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Adaptive Learning Model for English Classroom Based on Artificial Intelligence

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Abstract: This paper proposes an artificial intelligence-based adaptive learning model for English classrooms. By analyzing multidimensional learning data, including students' learning styles, learning states, and academic abilities, the model enables real-time prediction of learning performance and automatic adjustment of teaching strategies and learning content to sustain students' learning engagement and concentration. Specifically, the system can generate personalized learning paths, dynamically adapt learning content and difficulty levels, and realize student-oriented personalized instruction. Educational practice indicates that AI-driven adaptive learning possesses prominent advantages in classroom teaching. It can closely integrate with conventional teaching procedures, monitor learning progress continuously, and deliver tailored learning experiences through intelligent strategy adjustment. Furthermore, the system accumulates massive learning data to provide reliable educational evidence for teachers, helping them accurately perceive students' learning conditions, optimize teaching methods in a timely manner, and better satisfy students' diverse personalized learning demands.

1. Introduction

With the rapid development of economy and science and technology, new requirements are constantly put forward to people. The traditional "one-size-fits-all" assembly-line education model can no longer meet the needs of learners[1]. However, we are submerged in the sea of network information, but also suffering from the thirst for knowledge, so how to accurately find the required information in the complex information, to achieve meaning construction and how to make the Internet learning environment into the air, sunlight and soil to promote self-actualization and allow learners' creativity and curiosity to grow freely have become an urgent problem to be solved. In view of this, the research topic of adaptive learning design based on learning analytics is proposed[2].

2. Research background

According to the purpose of "student-centered" proposed by constructivism theory, it is

imperative to provide personalized learning objectives and contents for each student in the era of artificial intelligence[3]. In the process of improvement, the intelligent adaptive learning mode will realize the goal of "providing a teacher for every student" step by step, so as to realize personalized learning. In the learning process, the system can recommend the next knowledge point and video material to students according to the antecedent relationship or correlation between the knowledge point and other knowledge points, and provide students with the best personalized learning path through the algorithm pointing to the weak knowledge point[4]. Therefore, different students have different learning paths even if they learn the same knowledge point. Based on Item Response Theory (IRT) to track and model the knowledge of learners, learners' ability is measured and simulated by establishing a probability expression of whether students answer correctly or incorrectly, which is closely related to whether learners master the knowledge point[5]. IRT has three theoretical assumptions: uni-dimensional, local independence and item response model. Automatic Speech Recognition is the full English name of speech recognition technology. How to make computers understand human speech correctly is its main research content. Since the birth of artificial intelligence, scientists have been striving to pursue the goal of being able to make machines understand and understand every word people say, every sentence. In the course of technological development, speech recognition has experienced three major stages: standard template-matching algorithms, statistical-model-based algorithms, and deep neural networks[6]. The correct rate of speech recognition by artificial intelligence has exceeded 97% in China, leading the world, while responding to the world with rapid speed. Human speech machines can also understand and give immediate feedback. The speech recognition technology of IFLYTEK has been widely used in Chinese Putonghua level examination and English spoken test, and its performance in all indicators far exceeds that of manual experts. Detailed introduction of each part of the technical selection, the framework used, as shown in Table 1.

Table 1 Development environment of intelligent adaptive learning system

System, language, or tool	Description
Algorithm training operating system	Ubuntu 18.04
Memory	32G
The processor	i9 -9900K
CPU frequency	3.6GHZx16
Graphics card GPU	GeForce GTX 1080 Ti
Deep learning framework	TensorFlow 1.13.1
Algorithm development language	Python 3.7

In the learner's situation report module, the entities mainly involved include exercises, assessment papers, comprehensive evaluation based on knowledge tracking and recommended graph rules—deep knowledge tracking GR-DKT model, learners' answer sheets and learner's situation assessment report. The relationship between GR-DKT and assessment papers is one-to-many, because several assessment papers are driven by the GR-DKT model and related algorithms, and specific assessments are generated by combining static data and dynamic data of the current learner model. The relationship between the test paper and the learner's answer sheet is one-to-many. A test paper may have more than one person to participate in, and multiple answer sheets will be generated, but each answer sheet only belongs to one test paper. The learner's answer sheet and the assessment report are one-to-one. After each learner completes the test paper answer, the system will automatically obtain the evaluation and inference information of the learner's mastery of the knowledge point according to the corresponding relationship between exercises and knowledge points according to the answer situation. And then it generates a corresponding intelligent learning situation assessment report of current learners to help learners understand their

current learning situation, that is, the mastery of each knowledge point. According to the database design process, after completing the E-R diagram of the database conceptual design, we will carry on the logical design of the database, and convert the conceptual model into the data table of the relational database[7]. Below, the main database table structures related to the learning situation assessment report of the intelligence learning situation module in the intelligent adaptive learning system will be introduced, which are problem list, test paper list, GR-DKT model table, learners' answer sheet and learning situation report table. Therefore, exercise list is the main data table of the intelligence information module, which serves as the storage structure of data statistics of the domain knowledge model and plays corresponding functions with the domain knowledge model. The details of the problem sheet are shown in Table 2.

Table 2 List of exercises

Field name	Field type	Primary key	Foreign key	Allow null	Field Description
quiz_id	int	Yes	No	NOT NULL	Problem sets number
quiz_title	text	No	No	NOT NULL	The title
quiz_body	longtext	No	No	NOT NULL	Subject matter
quiz_type	int	No	No	NOT NULL	Question type
difficulty	float	No	No	NOT NULL	The difficulty
answer	longtext	No	No	NOT NULL	The answer
analysis	longtext	No	No	NOT NULL	Answer analysis

In each dynamic evaluation, the GR-DKT model of the intelligent adaptive learning system automatically extracts some representative exercises from the question pool to form an evaluation paper through model calculation. The dynamic generation process of this test paper reflects the dynamic evaluation and recommendation of GR-DKT model combined with domain knowledge model and learner model. Through the evaluation and recommendation algorithm to call the GR-DKT model, in the process of learners' participation in the evaluation of intellectual situation, the exercises related to the evaluation knowledge points containing the most inferred information are recommended to carry out the evaluation. The intelligent adaptive learning system accurately evaluates the learning state of learners by recommending exercises to realize knowledge tracking. The specific information of the test paper is shown in Table 3.

Table 3 Assessment papers

Field name	Field type	Primary key	Foreign key	Allow null	Field Description
test_id	int	Yes	No	NOT NULL	The examination paper number
subject_id	int	No	No	NOT NULL	Course number
remark	text	No	No	NOT NULL	The examination paper evaluation
create_type	int	No	No	NOT NULL	Create a type
create_date	datetime	No	No	NOT NULL	Creation time
create_user_id	int	No	No	NOT NULL	Creator ID
model_id	int	No	Yes	NOT NULL	The model number

As the core driving model of intelligent adaptive learning system, GR-DKT model table is used

to store the update information of GR-DKT and its sub-models. The information in GR-DKT model table mainly includes model number, model evaluation type, creator ID, creation time, learner model number, domain knowledge model number, model static grade information, model evaluation content and test paper number. It is a fusion model of learner model and domain knowledge model, which is the core personalized function of intelligent module. The specific information is shown in Table 4.

Table 4 GR-DKT model table

Field name	Field type	Primary key	Foreign key	Allow null	Field Description
model_id	int	Yes	No	NOT NULL	The model number
model_type	int	No	No	NOT NULL	Model evaluation type
create_user_id	int	No	No	NOT NULL	creator ID
create_time	datetime	No	No	NOT NULL	Creation time
learner_model_id	int	No	No	NOT NULL	Learner model number
domain_model_id	int	No	No	NOT NULL	Domain knowledge model number
grade	int	No	No	NOT NULL	Model static grade information

3. Experiments and analysis

According to the statistical analysis, 139 students, accounting for 85.80%, like the learning mode of intelligent adaptation, and no students do not like this learning mode; There were also 150 students who believed the accuracy of the test report of the intelligent adaptation system, accounting for 92.59%; 94.44% of the students think that teachers' guidance is of great help to their learning. These data all reflect that students highly approve of the intelligent adaptation learning mode. See Figure 1.

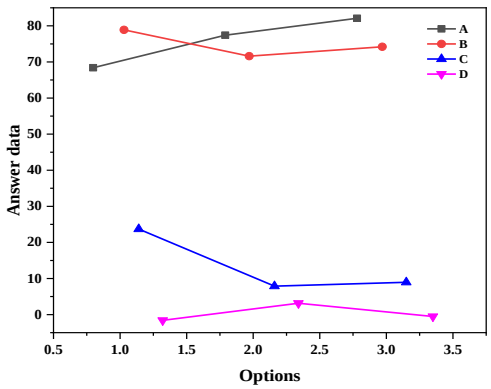

Figure 1 Line chart of students' attitude to intellectually adaptive learning

When applying the intelligent adaptive learning system to teaching, we must make clear the basic theory of education that should be followed. Based on relevant teaching design principles, combined with the psychological traits of college students and characteristics of College English, the study gives full play to the advantages of the system and scientifically designs the pre-class teaching process to realize efficient learning and personalized development of students. Based on

the relevant design theories and design principles obtained in the teaching process of intelligent adaptation education institutions, the design mode of intelligent adaptation learning mode for English teaching is summarized, and the structure of the teaching design mode is shown in Figure 2.

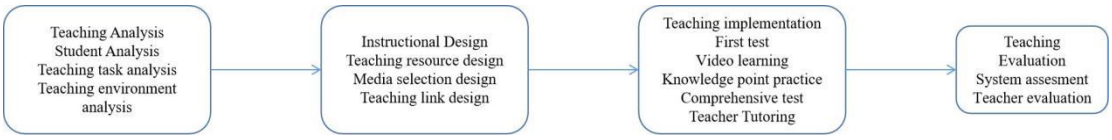

Figure 2 Teaching design mode under intelligent adaptive learning mode

Taking the personalized learning function provided by the online learning platform as the clue, the present situation is investigated and studied from the aspect of learners. This survey selected learners with online learning experience and designed a Questionnaire on Learners' Personalized Learning Needs. The personalized learning functions provided by current online learning platforms and students' demands and expectations for future online learning platforms are investigated and analyzed, providing reference for the construction of adaptive learning design framework based on learning analytics. The questionnaire was compiled based on a large number of literature review on adaptive learning and learning analytics, and combined with interviews with some learners. The introductory part introduces the purpose of the survey and the way of answering the questionnaire. This survey starts from the two key words "learning analytics" and "adaptive learning", mainly investigates the personalized learning function perceived by learners in the process of using online learning platform, as well as the limitations of current online learning platform, and designs survey items from five parts. They are learning style, learning path, emotional support, time management and learner expectation[8,9]. A total of 27 questions are set, and five-point option scoring method of Likert scale is used in the survey. Among them, "learning style", "learning path", "emotional support" and "time management" have five choices for each item, that is, completely inconsistent, inconsistent, neutral, consistent and completely consistent; There are five choices for each item in learners' expectation section: completely disagree, disagree, neutral, agree and completely agree. Table 5 shows the setting and coding of the questionnaire items.

Table 5 Questionnaire design

Dimension	Coding	Survey item	Item No.
Learning style	LSQ1	Online learning platforms measure learning styles before class.	1、2、3、4、5
	LSQ2	Online learning platforms offer pre-class guidance and advice on learning methods.	
	LSQ3	Learning resources recommended to me by the online learning platform are indeed the ones I am interested in.	
	LSQ4	Online learning platforms present courses to me (such as video, text, etc.) that I like and accept.	
	LSQ5	Online learning platforms arrange learning materials in a style that fits my personal learning preferences.	

Before the formal questionnaire survey, this study simply tested the questionnaire in the form of questionnaire star to test the reliability of the questionnaire. A total of 35 questionnaires were collected this time, and the survey subjects were mainly graduate students of Northeast Normal University. 31 valid questionnaires were obtained after screening, with an effective rate of 88.57%. SPSS software was used in this study, and Cronbach's α coefficient was used to test the reliability of the questionnaire. When a value was greater than 0.7, the reliability of the questionnaire was high,

and the analysis results were shown in Table 6[10].

Table 6 Statistical table of questionnaire reliability analysis

Variable	Cronbach's α value	Number of items
Learning style	0.766	5
Learning path	0.750	6
Time management	0.779	7
Emotional support	0.794	5
Learner expectation	0.848	4
Overall reliability of the questionnaire	0.890	27

After the reliability test of the questionnaire, questionnaires were distributed through Wenjuanxing. A total of 182 questionnaires were collected in this time. After excluding invalid questionnaires (incomplete questionnaires or identical answers to all options), 157 valid questionnaires were collected, with an effective rate of 86.26%. Excel software is used to process data, and basic information of learners is analyzed, including gender, identity, educational background and professional background of learners, as shown in Table 7.

Table 7 Statistical table of basic information of learners

Category	Option	Frequency	Percentage
Identity	Students	124	79.98%
	Working professionals	33	21.02%
Gender	Male	38	24.20%
	Female	119	75.80%
Educational background	Junior college and below	4	2.55%
	Undergraduate	72	45.86%
	Master’s degree	79	50.32%
	Doctoral degree	2	1.27%
Professional background	Science	92	58.60%

This part will conduct a descriptive statistical analysis of the data on the use of personalized learning functions of online learning platforms, so as to further understand the data of each dimension. The analysis results include the mean, standard deviation and variance of each item, as well as the mean, standard deviation and variance of each dimension. According to the descriptive statistical analysis of learning style variables, the mean value of this dimension variable is 3.19 points, which is at a medium level. In other words, learners think that online learning platform basically meets their personal "learning style". The statistical table of learning style variables is shown in Table 8.

Table 8 Statistical table of learning style variables

Variable	Measuring item	Mean	Variance	Variable mean
Learning style	LSQ1	2.39	0.857	3.16
	LSQ2	2.95	0.851	
	LSQ3	3.33	0.642	
	LSQ4	3.50	0.672	
	LSQ5	3.76	0.731	

Most of the students think that the online learning platform better realizes the planning of learners' learning path. LPQ5 has the lowest mean value of 2.69. Respondents believe that online learning platform fails to provide video annotation function, so students need to take a lot of notes

to assist learning during online learning, which reduces learning efficiency to a certain extent. Corresponding to LPQ4, with the popularity of personalized learning concept, more and more online learning platforms have realized this problem. Some online learning platforms provide tools or functions such as tagging, taking notes, and asking questions in real time. When referring to whether the online learning platform has planned a learning path for learners, such as watching videos first, then doing exercises, and then participating in discussions (LPQ2), 35.7% of learners believe that most platforms meet this requirement. Statistical table of variables of learning path is shown in Table 9.

Table 9 Statistical table of learning path variables

Variable	Measuring item	Mean	Variance	Variable mean
Learning path	LPQ1	3.83	0.639	3.37
	LPQ2	3.62	0.851	
	LPQ3	3.61	0.792	
	LPQ4	3.18	0.870	
	LPQ5	2.69	0.842	
	LPQ6	3.30	0.878	

In terms of time management, learners believe that the online learning platform fails to accurately implement the time management function. In order to explore the reasons, further analysis was made on each item, and most learners chose other items that did not match. Specifically, it is reflected in the recording of video click behavior. By recording the behavior time of learners, it is helpful for learners to reflect in time. Analysis of video click behavior is helpful for learners to find learning content quickly. For example, learners repeatedly jump at a node at a certain time, which may indicate that this part of content is difficult, and learners need to watch it repeatedly to grasp knowledge points[11]. Statistical analysis of time management variables is shown in Table 10.

Table 10 Statistical table of time management variables

Variable	Measuring item	Mean	Variance	Variable mean
Time management	TMQ1	3.54	0.686	2.79
	TMQ2	3.81	0.553	
	TMQ3	2.60	0.908	
	TMQ4	2.52	0.918	
	TMQ5	2.62	0.917	
	TMQ6	2.25	0.855	
	TMQ7	2.20	0.749	

Learners generally believe that they do not get emotional help in the process of online learning, which is consistent with the research conclusion of other scholars—namely, learners have a sense of disorganization and loneliness in the process of online learning. The item with the higher mean is ESQ1. Statistical analysis of emotional support variables is shown in Table 11.

Table 11 Statistical table of variables of emotional support

Variable	Measuring item	Mean	Variance	Variable mean
Emotional support	ESQ1	2.90	0.861	2.45
	ESQ2	2.31	0.793	
	ESQ3	2.24	0.659	
	ESQ4	2.32	0.772	
	ESQ5	2.68	0.862	

The textbook knowledge base in the intelligent learning module is an important input module of the intelligent learning. The construction of textbook knowledge base is closely related to domain knowledge model, in which each knowledge point chapter diagram comes from the tree knowledge structure database of domain knowledge model, containing the information of each chapter. The intelligent learning module mainly completes the learner-driven exercise function, and the learner-driven exercise process is shown in Figure 3.

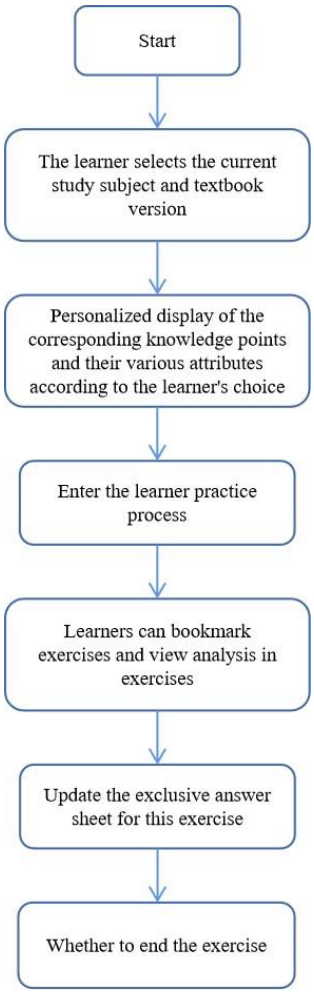

Figure 3 Flow chart of learner driven practice

The introduction of intelligent adaptive learning modes into teaching represents an upgrade of teaching modes in the artificial intelligence era. According to the findings of this investigation, this paper analyzes the application of intelligent adaptive learning modes in college English teaching.

4. Conclusion

The rapid development of artificial intelligence has accelerated the fourth industrial revolution and profoundly reformed modern education. It reshapes students' learning behaviors and teachers' teaching modes, and drives the innovative development of college English teaching. Against this background, this study focuses on AI-driven teaching reform and constructs an intelligent adaptive learning model for college English classrooms. Combined with relevant theories, literature research, scholar interviews and questionnaire data, this paper clarifies the role of intelligent technology in college English teaching and identifies key influencing factors, establishing a complete research

analytical framework.

This study summarizes the theoretical basis of AI-enabled college English teaching reform. Guided by educational change theory, distributed cognition theory and technological innovation theory, it explores the practical changes and development trends of college English teaching in intelligent learning environments. Based on the GR-DKT knowledge tracking model, this paper constructs an adaptive English classroom learning model and optimizes the supporting system database structure, realizing dynamic learning evaluation, personalized resource recommendation and intelligent learning state analysis for college students. Questionnaire results prove that the proposed model can well adapt to college students' learning styles, learning paths and personalized learning demands, providing effective practical references for the intelligent reform of college English teaching.

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