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Research Article

Innovative Research on Collaborative Design of Blended English Teaching in Higher Vocational Colleges Based on Digital Technology

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By combining the advantages of online teaching and offline teaching under digital technology, blended teaching can break the limitation of time and space, which reflects the transformation of the "student-centered" teaching paradigm. With the expansion of the blended teaching scale, how to analyze and match the features through the data of learners' learning behaviors to improve their learning efficiency and teachers' teaching level and quality has become an urgent problem. Therefore, in this paper, collaborative design is carried out for blended English teaching platform in higher vocational colleges, where students' cognitive ability and difficulty of teaching resources are cooperatively matched. At the same time, blended recommendation of teaching resources is implemented based on collaborative filtering algorithm, thus developing a matching algorithm in light of the above dynamic adjustment. The results of the iterative test show that the platform can optimize the current English teaching mode and enhance the learning feedback between teachers and students, thus improving students' English learning level.

1. Introduction

At present, Internet not only plays an optimization and integration role in the allocation of production factors, but also is introduced into the basic requirements of public English teaching in colleges. It emphasizes the significance of actively introducing computer and network technology that can enhance students' consciousness and enthusiasm in English learning. Under the background of the new situation, with the rapid development of network information technology in China, various English autonomous learning platforms came into being [1–3]. Compared with traditional English learning methods, the network-based learning model can meet the diverse needs of students' learning resources, which helps students to manage their learning time flexibly. Moreover, it gives full play to the guiding role of network learning for students, which quickly improves students' English learning efficiency and effect. Under the above platform, students can be engaged in online English learning by combining the hot issues and contents that they are interested in and accumulate experience in English learning. However, in the face of massive learning resources, there is a serious problem of overload information, especially in the field of basic English teaching. The selective difficulty caused by information overload makes it difficult for learners to quickly find the learning content suitable for their own abilities, which not only delays their valuable time and reduces their learning efficiency, but also causes resistance to English learning [4, 5].

Combining blended teaching mode with digital technology can meet all kinds of needs of English teaching development. This teaching method of combining theoretical knowledge with practice can improve the traditional way of students' class learning and provide guarantee for the all-round development of their ability. In addition, the blended teaching mode provides rich resources for students, which can comprehensively improve students' comprehensive comprehension of English knowledge [6, 7]. At present, the

application of the blended teaching mode is superficial, teachers have failed to strengthen the reform of traditional classroom teaching methods and create a learning environment based on the network platform. Therefore, it is significant to research the collaborative design of blended English teaching in higher vocational colleges under digital technology, which can integrate the public English teaching mode and methods with modern teaching forms, so as to promote the effective development of English teaching.

2. Establishment of Blended English Teaching Platform

2.1. Connotation of Blended Teaching

2.1.1. Significance of Blended Teaching. The implementation of blended teaching involves students, teachers, colleges, and other subjects. In fact, it has formed a complex system, which also brings challenges to blended teaching [8]. However, digital technology gives a good solution. Various Internet tools such as Internet system management platform and Internet information storage provide technical support for blended teaching system management that mainly includes teaching evaluation system, teaching resource sharing system, teaching curriculum arrangement system, etc. Through the blended teaching mode, teachers can not only teach through the network but also make preparation for class, assign homework, correct homework, and answer questions online. Similarly, students can interact with teachers online to solve the confusion about English learning [9, 10].

2.1.2. Digital Support for Blended Teaching. The development of digital technology provides a reliable mobile platform for blended teaching. Students' extracurricular practice cannot be separated from the support of abundant network resources, so the interactive design of learning content, including content structure design, multimedia presentation design, problem design of teaching content, and operability design of teaching tasks cannot be separated from the support of mobile platform [11, 12]. The use of the mobile platform can greatly expand the space of class, and teachers can communicate with students through various ways, such as network teaching platform before and after class, so as to keep abreast of students' learning situation and their feedback. Especially, the establishment of college resource sharing platforms has created a harmonious, open, interactive, and exploratory environment for students, which enables students to freely discuss problems with online students or teachers equally and easily through the network, and always maintain a positive self-activation state in the learning process.

2.1.3. Existing Problems. Due to the characteristics of learners and learning resources, the traditional network teaching platform cannot effectively adapt to the blended teaching mode, and it is difficult to integrate the learners' changing cognitive ability and the difficulty of learning resources for personalized collaboration. In addition, most online English teaching resources are simply piled up, which is not only a lack of semantic and logical hierarchy of knowledge points but also a lack of marking of knowledge points.

2.2. Recommendation of English Teaching Content

2.2.1. Recommendation Based on Teaching Resources. Recommendation based on teaching resources is to use the content attributes of teaching resources to predict the information related to it and users' personal information. The system recommends learning resources for learners that are similar to their past studies, hobbies, and abilities [13]. This method can not only avoid the cold start problem of learning resources but also analyze the relationship between learning resources first and then implement the recommendation [14]. It finds the relevance of resources in terms of content according to the annotation metadata and then recommends similar learning resources to users based on user's historical learning records, as shown in Figure 1:

We model the metadata of learning resources, then discover the similarity between learning resources through these metadata, and finally, make recommendations according to the similarity. Content-based recommendation only considers the nature of objects and forms a set of objects according to tags. If the learning resources that users like appear in this set, other objects in the collection are recommended to them [15, 16]. In addition, it needs to use related technologies to describe learning resources and learners' personal information, as well as strategies and algorithms that can compare personal information with content description. Its architecture diagram is shown in Figure 2:

The recommendation system only uses the current user's preferences and related historical learning records to build the personal information model, which presents the reasons why content resources are recommended by the way of display (content features or descriptions). In addition, it can also recommend new content without any comments from users, which can make good use of learners' interests and receptivity to model, thus making the recommendation result more accurate [17, 18].

2.2.2. Recommendation Based on Learner's Ability. Accurate mastery of students' English knowledge and learning ability is helpful to better implement the "online" part of blended teaching. The recommendation based on learners' ability is based on learners' personal characteristics (existing knowledge base, cognitive characteristics, learning style, etc.) and demographic information (age, gender, place of residence, interest, etc.). First, the algorithm takes learners' personal data to automatically cluster and group students and then recommends different learning contents according to specific learners' abilities. Learners can choose their own learning materials, learning methods, and evaluation methods that best suit their own characteristics. The basic process of the recommended algorithm is as follows:

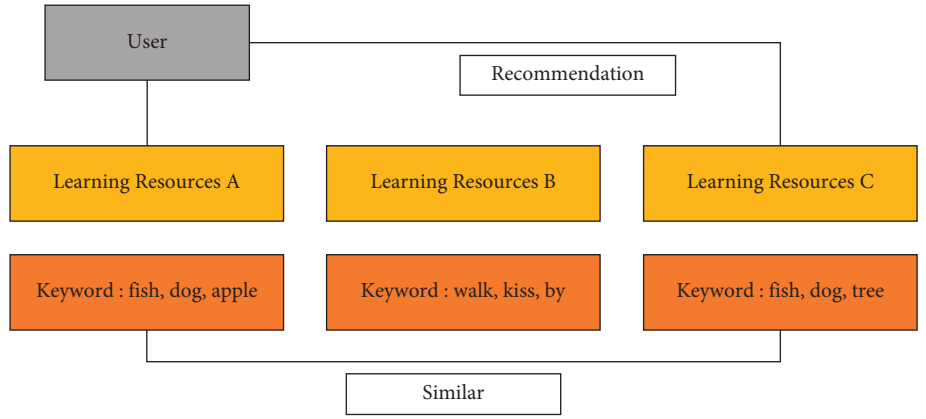

Figure 1: Recommendation of English teaching content.

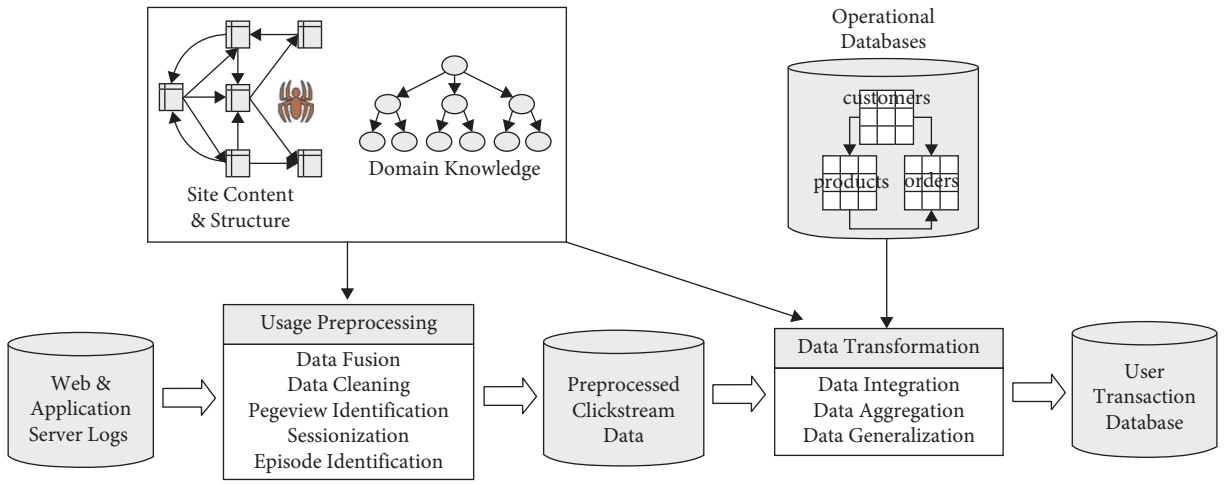

Figure 2: Framework of recommendation on English teaching content.

(1) Obtain information of learner's ability

(2) Look up the matching information of ability and difficulty

(3) Search for learning resources by using the information of difficulty matching

(4) Check the recommended result set, and if the result set is larger than the preset list length, go to step (6); if it is less than the preset list length, continue to (7); otherwise, return to (5);

(5) Output and display the recommendation list

(6) Reduce the difficulty standard to retrieve learning resources again and back to (4)

(7) Increase the difficulty standard, re-search the learning resources, and back to (4)

2.2.3. Recommendation Based on Collaborative Filtering. Both user-based recommendation and teacher-based recommendation need to obtain relevant information. User-based recommendation needs to obtain user's rating data and their "interests and abilities," while teaching-based recommendation needs to obtain teacher's curriculum design [19]. Collaborative filtering recommendation can overcome the problem of recommendation based on users, teachers, and English teaching resources. When the description information of teaching resources is incomplete or difficult to obtain, collaborative filtering algorithm can make recommendations through feedback from other users.

The biggest feature of the collaborative filtering recommendation algorithm is that it considers the similarity between users and makes full use of collective wisdom; that is, it digs out a small number of user groups (clustering grouping, which is called neighbors in collaborative filtering) that are similar to their interests and abilities among users. Afterward, an ordered list is formed according to the collection of objects related to them for recommendation [20, 21].

2.2.4. Blended Recommendation. Due to the personalized differences of users' learning, it is not only users' ability and resources that can be used as the basis for recommendation but also can be based on their learning records, hobbies, and learning results. In addition, collaborative filtering recommendations can be made according to users with the same ability level and learning resources. Because of the difficulty

of learning resources and the error of cognitive ability calculation, an algorithm may only be suitable for parts of learning resources or learners. It is necessary to establish a configuration framework of individual-based learning resources or individual learner recommendation algorithm. In addition, the framework of the recommendation algorithm is generally based on a configurable mechanism. Therefore, the usage scenarios, targeted users, data on which recommendation depends, recommended data sources, and applicable scope of the recommendation algorithm are analyzed. Moreover, combined with the configuration parameters of data, a configuration framework of blended recommendation algorithm is designed, which designs all kinds of recommendations into system processes that can be called independently and specifies the storage locations of input data and output results, thus realizing the separation of the recommendation algorithm from the system platform and achieving the goal of dynamically configuring or adjusting the recommendation algorithm. Under the framework, the general flow of this recommendation algorithm is as follows:

(1) Learner user login
(2) Open the page that contains the function of recommendation
(3) Income navigation information for the page and user parameters
(4) Search the recommendation algorithm configuration table of users and page positions
(5) Obtain the type, dependent data, and the output position of the result the in recommendation algorithm
(6) Obtain recommended dependence data
(7) Call the recommendation algorithm process to transfer recommendation dependent data and user information
(8) Recommend the algorithm to be executed, record the output result to the established position, and notify the caller to complete it
(9) Check the recommended calculation automatically
(10) Obtain a recommendation result list according to the calculation result mark

The whole process involves learner, pages, background algorithm scheduler, the process of recommendation algorithm, and detection program, whose collaborative design process of teaching resources is shown in Figure 3.

Algorithm 1 shows the recommendation algorithm.

2.3. Microservice Architecture. Because the online English learning platform is a multiuser system based on the Internet, the microservice architecture is adopted in this system architecture model [22]. Microservice architecture is an architecture style, which organizes a series of collaborative services into a system to support business. The aim is to decouple the whole scheme by splitting the functions into discrete and independent services where each microservice can be independently developed, deployed, run, and upgraded. Compared to the traditional Java Web development method, the microservice architecture can be implemented by means of containers or virtual machines [23].

In order to follow the development principle of "low coupling, high cohesion" and realize the robustness and scalability of the code, layered technology is adopted for the establishment of this platform. Different layers are responsible for different functions, and the layers are combined through API interface calls, as shown in Figure 4.

In order to better reduce the coupling between layers, the software implementation is generally divided into three-tier architecture, and object-oriented programming is adopted. The upper layer calls the lower layer through interfaces, while the lower layer provides services to the upper layer, which is the implementation class of the lower layer interface. The API interface of the service standard is the same, and the service provider can change it. The three-tier architecture consists of a user interface layer, business logic layer, and data access layer, each of which has the following functions:

(1) User interface layer, which is responsible for interacting with users
(2) Business logic (BL) layer, which is mainly aimed at the operation of specific problems, can also be represented as the operation of data layer and the logical processing of data business
(3) Data access layer, which mainly operates on the database, not data, and specifically provides data services for the business logic layer or user interface layer

3. Testing of the Platform

3.1. Test Method. During the test, the recorded data of users' learning process are used, and more than 100000 user information, 40000 English sentences, 30000 words pronunciation data, and 500 English article data in the system are selected. The test process used user tables, user learning tables, teaching resource tables, and so on. In order to better realize blended teaching, the learner's test and feedback are recorded. The matching index of resources is defined as the ratio of learning score and cognitive ability of resources; that is, after the user finishes learning, the learning content is tested by the test bar, and the obtained score is divided by the user's cognitive ability and multiplied by 100%, as shown in formula (1). If the recommended learning materials meet the user's cognitive ability, users will be asked to complete the relevant test questions after learning the resources, so as to check whether they have mastered the knowledge and ability contained in the resources. If the user fails to complete the learning or test questions, it means that the recommendation does not meet their cognitive ability. Otherwise, it means that the resource is in line with the user's cognitive ability.

$$\text{MatchRate}(\%) = \frac{\text{TestSore}}{\text{CogAT}} \times 100\%. \quad (1)$$

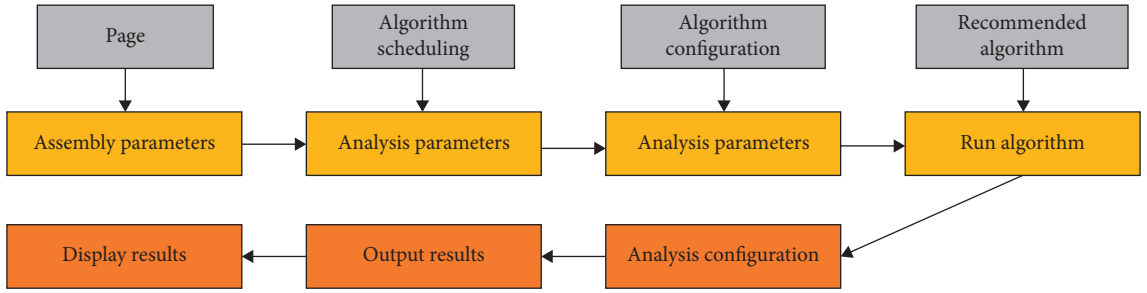

Figure 3: Collaborative design process of teaching resources.

```
Public float repeat value (Document doc1, Document doc2) {
   Float keyword TFIDF = 0.0f;
   Float doc1 TFIDF = 0.0f;
   Float doc2 TFIDF = 0.0f;
   For (String word: doc1.getContentTerms().keySet()) {
      If (doc2.getContentTerms().containsKey (word)) {
         Keyword TFIDF += doc1.getContentTerms().get(word);
      }
      Doc1 TFIDF += doc1.getContentTerms().get(word);
   }
   For (String word: doc2.getContentTerms().keySet()) {
      Doc2 TFIDF += doc2.getContentTerms().get(word);
   }
   Return (keyword TFIDF/doc1 TFIDF) * (keyword TFIDF/doc2 TFIDF);
}.
```

Algorithm 1: Recommendation algorithm.

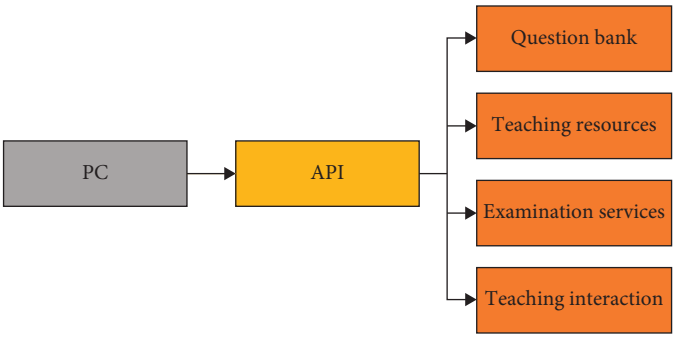

Figure 4: Architecture of blended teaching platform.

In the formula above, MatchRate indicates the degree of matching between learning resources and users' abilities, TestScore indicates the test scores of users after learning resources, and CogAT indicates users' cognitive abilities.

The evaluation system consists of process evaluation (mainly online evaluation) and summative evaluation (mainly offline evaluation). Online learning is mainly scored by online quantitative indicators, while offline learning is mainly scored by offline nonquantitative indicators. The blended teaching mode is mainly synthesized from the three processes before class, during class, and after class and the final evaluation. In each process, students can get online quantitative index scores and nonquantitative index scores evaluated by teachers.

Table 1: Test results of blended English teaching platform.

Grouping parameters	Iterations	Cluster average diameter	Calculation time (seconds)
3	80	4.6	1265
8	40	6.2	1038
12	20	6.9	1728
29	10	7.4	1189

3.2. Test Results. Firstly, the cognitive abilities of learners' users are calculated and grouped according to their cognitive abilities. The main basis of grouping is the geometric length of students' cognitive attribute vectors that mainly includes

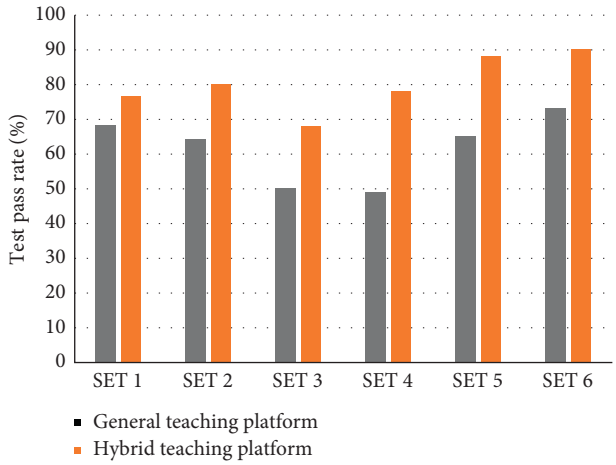

Figure 5: Comparison of students' test pass rate.

the cognitive abilities of age, vocabulary, and learning duration. The test results of grouping number and execution efficiency of related algorithms are shown in Table 1.

According to the results in the table above, when 8 groups are selected in groups and 40 iterations are selected, the execution efficiency is relatively high. In addition, the test results of college learners divided into 8 groups are in good agreement with the actual subjective judgment. The guiding significance of the test data lies in that we are basically in accordance with the actual test results. When students are grouped according to different learning stages, the cognitive abilities of students in each group are similar. If the grouping span is too large, the difference of cognitive abilities within the group will be larger, and the matching degree may decrease according to the recommendation of clustering grouping.

The matching effect of teaching resources is compared. For six groups of data, the number of users who have successfully passed the test on the blended English teaching platform is compared with the number of users who have passed the test on the original platform (the matching coefficient is over 60), and the result is shown in Figure 5.

It can be seen from the figure that under the original teaching platform, the lowest pass rate of users from SET1 to SET6 is below 50%. After adopting the blended recommendation algorithm, the collaborative feedback between users and teachers is obviously improved, and the test pass rate of students under the blended teaching platform remains above 65%, which is significantly higher than that of ordinary teaching platform. It shows that the promotion effect of the blended teaching platform on students' English learning is targeted and meets the learning ability of users. For teachers, the appropriate evaluation mechanism enables the platform to be used as an effective auxiliary tool for English teaching in higher vocational colleges, so as to truly advance learning and teaching through evaluation.

4. Conclusion

The blended English teaching mode based on digital technology can integrate modern technology with traditional teaching, and greatly improve the teaching quality of English in higher vocational colleges. By analyzing the shortcomings of blended English teaching at present, this paper designs a blended network teaching platform for higher vocational English, including the recommendation of teaching resources, overall structure, collaborative codes, etc. Moreover, the platform matches students' cognitive ability with the difficulty of teaching resources and tests the platform through the users' learning records and test completion. The results show that the collaborative feedback between users and teachers is significantly improved after the blended recommendation algorithm is adopted, and the test pass rate of students is above 65%, which is apparently higher than that of ordinary teaching platforms.

Data Availability

The dataset can be accessed upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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