

An Experimental Study on the Pair-Sharing Classroom Model Based on Artificial Intelligence Platform in Higher Vocational English Teaching

Wenqian Tang^{a,b}

^a*School of Education, Tianjin University, Tianjin, 300350, China*

^b*College of Foreign Languages, Haikou, Hainan, 570228, China*

Abstract. To improve the teaching efficiency of English in higher education, this paper constructs a pair-sharing classroom teaching model based on an artificial intelligence platform. The RBM (Restricted Boltzmann Machine) algorithm is used to inform the learning behavior of college students and identify the educational information data of college students through feature extraction. The Gibbs sampling algorithm is introduced in calculating index weights and parameters to improve the data mining efficiency and ensure the validity of obtaining the evaluation indexes of English teaching mode for higher education. The application effect of higher vocational English teaching was tested in practice to verify the feasibility of the AI platform-based pair-sharing classroom teaching model. The results show that the teaching model constructed in this paper can effectively improve students' learning efficiency in higher vocational English teaching, and the proportion of students in the 90–100 score range increases from about 3%–6% to 25%. The students' satisfaction with the teaching effect and class evaluation is around 80%. Thus, it can be seen that the pair-sharing classroom teaching model constructed in this paper has improved the effect of teaching English in higher education.

1. Introduction

Artificial intelligence technology is rapidly popularized and gradually becomes the new driving force and trend for the development of all industries [1, 2]. English teaching occupies an extremely important position in higher education, and its quality has become an important symbol to measure the quality of talent training in higher education institutions [3–6]. Artificial intelligence has started to penetrate higher education English teaching for a huge corpus, and learners can practice their college English skills through artificial intelligence platforms. Artificial intelligence brings more learning resources and changes learners' learning styles [7, 8]. Artificial intelligence can analyze learners' characteristics, design a suitable learning style, select a reasonable corpus, and match equivalent learning resources, making college English learning more efficient and personalized [9–11]. In higher-level English teaching, teachers lack the awareness of using modern teaching concepts and pedagogies, ignore the characteristics of language learning itself, and teachers mainly teach systematically while students passively accept. With the continuous promotion of the

Corresponding author: Wenqian Tang, mail address: vivian127224549@163.com

Received: 26 December 2024; Accepted: 25 February 2025; Published: 30 April 2025

Keywords. English Teaching; AI platform; Double Restricted Boltzmann Machine; Gibbs sampling algorithm

Cited this article as: Cita: Tang, W., An experimental study on the pair-sharing classroom model based on artificial intelligence platform in higher vocational English teaching. *Engineering and Its Applications*, 2(1), 2025, 1-16.

© 2026 Engineering Journals. Published by Engineering Journals.

classroom revolution, the higher vocational English classroom has welcomed the opportunity and challenge of reform [12, 13]. In higher vocational English teaching, we should emphasize the concept of “student-centered” education and establish a teacher-led and student-centered “activity-based and effective” higher vocational English classroom model [14–16]. English teaching in higher education should be based on the teaching materials, with the application as the purpose and needs as the measure, and implement scientific, practical and dynamic teaching, focusing on the teaching of learning methods and the cultivation of theoretical knowledge into practical ability [17–20].

English teaching in higher education is an important part of higher education, and how to position higher English teaching, organize English teaching and improve the English proficiency of higher education students to implement the cultivation goals of higher education is an important task faced by higher English teachers. Zhu [21] proposes a new scaffolding teaching approach, which can decompose abstract knowledge and mainly includes the following aspects: setting up scaffolding, setting up teaching situations, independent inquiry, cooperative learning and effect evaluation. Students are mainly placed at the core of the classroom, and the teacher is transformed into a course tutor to help students solve the problems they encounter during their studies. Shao et al. [22] adopt the teaching method of micro-classroom with video as the main carrier to record the whole process of teachers’ exciting teaching activities around a certain knowledge point or a certain link in the classroom teaching process. Lorenzo-Lledó et al. [23] proposed applying the hybrid teaching mode to AI courses, dividing the traditional classroom into three: pre-class phase, in-class phase, and post-class phase, and combining the high-quality electronic resources on the online platform to realize the flipping of the traditional classroom. Wang [24] reformed the traditional teaching model by reversing the arrangement of knowledge transfer and internalization, changing the roles of teachers and students in traditional teaching and reprogramming the use of class time. The methods in the above literature have a single evaluation of effectiveness, lack relevance, fail to stimulate students’ learning, and are not suitable for long-term teaching.

Based on this, this paper uses an artificial intelligence platform as the basis to find the integration point between information technology and the pair-sharing classroom utilizing artificial intelligence technology, thus constructing a pair-sharing classroom model for higher education English teaching based on an artificial intelligence platform. In constructing the model, firstly, information processing of college students’ learning behaviors is carried out through RBM technology algorithm to factor. Secondly, the evaluation indexes about the model are calculated by the Gibbs information sampling algorithm, and data mining is performed based on the calculation results. Finally, the teaching practice of the AI platform-based pair-sharing classroom model is carried out, and the application effect of the model is judged by students’ test scores, evaluation indexes of the model and acceptance status. It is proved that the platform can improve the English performance of college students, provide a new perspective for higher-level English teaching, and effectively solve the singularity of traditional theoretical teaching.

2. Information Technology Data Processing Algorithm

2.1. RBM Algorithm

The RBM algorithm is used to represent students’ learning behaviors in a higher education English teaching model, where v is the visible layer, and student learning data samples in higher education English teaching are input from the visible layer, and h is the hidden layer, which represents the input of student behavior data and behavior feature extraction, respectively. It is assumed that the RBM network has m visible units and n hidden units, and vectors $v = (v_1, v_2, \dots, v_m)^T$ and $h = (h_1, h_2, \dots, h_n)^T$ represent the unit states. $a = (a_1, a_2, \dots, a_m)^T$ is the bias vector of the visible layer, a_i denotes the bias of the i -th visible unit, $b = (b_1, b_2, \dots, b_n)^T$ is the bias vector of the hidden layer, and $W \in \mathbb{R}^{m \times n}$ denotes the weight matrix between the visible and hidden layers. w_{ij} denotes the weight of the i -th node in the visible layer and the j -th node in the hidden layer. The process of implementing the RBM technique is to obtain the parameter $\theta = \{a_i, b_j, W_{ij}\}$ for learning behavior tracking, which is given by:

$$E(v, h) = - \sum_{i \in v} a_i v_i - \sum_{i \in h} b_i v_i - \sum_{i, j} v_i h_j w_{ij} \quad (1)$$

where $E(v, h)$ is the energy function of the RBM, and a probability value is assigned to each pair of behavioral data and feature extraction by the energy transfer function.

$$p(v, h) = \frac{1}{Z} e^{-E(v, h)} \quad (2)$$

where Z is the partition function and the expression is:

$$Z = \sum_{v, h} e^{-E(v, h)} \quad (3)$$

The expression of the logarithmic gradient of Eq. (3) for the weights is:

$$\frac{\partial \log p(v, h)}{\partial w_{ij}} = \langle v_i h_j \rangle_{\text{data}} - \langle v_i h_j \rangle_{\text{model}} \quad (4)$$

where $\langle v_i h_j \rangle_{\text{data}}$ is the expectation of English performance and $\langle v_i h_j \rangle_{\text{model}}$ is the expectation of English learning behavior in higher education; the learning performance rule of RBM can be derived from this formula.

$$\Delta w_{ij} = \varepsilon (\langle v_i h_j \rangle_{\text{data}} - \langle v_i h_j \rangle_{\text{model}}) \quad (5)$$

An unbiased sample of the data distribution can be obtained quickly for data expectation since there is no direct connection between the RBM hidden layer cells. Assuming a randomly given training medium (e.g., image, etc.) of v , the probability that the binary state of a hidden layer cell is 1 is:

$$P(h_j = 1 | v) = \sigma \left(b_j + \sum_i v_i w_{ij} \right) \quad (6)$$

Similarly, the probability that the binary state of the visible layer cell is set to 1 is:

$$p(v_i = 1 | v) = \sigma \left(a_i + \sum_j h_j w_{ij} \right) \quad (7)$$

$$\sigma(x) = \frac{1}{1 + e^{-x}} \quad (8)$$

where $\sigma(x)$ can be implemented similar to the forward propagation process of neural networks by Eqs. (6) and (7), and repeatedly applying Eqs. (6) and (7) to the calculation, all states of the student's learning behavior can be found. In this paper, it is obtained by calculating the log-likelihood maximization of RBM over the learning set with the following formula:

$$\theta^* = \arg \max_{\theta} \left(\sum_{t=1}^T \log (P(v^{(t)} | \theta)) \right) \quad (9)$$

In the case of a given hidden layer, it is assumed that the student learning unit satisfies the conditional multinomial distribution, while the feature extraction unit satisfies the Bernoulli distribution in the case of a given display layer, whose distribution functions are shown in Eqs. (10) and (11).

$$p(V_{u,m} = s | H) = \frac{\exp(b_{ms} + \sum_{k=1}^K h_{uk} w_{mks})}{\sum_{s'=1}^S \exp(b_{ms'} + \sum_{k=1}^K h_{uk} w_{mks'})} \quad (10)$$

$$p(H_{uk} = 1 | V) = \sigma \left(b_k + \sum_{m \in p_u} w_{mk} v_{u,m} \right) \quad (11)$$

Here, $H \triangleq (h_{uk}) \in V^{U \times K}$, $W \triangleq (w_{mks}) \in V^{M \times K \times S}$, where h_{uk} denotes the k -th learning higher level English behavior data corresponding to student u , w_{mks} is the connection weight, U denotes the set of the number of students, M denotes the set of the number of learning behaviors, K denotes the set of the number of test scores, S denotes the set of student rating levels, and b_{ms} and b_k are the offset, with $\sigma(\cdot)$ given by:

$$\sigma(x) = 1 / (1 + e^{-x}) \quad (12)$$

The marginal distribution function of the display layer is as follows:

$$p(v) = \sum_h \frac{\exp(-E(v, h))}{\sum_{v', h'} \exp(-E(v', h'))} \quad (13)$$

The RBM algorithm comprises a display layer and a hidden layer with several nodes in each layer. This algorithm is used in higher-level English teaching, where the nodes in the display layer represent the parameters of student learning behavior data and the hidden layer represents the state of feature extraction. Nodes in the same layer are not connected, and different layers rely on messages to connect, and when the messages change, the states of different layers change accordingly. The recommendation process is divided into 3 phases: initialization, training and learning, and recommendation. In the initialization phase, the connection weights are randomly initialized, and the states of the hidden and display layers are set. In the training-learning phase, each layer's state and connection weights are continuously updated according to the given learning samples until the parameters are less than the threshold. In the recommendation phase, the behavioral data units and behavioral feature units of students in the accepted state are given in conjunction with the higher level English learning phase results.

2.2. Gibbs Information Sampling Algorithm

The model is used in the training phase of higher English teaching, and the corresponding evaluation indexes are obtained by upgrading the weights and preference parameters through continuous training and learning, using the contrast scatter to do the calculation with the following formula:

$$\Delta w_{mk} v_{u,m} = \eta (\langle v_{u,m} h_k \rangle_{\text{data}} - \langle v_{u,m} h_k \rangle_T) \quad (14)$$

where η represents the evaluation parameter of the English teaching mode in higher education, $\langle v_{u,m} h_k \rangle_{\text{data}}$ represents the frequency of the state of the hidden layer k being accepted and the state value of the display layer being $v_{u,m}$, $\langle v_{u,m} h_k \rangle_T$ represents the expectation under the sampling distribution obtained by using Gibbs sampling, and T represents the number of samplings. Usually the parameter is chosen at the beginning with $T = 1$, and the value of T is increased as the English learning process progresses, so that the difference between $\langle v_{u,m} h_k \rangle_{\text{data}}$ and $\langle v_{u,m} h_k \rangle_T$ can be small enough if the value of T is large enough. In practical applications, the value of T is usually taken to be 1000, with the maximum not exceeding 5000.

In the recommendation stage, the evaluation metrics of the pair-sharing classroom teaching model under the AI-based platform are obtained using Equations (15) to (17) by combining the weight parameters and the preference parameters.

$$\hat{v}_{u,m} = \sum_{s=1}^S s \cdot P(v_{u,m} = s | \hat{p}_u) \quad (15)$$

$$P(v_{u,m} = s | \hat{p}_u) = \frac{\exp(b_{ms} + \sum_{k=1}^K \hat{p}_{uk} w_{mks})}{\sum_{s'=1}^S \exp(b_{ms'} + \sum_{k=1}^K \hat{p}_{uk} w_{mks'})} \quad (16)$$

$$\hat{p}_{u,m} = P(H_{uk} = 1 | V) = \sigma\left(b_k + \sum_{m \in p_u} w_{mk} v_{u,m}\right) \quad (17)$$

The evaluation indexes of the above teaching model can be combined with Gibbs' information sampling algorithm to provide a more detailed explanation of English teaching in higher education, which can help experimental research on English teaching.

3. Create a Higher Vocational English Teaching Mode

3.1. Artificial Intelligence Platform

With the development and popularity of mobile Internet technology, the artificial intelligence learning environment can effectively take advantage of traditional “lecture classrooms” and online “discussion classrooms”, which has become the new normal of a learning environment in the Internet era. A better and more convenient learning environment is created for learners to make learning easy, convenient, and efficient for teachers. The basic structure is shown in Fig. 1.

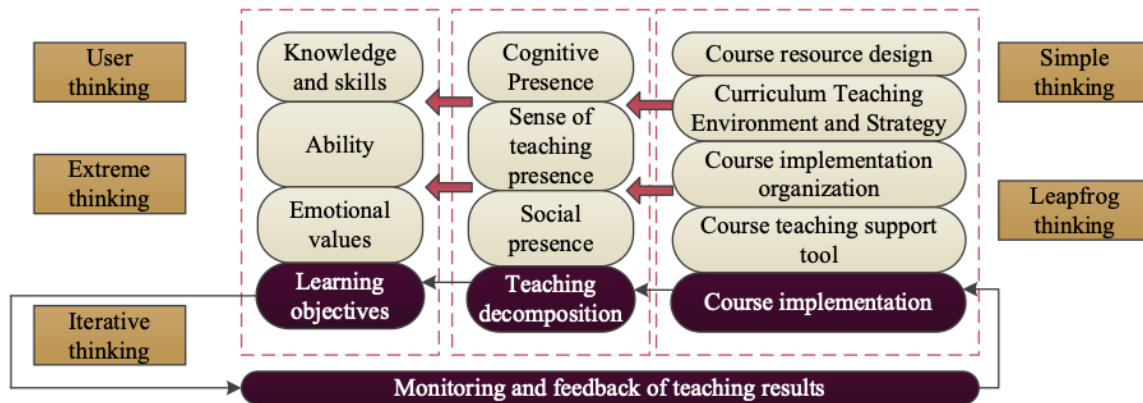


Figure 1: Artificial intelligence platform

The platform can achieve learning goals under user thinking, extreme thinking and iterative thinking, and course implementation under simplicity and cross-border thinking. Extreme thinking means that everything is centered on the user’s experience, and the product service and user experience are made to be the best. Iterative thinking is a user-focused, iterative, step-by-step development method in product implementation, in the rapid succession of iterations to improve the product and eventually achieve the ultimate goal. Minimalist thinking means the simpler something is, the easier it is for users to use and spread it and get a good user experience. And the essence of cross-border thinking means sharing valuable things within the intelligent platform to the teaching field, co-integration sharing and collaborative innovation.

3.2. Pair-Sharing Classroom Teaching Model

The era of artificial intelligence in education has officially kicked off, and English teaching in higher education institutions has also ushered in significant changes. Professor Zhang Xuexin of Fudan University combined the advantages of lecture- and discussion-based classrooms and proposed the pair-sharing classroom’s teaching model [25, 26]. The core concept is to divide the classroom time, with half of the time allocated to the teacher for lecturing and half for students to discuss, leaving time for students to internalize and absorb what they have learned in the lecture and discussion sessions. The specific process is shown in Fig. 2.

The pairwise classroom model includes three stages: classroom lecture, internalization and absorption, and group discussion, in which the internalization and absorption are online learning, while the classroom lecture and group discussion are “online + offline” blended learning. The first half of the class discusses the content of the previous week’s class. This is the core feature of the dyadic classroom and is known as an alternate classroom discussion. For each chapter, the instructor does not ask students questions or organize discussions during the lecture session. The content, focus, and difficulties are introduced through a one-way lecture. Students have a week to read the material and complete assignments between the lecture and discussion sessions. According to their interests and needs, they choose the most appropriate method and approach to deeply understand the course for personalized internalization and assimilation at the appropriate time.

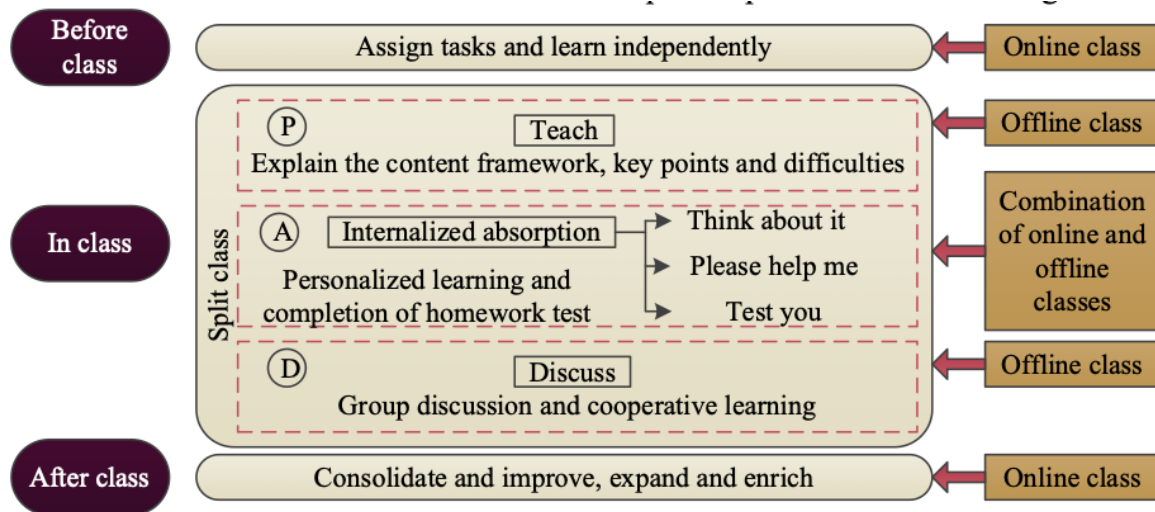


Figure 2: Flowchart of the dyadic classroom model

In the dyadic classroom, the instructor introduces the basic framework and concepts, focusing on key points and difficulties but not exhausting the material's content. After the class, students can internalize and assimilate the material at their own pace, according to their characteristics and specific situations, to complete a more comprehensive learning and understanding of the material. Interaction is a necessary tool for students to internalize and assimilate classroom knowledge and an effective way to improve students' ability to use English in practice. The key to the classroom is to stagger the lecture and discussion so that students have some time in between to organize their learning. After internalization and absorption, students discuss what they have learned in the classroom through group discussions. The same content is learned in stages through three processes: teacher lecture, post-class review and group discussion, leading to a gradual increase in understanding.

In the dyadic classroom, since students are required to study independently before each discussion, including collecting information, thinking about problems, and summarizing, the dyadic classroom enables students to keep up with the teaching progress and take the initiative to refresh their knowledge. It is a great way to improve students' expression and communication skills. Students can identify their weaknesses in the discussion and the teacher's comments and check for gaps. They can also learn from the problem-solving skills of other students in the same group to complement their strengths and weaknesses.

This paper constructs a pair-sharing classroom model based on an artificial intelligence platform to find the integration point of information technology and pair-sharing classroom through artificial intelligence technology, to form a teaching model in which information technology and pair-sharing classroom support each other. This paper updates the traditional higher vocational English teaching model in terms of both teaching methods and means, and uses AI technology to track students' learning to help personalized learning and refined review, thus helping teachers grasp the learning situation, promoting precise teaching and targeted counseling for students, and also improving the effectiveness of teaching. Students achieve independent learning and improve their learning motivation through the pair-sharing classroom model.

4. Analysis of the Results of English Teaching Simulation Practice in Higher Education

To verify the effectiveness of the application of the AI-based platform for the pair-sharing classroom teaching model in higher education English teaching, a teaching pilot practice of the model was started in the fall of 2019. The three segments of lecture, discussion and absorption are integrated into classroom teaching, and the RBM algorithm is used to inform the learning behavior of college students. In the long-term teaching activities of English courses in higher education, we have used the traditional teaching model

of classroom lectures on theory. After the practice of the contrastive classroom teaching model, we selected the score interval segments to which the class grades belonged in the last five years of the course taught by the same teacher and applied the marginal distribution function to calculate the interval values for the grades, as shown in Fig. 3.

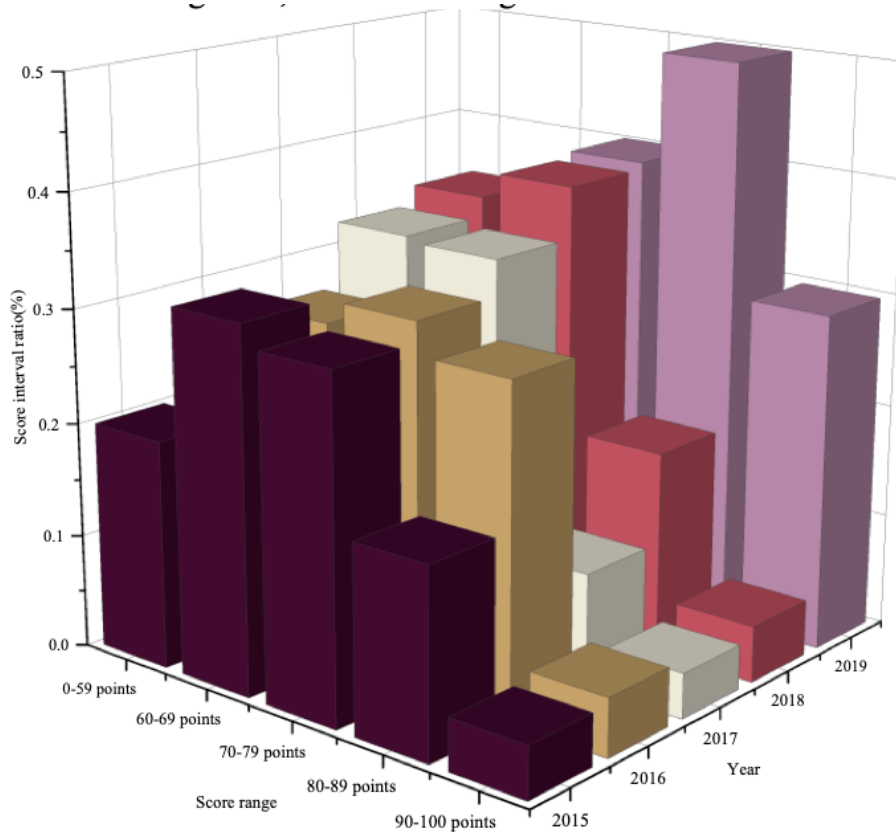


Figure 3: Comparison of performance bands over the years

We have found that after implementing the pair-sharing classroom model in 2019, the percentage of students in the 90–100 range has increased from about 3%–6% to 25%. The proportion of students in the 80–89 range increased to 49%, and the majority of learners in the class achieved more desirable learning outcomes. At the same time, the percentage of students in the 70–79 range dropped by 10% to 30%, and the percentage of students in the 60–69 range dropped significantly to only 10%. This indicates that implementing the split-classroom teaching model has improved students' learning initiative and motivation. Not only can it effectively improve the learning efficiency of learners, but also learners of different levels can achieve better learning results through this teaching method.

According to the above analysis, the AI platform-based pair-sharing classroom teaching model has brought a new way of reforming English teaching in higher education. Compared with previous years' results, students using this teaching model have also made great progress in their performance, as reflected in their speaking, listening, reading, and writing abilities, as shown in Table 1. In the first month, students improved their speaking skills by 18%, their listening skills by 21%, their reading skills by 29%, and their writing skills by 32%. By the second month, the scores improved by an average of about 30%. And in the third month, the writing ability had improved by 91%, and the reading level had improved by 89%, with a significant increase in overall level. It shows that using the dyadic classroom model in teaching English in higher education can make the English level detailed and interesting to achieve a breakthrough in teaching important and difficult points.

Table 1: Achievement data table

	Speaking skills	Listening level	Reading Level	Writing skills
First month	18%	21%	29%	32%
Second month	49%	57%	55%	59%
Third month	77%	82%	89%	91%

During the practice of this teaching model, to understand the learners' acceptance attitude towards this teaching model, we improved the data mining efficiency by introducing the Gibbs sampling algorithm and calculated two evaluation indicators. The 2 indicators are classroom evaluation satisfaction and post-class comment satisfaction for feedback description. Four classes were selected for the practice test, represented by classes 1, 2, 3 and 4, and the specific data are shown in Fig. 4.

As can be seen in Fig. 4(a), after the implementation of pair-sharing split classroom teaching, the satisfaction of class evaluation in all four classes is about 80%, which is about 25% higher than when it was not used, and a gradually increasing trend promotes it. It is possible to implement the teaching concept of diversified evaluation, cultivate students' independent learning and cooperative learning ability, and improve students' learning initiative. It also improves students' written expression skills and teachers' teaching quality through students' active construction. This shows that adopting this teaching method in higher-level English classrooms is feasible.

From Fig. 4(b), we can see that all four classes have improved their satisfaction with the teaching effect after using this mode of teaching, and the satisfaction with the teaching effect had increased by about 20% on average compared with that when this teaching mode was not used. This indicates that this teaching mode can further improve the evaluation quality of higher vocational English teaching and help teachers to analyze and study students' knowledge mastery, actual learning difficulties and needs, and various competency development needs in all aspects.

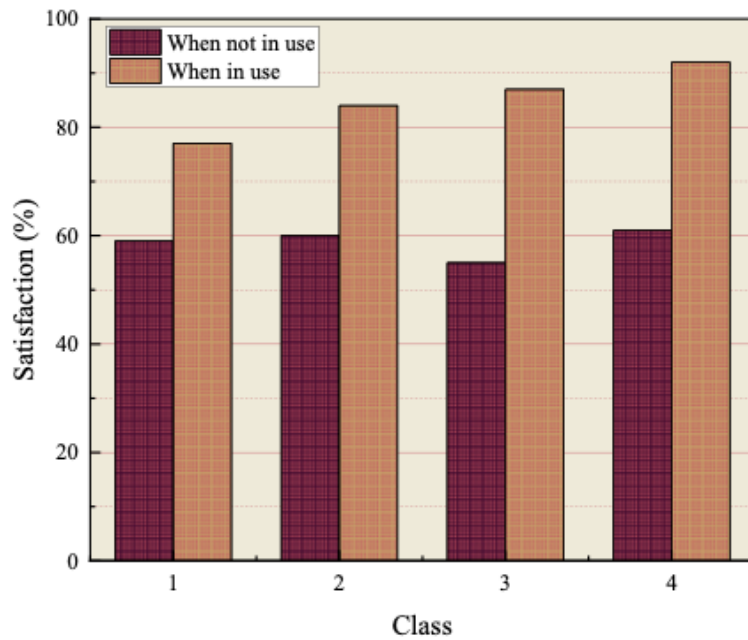
In conjunction with the above analysis, 71 students from two classes participating in the teaching practice pilot were selected and surveyed during a three-month teaching practice period. The Bernoulli distribution function was used to show the reception status of this teaching mode, as shown in Table 2.

Table 2: Calculation results

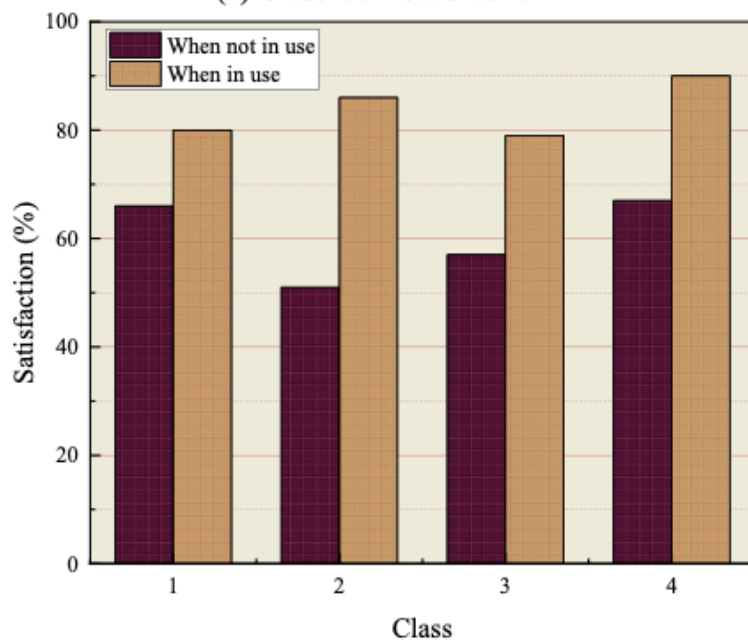
	Support	Not essential	Not necessary
First month	30%	49%	21%
Second month	61%	28%	11%
Third month	87%	8%	5%

The application of the pair-sharing split classroom model has gradually gained general acceptance among students. In the first month of implementation, only 30% of the students supported using this format, 49% considered it optional, and 21% considered it unnecessary. In the second month, the number of students who thought it was optional dropped by 21%, and only 11% thought it was unnecessary. In the third month, 87% of the students liked the teaching style. They found the teaching method very new and interesting, while only 5% of the students found it unnecessary. This shows that the practice of the hybrid teaching mode has improved the quality of teaching and learning English courses in higher education and has formed certain characteristics. This adds to a lively classroom atmosphere, stimulates students' interest in learning, and cultivates students' habits of mutual help learning.

In teaching English in higher education, constructing a counterpoint classroom teaching model based on an artificial intelligence platform can strengthen the effectiveness of teaching and learning, as well as develop student's analytical skills, inductive and generalization skills, and writing skills. This model uses the advantages of the Internet to assign homework assignments accurately and to develop students' teamwork skills through cooperative group learning. It also allows for flexible teaching time without being formal. It allows students to experience continuous progress, enhances their sense of academic achievement, and motivates them to learn.



(a) Classroom satisfaction



(b) Satisfaction with teaching effectiveness

Figure 4: Teaching satisfaction

5. Conclusion

In this paper, we built a teaching model of a higher vocational English pair-sharing classroom based on an artificial intelligence platform and analyzed the data of the higher vocational English teaching model through artificial intelligence technology. And the application effect of the platform is verified in the teaching simulation practice, and the conclusions are as follows:

1. Through the marginal distribution function to calculate the interval value for students' performance, the proportion of the number of people in the 90–100 mark interval segment is increased to 12%, and the proportion of the number of people in the 60–69 mark interval segment is decreased to about 10%. This means that learners at different levels can achieve better learning results and improve their language skills.
2. The Bernoulli distribution function was used to show the students' reception status of this teaching mode. The number of students who supported this form increased from 30% to 87%, and the number of students who considered this mode optional and unnecessary decreased by 21% and 11%, respectively, so it can be seen that students have generally accepted the AI platform.
3. The satisfaction of class evaluation is basically around 80%, which is about 25% higher than when it was not used, and the satisfaction of teaching effect has increased by about 20% on average, and the trend is gradually increasing. This is strong proof that the dyadic classroom model provides a new perspective for reforming English teaching in higher education and can further improve the teaching quality.

Acknowledgements

Supported by Education Commission of Hainan province of China (HnjgY2022-3).

References

- [1] Kebisek, M., Tanuska, P., Spendla, L., et al. (2020). Artificial intelligence platform proposal for paint structure quality prediction within the Industry 4.0 concept. *IFAC-PapersOnLine*, 53(2), 11168–11174.
- [2] Sterne, J. (2017). Artificial intelligence for marketing (practical applications) — The AI marketing platform. 218–231.
- [3] Rao, N. (2019). 'Teaching excellence' in higher education: A comparative study of English and Australian academics' perspectives. *Journal of Further and Higher Education*, 43.
- [4] Z., Y., & Dikilitaş, K. (2018). Listening comprehension strategies of EMI students in Turkey. In *Key issues in English for specific purposes in higher education* Volume 11 (pp. 265–287).
- [5] Lin, T., & Lei, J. (2021). English-medium instruction and content learning in higher education: Effects of medium of instruction, English proficiency, and academic ability. *SAGE Open*, 11(4), 71–83.
- [6] Fook, C. Y., Sidhu, G. K., Narasuman, S., et al. (2016). Enhancing e-learning using smart mobile English learning tool (SMELT). In *7th International Conference on University Learning and Teaching Proceedings* (pp. 493–509).
- [7] Auer, M. E., Guralnick, D., & Simonics, I. (2018). The use of new learning technologies in higher education classroom: A case study. In *Teaching and learning in a digital world* Volume 715 (pp. 499–506).
- [8] Cong, T. N., Oterkus, S., & Oterkus, E. (2021). Application of artificial intelligence and machine learning in peridynamics. *Peridynamic Modeling, Numerical Techniques, and Applications*, 419–435.
- [9] Brower, V. W. (2021). Machine-believers learning faiths & knowledges: The new gospel of artificial intelligence. *Internationales Jahrbuch für Medienphilosophie*, 97–122.
- [10] Rattan, P., Penrice, D. D., & Simonetto, D. A. (2022). Artificial intelligence and machine learning: What you always wanted to know but were afraid to ask. *Gastro Hep Advances*, 1(1), 70–78.
- [11] At, A., Ha, B., & Fy, C. (2021). Artificial intelligence and machine learning to predict student performance during the COVID-19. *Procedia Computer Science*, 184, 835–840.
- [12] An, A., Ryz, B., Xi, C., et al. (2022). Review of machine learning technologies and artificial intelligence in modern manufacturing systems. In *Design and operation of production networks for mass personalization in the era of cloud technology* (pp. 317–348).
- [13] Zheng, Z., Zhang, L., Wang, H., et al. (2021). Research and practice of hybrid teaching mode based on "SPOC+pair classroom": Taking architectural drawing and CAD course as an example. *Curriculum Education Research*, 2021(15), 138–139.
- [14] Ye, M., & Xiao, C. (2021). The application of the blended pair of divided classroom model in teaching English writing in higher education. *Modern Vocational Education*, 2021(19), 36–37.
- [15] Sun, Y. (2019). Exploring the integrated application of flipped classroom and counterpart classroom in English general reading course in higher education. *Campus English*, 2019(42), 57.

- [16] Wei, Y., & Zhou, X. (2020). Exploration on the use of pairwise split classroom in online teaching of English in higher education. *Shandong Youth*, 2020(5), 265, 267.
- [17] Dong, W., & Ding, H. (2020). A study on the application of pairwise classroom in higher vocational English teaching. *Wen Cun Reading Journal*, 2020(34), 84, 83.
- [18] Zhu, L., & Huang, H. (2021). Research on intelligent learning platform of college English in higher education institutions based on big data. Volume, 11(10), 280–281.
- [19] Chen, Y. (2020). Research on the application of blended teaching mode of public English in higher education based on intelligent teaching platform. *Friends of Humanities*, 2020(14), 193.
- [20] Li, Y. (2019). Exploring the implicit tiered teaching mode of public English in higher education based on “Internet+”. *Campus English*, 2019(38), 58.
- [21] Zhu, S. (2021). A brief analysis of the three-stage scaffolding teaching mode of international trade practice course in higher education. *Wen Cun Reading Journal*, 2021(17), 112.
- [22] Shao, K., Zhu, Y., & Zhao, D. (2018). StarCraft micromanagement with reinforcement learning and curriculum transfer learning. *IEEE Transactions on Emerging Topics in Computational Intelligence*, 73–84.
- [23] Lorenzo-Lledó, A., Lledó, A., Gilabert-Cerdá, A., et al. (2021). The pedagogical model of hybrid teaching difficulties of university students in the context of COVID-19. *European Journal of Investigation in Health, Psychology and Education*, 11, 1320–1332.
- [24] Wang, X. (2016). On the application of flipped classroom in teaching English writing in higher education. *Science and Education Wenhui*, 2016(15), 179–180.
- [25] Wang, F., & Wang, Z. (2016). The application of a pair of divided classrooms in teaching basic nursing to undergraduate nursing students. *Nursing Research*, 30(30), 3820–3821.
- [26] Sabir, Z., Amin, F., Pohl, D., et al. (2020). Intelligence computing approach for solving second order system of Emden–Fowler model. *Journal of Intelligent & Fuzzy Systems*, 38(6), 7391–7406.