cultural interpretation when they encounter difficult situations, so as to help them gradually improve their cross-cultural communication ability in practice. When customizing teaching content, teachers need to be flexible when adjusting their teaching strategies according to students' learning status and feedback, combined with the data provided by AI. With the assistance of AI technology, teachers can more quickly understand the learning status of students, make more accurate teaching decisions, and ensure that each student can improve his or her cross-cultural communication skills in an appropriate learning environment.

2.4.2 Effect Analysis Path of AI Interactive Teaching

The AI interactive teaching model emphasizes the interaction between teachers and students, but also pays attention to the interaction between students and virtual systems. Through the interactive mode, students can learn cross-cultural communication knowledge under the guidance of teachers, and they can also obtain instant feedback and guidance by interacting with the AI system. The analysis of the AI interactive teaching outcomes is discussed below.

Teachers use AI-assisted tools to collect learning data from students, such as the accuracy, fluency and cultural adaptability of students during the interaction. Through the analysis of data, we can ascertain the learning outcomes of students and the adaptability of teaching content. For example, the AI system can provide real-time feedback on students' language expression ability in cross-cultural situations, helping teachers to understand students' weaknesses and make targeted adjustments accordingly. AI interactive teaching can also record students' emotional responses and learning emotions, and assess students' interest and engagement in teaching activities through sentiment analysis techniques. These data provide an important basis for optimizing the teaching process and improving the learning outcomes of students.

The analysis of the outcomes of AI interactive teaching must take into account any changes in students' performance during actual cross-cultural communication. Simulated cross-cultural communication scenarios enable students to interact with AI systems. AI uses speech recognition and situational simulation technology to assess students' resilience and language adaptation in certain scenarios. At the end of the experiment period, teachers evaluated the actual effect of the AI interactive teaching mode by comparing students' learning performance and interactive data at different stages. The evaluation criteria were: the improvement of students' cross-cultural communication ability, language expression ability, and cultural adaptation ability.

The analysis of the outcomes of AI interactive teaching also needs dynamic evaluation with the help of a feedback mechanism. Students can input their understanding and feelings to the AI system at any time during the teaching process, and the AI system can make timely adjustments according to this feedback information. This two-way interactive learning mode helps students to gradually improve their language ability and cross-cultural communication ability, as their learning strategies are constantly being adjusted.

3. RESULTS AND DISCUSSION

3.1 Results

3.1.1 Comparison of Intercultural Communication Competence Improvement

The results of the comparison between the experimental group and the control group show the extent of improvement of students' intercultural communication ability with and without AI-assisted learning, respectively. The experimental group was taught by AI-assisted intercultural English teaching tools, while the control group was taught by traditional methods. By assessing the cross-cultural communication ability of the two groups of students before and after teaching, we can clearly see the role of AI tools in improving students' ability.

The improvement of intercultural communication ability of students in the experimental group showed that the language expression skills of students in the experimental group were significantly improved in terms of language fluency and accuracy during the simulated scenario. With instant feedback and interactive exercises provided by AI-assisted tools, students can constantly adjust their language expression in a simulated cross-cultural communication environment, gradually improving the accuracy and naturalness of their language. Figure 2 below shows the scores before and after the experiment. The experimental group's language expression ability in the situational simulation test increased by 15.2%. The acculturation ability was also enhanced. Students in the experimental group acquired English language knowledge by interacting with the AI system, and understood the communication methods, habits and taboos of different cultures through the cross-cultural situation simulated by AI. Compared with the control group, the students in the experimental group showed greater improvement in their adaptability and cultural sensitivity in cross-cultural situations, and performed better in simulated cross-cultural negotiation and daily communication. According to the test data, the cultural adaptability score of the experimental group of students increased by 18.3%.

The students in the control group improved their intercultural communication ability relatively more slowly under the traditional teaching methods. Although there are cross-cultural education contents in traditional teaching methods, there is a lack of personalized feedback and interaction, and students' coping ability and language fluency in real cross-

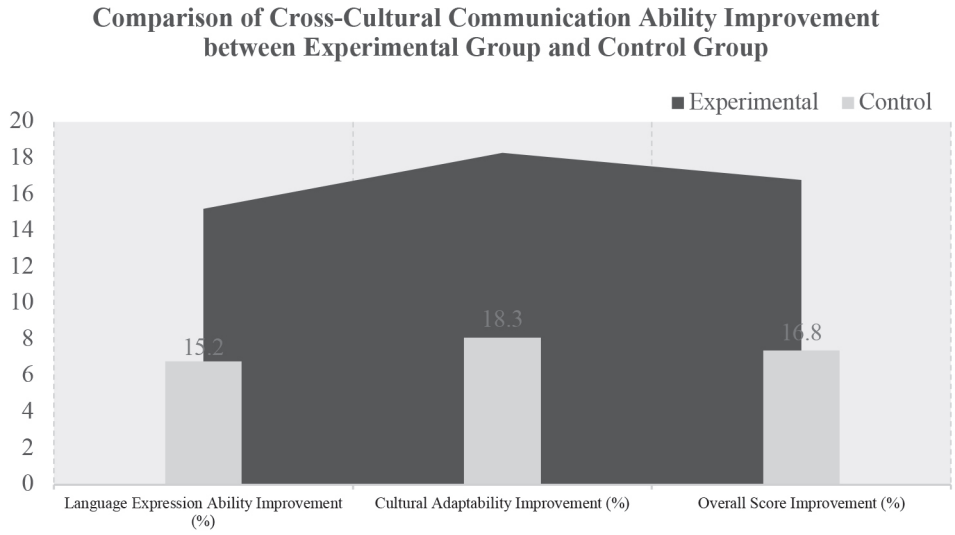

Figure 2 Comparison of the improvement of intercultural communication ability for the experimental group and the control group.

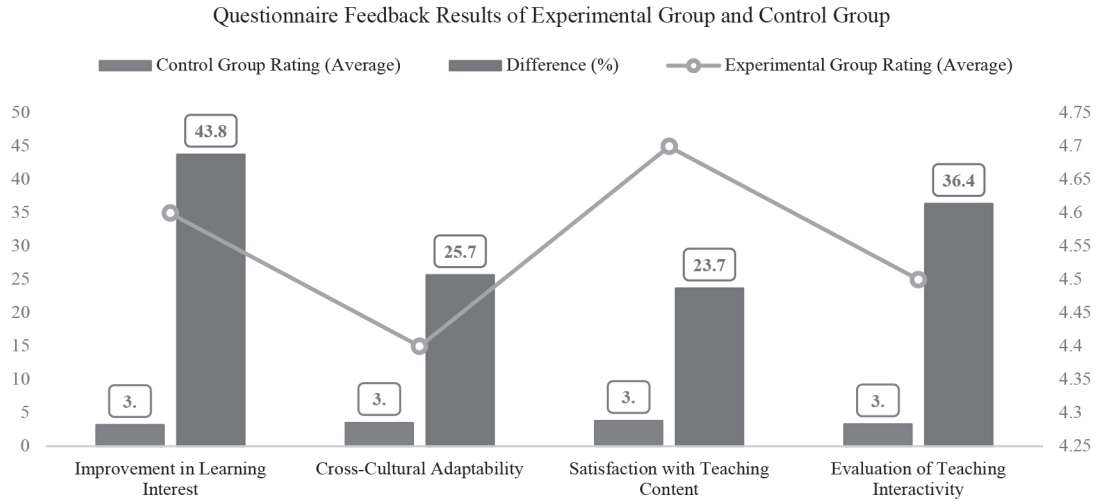

Figure 3 Questionnaire feedback results of experimental group and control group.

cultural communication have not been significantly improved. The language ability and cultural adaptability of the control group increased by 6.8% and 8.1%, respectively. Comparing the performance of the two groups of students in various tests, it can be seen that AI tools have a positive impact on improving students' cross-cultural communication ability. The scores of the experimental group are generally higher than those of the control group, demonstrating the advantages of AI-assisted teaching tools in improving students' language ability and cross-cultural adaptability.

3.1.2 Survey Results of Student Feedback and Learning Effect

In this study, through the analysis of the questionnaire feedback results of the experimental group and the control group, the impact of AI-assisted intercultural English teaching on students' intercultural communicative competence was evaluated. In general, students in the experimental group stated that AI-assisted teaching improved their interest in learning and class participation. Through the personalized learning content and real-time feedback provided by the AI system, students were able to self-adjust according to their learning progress. This flexible way of learning made students more confident in cross-cultural situations and able to better understand the differences between different cultures. Students generally reported that AI-assisted tools enhanced their adaptability and cultural sensitivity by simulating cross-cultural communication scenarios.

The feedback from the control group showed a more traditional assessment. Although they obtained a certain amount of knowledge within the classroom, the traditional teaching method lacks sufficient interaction and personalized feedback, resulting in students being more conservative in the face of complex cross-cultural communication situations. Most students believed that traditional teaching lacks relevance, fails to fully stimulate their interest in cross-cultural communication, and fails to improve their sensitivity to cultural differences.

As shown in Figure 3 below, the satisfaction score of the experimental group is generally higher than that of the control group, with significant differences in two dimensions: "learn-

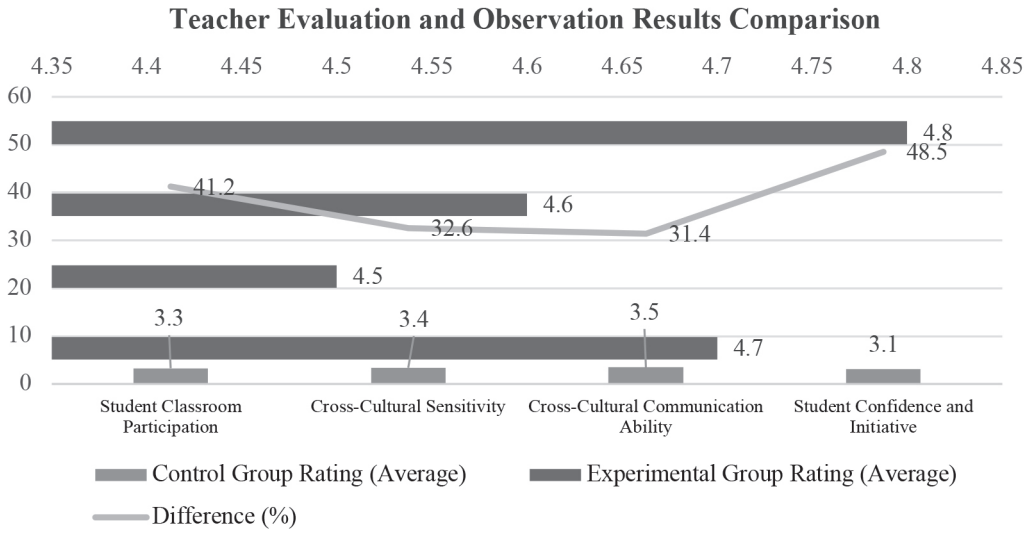

Figure 4 Comparison of teacher evaluation and observation results.

ing interest enhancement" and "cross-cultural adaptability". The average score of the experimental group for "learning interest enhancement" is 4.6, while that of the control group is 3.2. In terms of "cross-cultural adaptability", the experimental group scored 4.4 and the control group 3.5. These feedback results show that AI-assisted teaching has obvious advantages in improving students' intercultural communication ability and motivation to learn.

3.1.3 Teacher Evaluation and Observation Results

The teachers conducted detailed evaluations and observations of the performance of students in the experimental group and the control group in terms of intercultural communication competence. Through the observation of students' participation, interaction and cultural understanding ability during classroom teaching, the key evaluation results are obtained. As shown in Figure 4 below, teachers of the experimental group generally reported that students' participation in class increased significantly. Students showed greater enthusiasm during group discussions and role-playing activities, and they were able to participate actively in the simulation scenarios of cross-cultural communication, raise relevant questions, and try to address the barriers in cross-cultural communication. Teachers also observed that students showed more sensitivity when interacting with people from different cultural backgrounds, were more aware of cultural differences, and accordingly made adjustments in communication. The improvement in students' capabilities is due in part to the real-time feedback and personalized learning support provided by AI tools.

Conversely, in the control group classroom, the main problem observed by teachers was that students lacked sufficient self-confidence and flexibility in cross-cultural communication situations. Most students are more conservative in the face of cultural differences, and their class participation and enthusiasm for discussion are lower than those in the experimental group. Teachers pointed out that although traditional teaching methods can also impart cross-cultural knowledge, the lack of effective practical links and targeted teaching support leads to students' weak understanding of, and ability to cope with, cultural differences.

3.2 Discussion

3.2.1 Problem Summary

The results of this study show that AI has advantages in intercultural communication English teaching, but it also has shortcomings. The comparison of results for the experimental group and the control group, as well as the teacher's evaluation and observation, indicates that AI-assisted teaching can effectively improve students' cross-cultural communication ability. The personalized learning support from AI tools enabled students to be more flexible and confident in understanding and responding to cultural differences. The instant feedback and simulation exercises provided by AI helped students better combine theory with practical applications, improving their cultural sensitivity and communication skills. The students in the experimental group showed significant improvement in terms of class participation, communication ability and cultural adaptability compared with the control group.

However, the application of AI in teaching is also not without shortcomings, and while AI can provide a personalized learning experience, its depth and breadth in regard to cross-cultural communication are still limited. AI systems rely mainly on data-driven models, and while capable of processing large amounts of information, it is still difficult to completely replace the emotional interaction and personal care provided by teachers. In the classroom, students' cultural understanding does not depend solely on the feedback given by the machine; students also need to be guided and inspired by the teacher. The application of AI technology may lead some students to rely too much on technology and neglect emotional communication and interpersonal interaction in cross-cultural communication.

3.2.2 Research Suggestions

Based on the research results, it is essential to optimize the application of AI in intercultural communication English

teaching. First, AI systems should be designed so that they can understand cultural context in multiple dimensions. In cross-cultural teaching, the differences in cultural backgrounds is often the key factor affecting the communication outcome. The AI model can improve the adaptability and flexibility of speakers in different cultural scenarios by introducing richer cultural data and situation simulation. AI technology should focus more on synergies with teachers. While AI can provide a personalized learning path, the emotional guidance and human interaction provided by teachers are still necessary to promote students' deep understanding and cross-cultural adaptation. The design of an AI system should be integrated with teachers' teaching strategies to create a more effective teaching impact.

However, there should not be an over-reliance on the use of AI tools should avoid over-reliance. In order to maintain the initiative and creativity of students, there should be a balance between the use of AI tools and traditional teaching methods. By designing more interactive activities, teachers can encourage students to explore themselves with the help of AI systems and increase their confidence in actual communication. Finally, when introducing AI-assisted teaching, educators need to strengthen students' training on the use of technology, help them understand the functions and limitations of AI tools, avoid the problem of over-dependence, and foster students' independent thinking and expression in cross-cultural communication. Further optimization of the application of AI technology, combined with the guidance and interaction of teachers, will give AI a more prominent role in intercultural communication English teaching and provide students with a richer learning experience and more opportunities for cultural exchange.

4. CONCLUSION

4.1 Main Findings and Conclusions of the Study

The most significant finding of this study is that the application of AI in intercultural communication English teaching has significant advantages that can improve students' intercultural communication competence. The comparative analysis of results for the experimental group and the control group, revealed that students using AI tools performed better than students who were taught by traditional methods in terms of cultural sensitivity, communication ability and cross-cultural adaptability in cross-cultural communication. The personalized teaching model of the AI system can provide tailored learning content according to students' learning progress and interests, and enhance students' understanding and ability to apply cross-cultural knowledge. In interactive exercises simulating different cultural scenarios, AI tools can help students to cope better with cultural differences in actual communication and improve their communication confidence and problem-solving skills.

Teacher evaluation and student feedback support the conclusion, as teachers generally believe that AI-assisted teaching can encourage more interaction and interest in classroom activities, and improve students' class participation and enthusiasm for learning. Students also said that the instant feedback and self-directed learning mode provided by AI enabled them to improve in a stress-free environment, especially when dealing with cultural differences and cross-cultural communication; moreover, with the aid of AI tools, they were able to better understand information and acquire relevant knowledge.

Although AI has shown good results in English teaching in cross-cultural communication, the research has also found limitations and shortcomings in the depth of cultural background and the level of human communication. AI systems currently rely more on data-driven models, and the depth of cultural adaptability and emotional interaction is still limited. Hence, the role of AI should be seen as complementary to traditional teaching methods, not as a substitute.

4.2 Limitations and Deficiencies of this Study

This study verifies the effectiveness of AI in teaching English intercultural communication, but it also has limitations. The sample size of the study was relatively small, focusing mainly on English learners in a certain region. Due to regional cultural differences, the generalizability of the results may be limited. The experimental period of this study was short, limited to one semester. In a shorter time frame, students' learning outcomes may not be fully reflected, and complex skills such as intercultural communication competence, may take longer to acquire and practice. The study did not investigate the specific ways in which AI technology is applied and its impact on the role of teachers. In the teaching of intercultural communication, the guiding role of teachers cannot be ignored.

4.3 Suggestions for Future Research

The conclusions and limitations of this study provide several directions for future research endeavours. The sample size and scope of the research should be expanded to comprise students from different regions, cultural backgrounds and various levels of English proficiency, so as to improve the representativeness and universality of the research results. Long-term, follow-up studies can help to determine the lasting impact of AI-assisted instruction on students' intercultural communicative competence, especially on the cultivation of language application competence and cross-cultural adaptability.

Future research should explore in depth the interaction mechanism between AI and teachers. In the teaching of intercultural communication, AI can provide students with personalized learning support, but emotional exchange and humanistic care are still unable to compete with those provided by teachers. Research should explore how to achieve better teaching outcomes by optimizing the design of AI systems and integrating them with teachers' classroom interactions.

Research should focus on the innovation that AI technology can bring to course content and teaching strategies, taking

into account the diversity and richness of cultural contexts. Future AI tools could extend their application in cross-cultural communication by introducing more cultural situation simulation, analysis of cultural differences and real-time feedback mechanisms. Future research should explore how to combine AI technology with other teaching methods to achieve the best teaching outcomes and promote the all-round development of students' cross-cultural communication ability. More in-depth research on the application of AI in intercultural communication English teaching will help promote the development of educational technology and provide new means for improving students' intercultural adaptability.

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