Research on the Construction and Quality Assessment of Smart English Classroom for Personalized Learning in Secondary Schools

Heng Li[1], Xiaomeng Li[2*]

{ylgllh@126.com[1], lixiaomeng0127@163.com[2*]}

School of Software and Artificial Intelligence, Chongqing Institute of Engineering, Chongqing China[1], Chongqing DePu Foreign Language School, Chongqing China[2]

Abstract. Traditional secondary school English classrooms are often conducted by teachers according to curriculum standards, fixed textbooks, and schedules, which cannot fully meet the learning pace and needs of each student. Intelligent-supported personalized learning in secondary school English refers to a new teaching model that uses intelligent teaching platforms to help students achieve personalized learning. By creating a smart classroom that integrates four organic links: pre-class preparation, classroom implementation, post-class consolidation, and intelligent evaluation, it creates an interactive and flexible learning environment for personalized learning in secondary school English, enhances student engagement, and meets the needs of individual student development.Based on the student classroom performance data captured by three high-definition cameras in the smart classroom, a quantitative evaluation model for student classroom learning quality based on video intelligent recognition is constructed. Visualized evaluation results are obtained to achieve continuous adjustment and optimization of students' personalized learning status. At the same time, it points out that further research and practice are needed for this new teaching model in order to obtain broader development and application opportunities.

Keywords: Smart Classroom;Intelligent Assessment;Secondary School English; Personalized Learning.

1 Introduction

Intelligent support for personalized learning in secondary school English refers to the use of intelligent teaching platforms to provide customized and menu-based learning processes tailored to individual student differences, as well as implementing intelligent classroom teaching evaluation. It has four main advantages: making learning more flexible and personalized; providing personalized learning suggestions and guidance based on students' learning performance and feedback; offering personalized learning resources and pathways; and providing instant learning feedback and assessment. It is mainly suitable for experimental classes with small bilingual teaching settings, aiming to improve students' learning effectiveness and interest, and cultivate their autonomous learning abilities and lifelong learning awareness.

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By searching through large-scale data systems such as FARS, SpecialSci, CNKI, VIP, SuperStar, Baidu Library, etc., a considerable number of literature related to the topic of this article were retrieved, including the following: Weng Jiejing constructed an online high vocational "Practical English" premium course based on the perspective of multiple intelligences [1]; Zhang Haoyang studied the application of common intelligent tutoring tools in junior high school English teaching [2]; Liu Xiangyu proposed teaching strategies for junior high school English classes based on human-computer collaboration theory and technology [3]; Hu Ying conducted a survey and statistical analysis on the information technology capabilities of middle school English teachers in the context of smart education [4]; Li Wei proposed the application of immersive teaching mode in primary school English teaching [5]; Zhang Liqiong researched dormitory-based ethnic secondary school English reading teaching based on smart classrooms [6]; Cheng Yamei discussed the new model of secondary school English teaching based on "AI+ Education" [7]; Wei Yinling et al. analyzed the application of the theory of multiple intelligences in secondary school English teaching [8]; Zhang Yue discussed intelligent essay correction [9]; Richter F. conducted comprehensive and in-depth research on how to engage in personalized and autonomous learning [10]; Pasi A et al. conducted research on how to design personalized learning from management and other perspectives [11]; Sovetova N et al. analyzed and designed a municipal level digital education quality evaluation system [12].

The above research literature has investigated various issues related to personalized learning in secondary school English under intelligent support, such as intelligent course development, application of intelligent tools, classroom teaching strategies, English teaching models, and personalized junior high school English learning. Many of these contents are worth referring to, learning from, and drawing inspiration. However, the connotations and extensions of the research findings in the above literature are limited and specific, and their relevance to the research topic of this article is not high. Therefore, it is necessary to conduct a comprehensive and in-depth study on this topic.

2 Constructing smart classroom for personalized learning in secondary school English

2.1 Preparation before class

Preparation before class based on the intelligent teaching platform allows teachers and students to develop personalized learning plans and teaching strategies according to individual differences and needs, aiming to enhance the effectiveness and motivation of English learning.

Learning analysis. Through the functions of questionnaires, voting, grading, and other features on the intelligent teaching platform, teachers can analyze students' historical learning data and feedback information. This allows them to understand each student's learning level, knowledge mastery, learning preferences, and existing issues. By gaining a better understanding of individual differences among students, teachers can provide a foundation for personalized teaching.

Teaching resources preparation. Based on the analysis of learning situations, teachers can use intelligent teaching platforms to select and prepare corresponding teaching resources, such

as textbooks, English articles, exercises, micro-lesson videos, audios, interactive games, online discussions, and practical activities, to enhance students' engagement and motivation.

Intelligent lesson planning. Based on the requirements and standards of the secondary school English curriculum, teachers can use intelligent lesson planning tools to organize and arrange teaching content, select appropriate teaching strategies and activities, and develop personalized teaching plans according to students' learning needs, goals, and characteristics.

Pre-class preview. The intelligent teaching platform can provide students with pre-course content, such as reading materials and watching micro-lesson videos, and provide relevant learning tips and guidance to help students better understand and grasp new knowledge in the classroom.

2.2 Classroom Implementation

The implementation of personalized learning in secondary school English under the support of intelligent technology refers to the use of intelligent teaching platforms to enhance teaching effectiveness and improve the learning experience. It mainly includes the following aspects:

Electronic attendance. Before class, through the electronic attendance function of the intelligent teaching platform (including regular, gesture, location, QR code, and sign-in code), teachers can quickly record student attendance and update students' learning data in real-time. This helps teachers understand students' participation and learning performance and provides a data basis for personalized learning.

Knowledge review. At the beginning of the class, teachers can use the random exercise function of the intelligent teaching platform (including multiple-choice, fill in the blanks, true or false, and short answer questions) to understand students' mastery of previously learned knowledge through collective practice, and provide targeted explanations for common problems.

Introduction to new lessons. Teachers can use multimedia resources and interactive demonstrations on the intelligent teaching platform to present core new knowledge of this lesson, stimulate students' curiosity and interest in new knowledge.

Teacher-student interaction. Teacher-student interaction is crucial in personalized learning. Teachers can use the functions of the intelligent teaching platform such as selecting students or rapid response to interact with students, provide on-site comments, and offer targeted guidance and support.

Group discussions. Through the theme discussion function of the intelligent teaching platform, teachers can guide students to participate in group discussions related to the topic, conduct group discussions, or collaborate in real-time through online platforms. This helps cultivate students' critical thinking, communication skills, and teamwork spirit.

In-class exercises. Teachers can use the random exercise and grading functions of the intelligent teaching platform to design various forms of exercises to consolidate the knowledge learned in this lesson, and provide real-time feedback and guidance to students.

Ideological and political education in the curriculum. Ideological and political education is a core component of secondary school English teaching. Teachers can use the theme

discussion function of the intelligent teaching platform to integrate the socialist core values into the entire teaching process, cultivate students' correct values and develop good moral character.

Assignment of homework. Teachers can use the intelligent teaching platform to create personalized assignments of different difficulty levels and types based on students' learning progress and needs. At the same time, using the automatic grading and feedback function, teachers can understand students' completion of assignments in a timely manner.

Electronic whiteboard. Teachers can use the electronic whiteboard function of the smart classroom to display teaching content in real-time and save it as electronic files for students to study and review.

Classroom management. Teachers can use the three-camera system in the smart classroom (teacher's camera, student's camera, and PPT camera) to monitor students' classroom learning in real-time, reducing or eliminating behaviors such as dozing off, using mobile phones, having side conversations, and being absent-minded.

2.3 Post-class Consolidation

Post-class consolidation of personalized learning in secondary school English under the support of intelligent technology means that students can use the intelligent teaching platform to consolidate and reinforce the knowledge they have learned after class, while teachers can understand students' learning situation in a timely manner and provide guidance and support for further personalized teaching.

Homework. Students can use the smart teaching platform to complete homework in a timely manner and use its automatic grading function to check errors and make corrections.

Video review. After class, students can selectively review video recordings of the teacher's class based on their understanding and mastery of the knowledge discussed in class. This helps them fill in the gaps and deepen their memory and understanding of the knowledge.

Test paper generation. Based on students' learning levels and abilities, teachers can use the question bank or test paper generation function of the intelligent teaching platform to generate personalized test papers suitable for different proficiency levels and provide reference answers.

Online exams. By using the online exam function of the intelligent teaching platform, students can participate in English exams through links or QR codes, saving a significant amount of human, financial, and material resources. The platform also provides intelligent anti-cheating measures such as facial recognition, screen switching limitations, and randomization of questions to prevent cheating.

Intelligent marking. The intelligent teaching platform can automatically mark all objective questions (listening, vocabulary, grammar, reading comprehension, etc.) and evaluate subjective questions (translation, essay, etc.), providing real-time scoring and feedback.

Performance analysis. The intelligent teaching platform can provide individual and class-level performance analysis and evaluations for students, such as score reports (summary of scores, detailed score breakdown, and question type score details), an overview of exam

performance (highest and lowest scores, average score, excellence rate, pass rate, segment statistics, and score distribution), and test analysis (total score, average score, difficulty and discrimination, scores, difficulty, and common wrong answers for each question). This comprehensive analysis helps teachers understand students' learning performance and progress comprehensively and make targeted adjustments for subsequent teaching.

3 Video-based intelligent recognition for quantifying student classroom learning quality

With the vigorous development of educational informatization, many secondary schools widely use three-way videos (teacher, student, PPT) to monitor the process of smart classroom teaching. Usually, each 45-minute synthesized video generates about 500MB of data. By automatically processing and analyzing the video images, the classroom behaviors of teachers and students can be captured, recognized, and analyzed to achieve intelligent evaluation of the quality of smart classroom teaching. This article only discusses the model for quantifying the quality of student classroom learning.

3.1 Video data acquisition

By establishing a smart classroom, fixed high-definition cameras in the classroom are used to record students' videos to obtain accurate facial expressions and behavioral data. If possible, multiple cameras can be set up to capture students' facial expressions, postures, behaviors, etc. from different angles.

3.2 Video data preprocessing

Students face recognition. By pre-entering students' photos into the intelligent teaching platform, computer vision technology is used to compare students in the video, achieve face recognition and matching, and determine who is who. Furthermore, it quantitatively analyzes students' attendance rate, tardiness rate, early departure rate, and classroom leaving rate.

Facial expression analysis. By detecting indicators such as smiles, blink frequency, forehead wrinkles, etc., the students' facial expressions are analyzed to determine their emotional state and level of attention, evaluate their focus and emotional state, and judge whether their mental state is energetic.

Eye tracking. By using computer vision technology or eye trackers, the eye movements of students are tracked to determine what they are currently looking at, how long they have been looking, etc., in order to evaluate their level of attention to the teaching content and judge whether they are attentively listening, taking notes, or answering questions, etc.

Pose recognition. By using pose analysis technology, students' body postures and movements are identified to determine whether they are sleeping, using mobile phones, whispering, or being distracted in the classroom. It can also identify potential safety hazards such as chasing each other or falling during breaks.

3.3 Extraction of typical features

Focus. Measured by the percentage of time students spend focusing on the blackboard or teacher during each class.

Participation. Measured by the number of times students answer questions, engage in discussions, write on the board, or give presentations.

Behavioral compliance. Measured by the number of times students engage in behaviors such as sleeping, using cell phones, whispering, or being distracted.

By utilizing the following formula, the system automatically calculates the frequency of a specific characteristic for a particular student in a single class (based on a 90-minute duration).

$$M_{k,\ j} = \sum_{i=1}^{N} F_k\ (i,\ \ j) \qquad k = 1,2,3$$

In the formula, $M_{k,j}$ represents the frequency of the k-th characteristic for the j-th student in a single class (based on a 90-minute duration). F_k (i, j) represents whether the j-th student in the ith frame image belongs to the k-th characteristic. N represents the total number of frames in a single class, typically calculated at 25 frames per second. Then, according to Table 1, the classroom performance of each student is quantitatively scored.

Table 1. Extraction of typical features

Typical features	Example	Addition and subtraction
Focus	Focus on the blackboard or teacher 80% of the time.	+1
Participation	If a student's consecutive 750 frames belong to the characteristic of answering questions or similar behaviors, it is considered as one instance of active participation.	+1
Behavioral compliance	If a student's consecutive 750 frames belong to the characteristic of sleeping or similar behaviors, it is considered as one instance of non-compliant behavior.	-1

3.4 Model training, validation, and optimization

Sample data labeling. Known data with learning quality evaluation results are used as labeled sample datasets for training the model's target variable.

Selecting appropriate machine learning algorithms. Based on the specific problem and data features, suitable machine learning algorithms such as convolutional neural networks and support vector machines (SVM) are selected for model training.

Model training. The convolutional neural network and other models are trained repeatedly using the training data until the requirements are met.

Cross-validation. The model is validated using newly collected student classroom performance video data, and the performance of the model on the validation set is compared to evaluate its accuracy, reliability, and generalization ability.

Model parameter optimization. Based on the results of cross-validation, model parameters are continuously adjusted to improve the accuracy and robustness of the model's output.

3.5 Evaluation results of learning quality

The assessment results of each student's learning quality will be presented in a visual format for students, teachers, and parents to refer to. However, it is important to combine these evaluation results with other assessment methods such as final grades, midterm exams, and regular assignments to provide a comprehensive and objective evaluation of the students.

4 Conclusion

Personalized learning in secondary school English, supported by intelligent technologies, is a promising field. However, there are still some issues that require further research and practice in order to continuously improve this new teaching model. Firstly, how to address the hardware and software equipment issues related to intelligent teaching platforms? Secondly, how should the increased workload on English teachers be assessed? Thirdly, how can the personal privacy data security of teachers and students be ensured? Lastly, how to improve the accuracy and robustness of video-based intelligent recognition algorithms? Overall, with continued exploration and efforts, personalized learning in secondary school English, empowered by intelligent technologies, can better cater to the diverse needs of students and enhance their learning outcomes.

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