



Exploration of Information Practice of Constructive English Learning Platform Based on Ant Colony Algorithm

Xizhen Ai^(✉) and Yanyan Zong

Nanchang Institute of Science and Technology, Nanchang 330000, Jiangxi, China
nancy20210824@163.com

Abstract. This study explores the informationization practice of a constructive English learning platform based on ant colony algorithm. In traditional English learning, students are often passive recipients of knowledge and lack the ability to actively participate and solve problems. In order to change this situation, we have designed an information-based learning platform based on ant colony algorithm, aiming to enhance students' constructive learning experience. Our platform inspires students to actively participate and collaborate in learning by simulating the behavior of ants. In ant colony algorithm, ants represent students, and each ant represents a learner. On the platform, students can independently choose learning content, set learning goals, and construct new knowledge and understanding through collaborative learning and practical activities with other students. This article first briefly introduces the background and purpose of system design, and then conducts a detailed requirement analysis of the system, including a clear problem definition and feasibility analysis; In the preliminary design stage, a system structure model was established, and a database and interface were designed.

Through the simulation of ant paths and pheromones, we use the platform to provide guiding questions, stimulate discussions, and provide feedback, promoting students' thinking development and knowledge construction. Teachers play a guiding and supporting role on the platform, providing appropriate resources, guidance, and evaluation to ensure that students' learning goals are achieved.

However, we also realize that the platform still needs further improvement and refinement. For example, how to better guide students to engage in autonomous learning and evaluation during the learning process, and how to provide more diverse learning resources. In future research, we will continue to explore the development of a constructive English learning platform based on ant colony algorithm to enhance students' learning experience and effectiveness.

Keywords: Constructive · Ant colony algorithm · English learning platform · Information exploration

1 Introduction

The relevant theories of online learning will involve such scientific fields as pedagogy, psychological cognitive science, information technology, etc. From the first cry of babies after birth, they have started the life journey of communication with people. Mastering

language, the main tool of human communication, has also become an important task for children. English as a second language both in theory and in practice. Undoubtedly, the main obstacle to learning English after mastering your mother tongue is that there is no relatively pure English environment [1]. If you go to a country where English is your mother tongue, you will surely learn English well soon. How to create an effective English learning environment is the key and difficult problem of English learning.

An English learning platform aims to provide users with a convenient and efficient way to learn English, and provide different learning methods and learning contents according to the different needs of users. According to different user groups, we can divide the functions of application design into: examination, study abroad, daily English, business English, and so on. The design of this paper is mainly to provide convenience for users to use the services on the ESL Podcast website. There are already applications related to ESL podcasts in the Android market, but their functions and user experience are not good. Therefore, this paper will learn from existing applications, add features and functions that can improve user experience, and display all functions of this podcast website as perfectly as possible, Give full play to its role as an English learning platform. We hope that after using this app, users can learn common words and use them in combination with selected articles combining the culture of English-speaking countries, and improve and consolidate their English knowledge and ability by listening to online audio.

The system use case model is shown in Fig. 1.

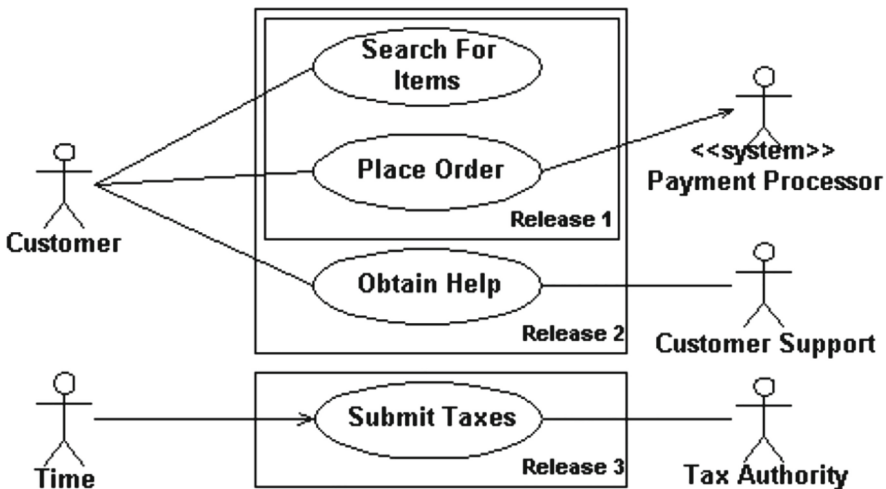


Fig. 1. System use case diagram

Through the above analysis, the application program implemented in this paper will have the following functions:

- (1) Crawl useful information from the web page. It is mainly aimed at practical English learning websites, eliminating redundant information, and summarizing and extracting the English articles, audio and other information we need. It will be displayed on

the mobile phone one by one. We should be able to extract enough information for mobile phone users to learn, and extract and classify the additional titles, pictures, links and other contents of the article [4].

- (2) Get as much audio information as possible. Ensure that users can see all articles and audio files provided on the website, and can view articles in specific article categories (tags).
- (3) Be able to obtain relevant audio and play it. It is required to play the listening materials attached to the extracted articles on the mobile phone. The playback interface should be friendly enough, and its functions should at least include: playback, pause, buffer progress, playback progress, playback time display, and manual adjustment of font size when the article is displayed.
- (4) Provide users with personalized services. Users can add their favorite articles to favorites, and can manage favorites.
- (5) Necessary translation function. When viewing the original text, users can query unfamiliar words. In order to improve the user experience, try to enable users to select words or translate words on the screen in real time.
- (6) Download service. This is a very important feature of this application. Users can save audio and articles locally for offline listening. There are many things to consider here, such as the network connection status, the judgment and prompt of WiFi network before downloading, starting thread download outside the main thread, multitasking, prompt of download progress, saving and restarting of download breakpoints, optimization of download speed, and so on.
- (7) Other services. Such as viewing help, user feedback, sending error reports, accessing the official website, etc.

2 Related Work

2.1 Ant Colony

The optimization process of the adaptive search algorithm in ant colony algorithm can be achieved by constructing a solution set using the finite set $C = \{c_1, c_2, \dots, c_y\}$ to represent the problem.

1. Initialize Ant Colony: Create a population containing multiple ants, each representing a candidate solution in the solution space.
2. Select initial solution: Randomly select one term from the finite set C as the initial solution. This initial solution can be a predefined solution or generated through other heuristic methods.
3. Ant movement and pheromone updates:
 - a. Each ant selects the direction to move next based on the current solution. Usually, decisions are made based on local pheromone concentrations and heuristic rules.
 - b. Ants move to the next solution and update the pheromone concentration on their corresponding path.
 - c. Repeat steps a and b until all ants have completed one iteration.
4. Evaluation solution set: Evaluate the final solutions of all ants and calculate the fitness or objective function value of each solution.

5. Update pheromone: Update the pheromone concentration on each corresponding path in solution set C based on the ant's movement path and objective function value. Usually, the concentration of pheromones on a path is influenced by fitness or objective function values.
6. Determine termination conditions: Check whether the conditions for stopping the algorithm have been met, such as reaching the maximum number of iterations or finding a satisfactory solution.
7. Repeat steps 2–6: If the termination condition is not met, continue the iteration process of the ant colony algorithm.

Through the above steps, the adaptive search algorithm in ant colony algorithm can gradually optimize the solutions in solution set C and perform adaptive search based on pheromone updates. During the search process, ants make decisions based on the current solution and pheromone concentration, while pheromones are updated based on the ant path and the fitness of the solution, gradually finding better solutions. For example, if the current node of ant k is i , the probability of the next node being j is:

$$p_{ij}^k(t) = \frac{\tau_{ij}^\alpha(t)\eta_{ij}^\beta(t)}{\sum_{l \in N'} \tau_{il}^\alpha(t)\eta_{il}^\beta(t)}, \forall j \in N_i^k, k \in 1 - m \quad (1)$$

Heuristic information is not a constant of consciousness, it refers to a simplified strategy or rule used in problem solving and decision-making processes. Heuristic information is inferred based on past experiences, assumptions, or intuition, and may change with changes in the context.

Heuristic information is used to help us make quick decisions when time and resources are limited. It can be a rule, a pattern recognition, or a reasoning method based on prior knowledge. Heuristic information can provide a guiding direction or strategy to help us make decisions or solve complex problems.

However, heuristic information is not a constant of consciousness, as it can be influenced and changed by various factors. For example, changes in different contexts, personal preferences, knowledge levels, or external information can all lead to changes in heuristic information.

Heuristic information is a useful tool used in decision-making, but it is not a constant of consciousness. It is a guiding principle based on experience and inference that can be adjusted and changed as the situation changes.

$$\tau_{ij} = (1 - \rho)\tau_{ij} \quad (2)$$

$$\tau_{ij} = \tau_{ij} + \sum_{k=1}^m \Delta\tau_{ij}^k, \forall (i, j) \in L \quad (3)$$

Ant colony algorithm has also been widely used in solving practical and theoretical problems. It was initially used to solve TSP problems and assignment problems, and gradually developed to solve static combinatorial optimization problems such as vehicle routing problems, orderly arrangement and combination, and dynamic combinatorial problems such as network routing.

2.2 How Ants Work

Ant individuals have only very simple ability in a complex environment. Why? Biologists have found that this is the result of the cooperative work of ant groups. A single ant cannot find the shortest path. Ants leave a certain number of substances (traces) called exogenous hormones on the way they pass [2]. Other ants can detect these traces. The more traces on a road, the higher the probability that other ants will follow the path, so the traces on the path will be strengthened, Guide more and more ants to follow this path. The following examples illustrate how ants find the shortest path [3].

Suppose that ants move back and forth between food source a and nest e at a crawling speed of 1 unit length/unit time (Fig. 2), where D is the distance, and 30 ants leave the nest and food source every unit time (Fig. 2a).

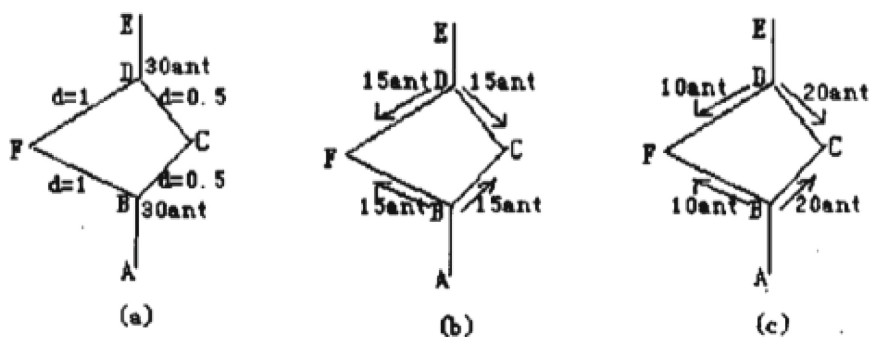


Fig. 2. Ant colony algorithm searching path graph

Imagine that at $T = 0$, there are 30 ants at points B and D, respectively (as shown in Figure B). Since there are no traces on the road, ants will choose one of the two paths with equal probability. Therefore, 15 ants chose to go to point C, while the other 15 chose to go to point F [4]. When $T = 1$, there are 30 ants crawling on path BCD, while there are only 15 ants on path BFD. This results in ant traces on path BCD being twice as large as on path BFD. Meanwhile, during this period, another 30 ants left points B and D. Therefore, 20 ants each chose to go to point C, while the remaining 10 chose to go to point F. This leaves more ant marks on the short path BCD. This process is constantly repeated, causing ant traces on the short path BCD to increase at a faster rate, and more and more ants are choosing this short path [5].

From the perspective of technical feasibility of learning path recommendation in online customer service. First of all, in the context of adaptive learning in online learning, many current studies on learning path recommendation recommend learning objects matching learners' characteristics to learners in the form of learning paths for specific learning tasks of learners, taking into account learners' personalized information and learning object attribute characteristics, to help them better complete learning tasks. In the self-service for customer-oriented problems, customers solve problems through self-study and play the role of learners, which is similar to adaptive learning in the field of online learning. Therefore, the research on learning path recommendation in the field

of online learning provides a basis for this. Secondly, from the perspective of customers and learners themselves, they have different characteristics. But from the perspective of learning, they have similar characteristics [6–8]. Learners in online learning have such characteristics as knowledge level, cognitive style, learning interest, user preferences, user goals, user feedback, etc. Therefore, the characteristics of customers can be analyzed from the same perspective. Thirdly, customers and learners have shared learning object resources. The learning objects in the online learning system can be used to solve customer problems, and the learning objects obtained through the search engine can also be used to solve customer problems [9]. The learning object database in the online learning system records the characteristics and metadata of the learning object, which can be used to define the learning object of the customer. To sum up, learning path recommendation has strong practical application in online customer service.

3 Constructive English Teaching Model and Classification

In English learning activities, the constructivist teaching model is indeed a dual subject model with students as the main body and teachers as the lead. Constructive teaching mode emphasizes students' active participation and autonomous learning. Through interaction and cooperation with teachers, students can construct new knowledge and understanding based on their own needs and interests. In the constructivist teaching model, the role of teachers is to guide students' learning process, provide appropriate learning resources and guidance, and encourage students to actively explore and think. Teachers can promote students' thinking development and knowledge construction by providing questions, stimulating discussions, and providing feedback. Teachers can also provide guidance and support to help students solve problems and overcome difficulties. Students play an active role in constructive teaching models. They actively construct knowledge by participating in classroom discussions, collaborative learning, and practical activities. Under the guidance of teachers, students can independently choose learning content, set learning goals, and deepen their understanding and application of English knowledge by solving practical problems and situations.

The goal of constructive teaching mode is to cultivate students' learning initiative, critical thinking, and problem-solving abilities. Through the dual subject interaction between students and teachers, students can not only passively accept knowledge, but also actively participate in the construction and application of knowledge, thereby better mastering the core concepts and skills of English learning. It is worth noting that the constructive teaching model does not mean completely abandoning the role and guiding role of teachers. Teachers still play an important role in constructive teaching, providing appropriate guidance, feedback, and evaluation to ensure that students' learning goals are achieved. The guidance and support of teachers are crucial for students' learning process and outcomes. Constructive teaching model is a dual subject model with students as the main body and teachers as the leading role, which has important practical significance in English learning. It emphasizes students' active participation and autonomous learning, helping them construct new knowledge and understanding through interaction and cooperation with teachers, and cultivating students' learning initiative and problem-solving abilities.

In this system, the lightweight SQLite database provided by Android system is used, including the creation, deletion, version update and other functions of the database, as well as the addition, deletion, modification and query of each data table [10]. Through the design of the data table, for the “user favorites” table, we need to achieve the operations of adding, deleting, updating, querying, and clearing favorites; For the “user download data” table, we need to query the download list, insert new download items, delete and update the download list and other operations; For the “Download Status” table, we need to get real-time download progress, so we need to insert new download tasks, query progress, query all download status, update download progress, initialize the total length of download files, initialize download status, update download status, delete completed download tasks and other operations; In the “Download Log” table, we need to update the total download length and download progress of each thread in real time under the multithreaded download task. When a thread finishes downloading, we need to delete the thread in the table [11–15]. Therefore, we need to implement the operation of adding a new download thread, querying and updating the download progress of each thread, and deleting a download thread; In the “local word” list, we refer to the external thesaurus. At the same time, when there is no query result in the local word list, we also need to insert the term information into the local data table through the network query, so we only need to implement the insertion and query operations.

4 Practical Exploration of Constructing English Learning Platform Based on Ant Colony Algorithm

4.1 Design of English Learning Platform

The design of an English learning platform is a complex and interesting task that requires a comprehensive use of knowledge from multiple aspects such as human-computer interaction, database design, and software development. This article will discuss how to design an English learning platform based on the Android platform, and introduce the corresponding open source projects and database design.

Firstly, designing an English learning platform requires consideration of user experience and interaction design. A user-friendly interface and intuitive operation are the key to attracting users. To achieve this goal, we can adopt Android’s Material Design style, utilizing visual language, animation, and transition effects to provide a modern and aesthetically pleasing user interface. In addition, it is necessary to enhance the user experience by using appropriate icons, colors, and layout.

Secondly, we need a strong backend support to store and manage learning data. For this, we can use open source database systems such as MySQL or Firebase. The database design should include key data tables such as student information, course content, learning progress, and test scores, in order to achieve personalized learning experiences for users. In addition, we can also use data analysis and recommendation algorithms to help students choose suitable learning content and provide personalized learning suggestions.

To achieve this design, we can create an open source project, such as using Android Studio for development. This project can include two different applications: student side

and manager side. The student end provides functions such as learning courses, taking exams, and viewing learning progress, while the manager end is used to manage student information, publish courses, and monitor learning progress. By combining these two applications together, we can achieve a complete English learning platform.

During the development process, we can also consider introducing some modern technologies to enhance the functionality of the platform. For example, we can use artificial intelligence and natural language processing technology to provide intelligent tutoring and speech recognition functions to help students better learn and practice speaking. In addition, we can also add social functions, such as interaction, discussion, and sharing of learning experiences between students, to promote a learning atmosphere and communication.

In summary, a successful English learning platform design needs to balance multiple aspects such as user experience, database design, and software development. Through reasonable interface design, database structure, and the establishment of open source projects, we can achieve a powerful and user-friendly English learning platform, providing students with personalized learning experiences and rich learning resources.

The network topology of the learning platform is shown in Fig. 3.

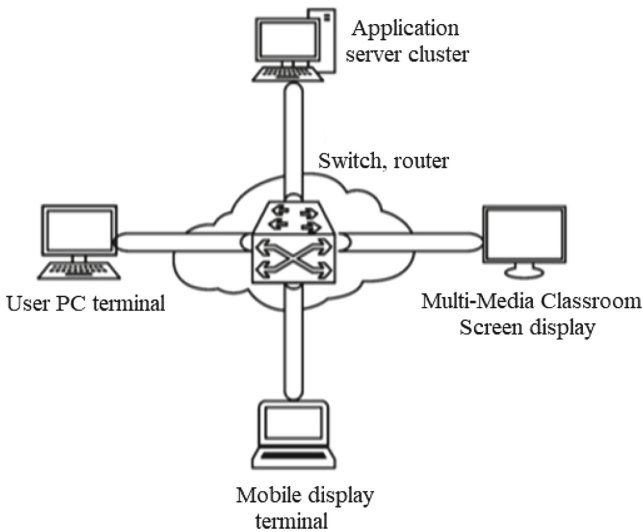


Fig. 3. Network topology

For the distributed network topology of English learning platforms, we can support different access permissions for different user levels (teachers, students, administrators) by implementing identity permission control. We can use a centralized authentication system to manage user authentication and login. Users need to provide a valid username and password for authentication, and assign corresponding permissions based on their identity level (teacher, student, or administrator). This can be achieved by establishing user tables in the database and assigning corresponding roles and permissions to each user. We can design a distributed network topology structure, including teacher

end, student end, and administrator end. The teacher side can provide functions such as uploading teaching resources, designing courses, and managing students. The student end can access the learning resources provided by the teacher and participate in activities such as online learning, quizzes, and discussions. The administrator is responsible for managing the overall operation and maintenance of the system, including user management, permission control, and data backup.

By implementing identity permission control on the platform, we can achieve the following functions:

1. Teachers can upload and manage their own teaching resources, create and submit course plans, and monitor students' learning progress.
2. Students can access specific course content, participate in discussions and online learning, complete exams and assignments, and view their personal learning progress and grades.
3. Administrators can manage user accounts, set permissions and roles, monitor the overall operation and performance of the system, and perform data backup and recovery operations.

To achieve these functions, we can use distributed database systems such as MongoDB or Cassandra to store and manage a large amount of user and course data. At the same time, we also need to design corresponding APIs and network protocols to support data transmission and communication between different ports.

By adopting a distributed network topology and identity permission control, we can establish a secure, reliable, and flexible English learning platform that provides teachers, students, and administrators with different levels of access permissions and meets their different needs. Its logic diagram is shown in Fig. 4.



Fig. 4. Logic diagram

The main function of the database of the English learning platform is to store and manage English learning courseware and question banks. The following are the main functions and design considerations of the database:

Storing courseware and question banks: The database needs to provide functions for storing and managing English learning courseware and question banks. These courseware and question banks can contain content of different learning difficulties and types, such as vocabulary, grammar, listening, and reading comprehension. Each learning content can contain relevant multimedia resources such as text, images, audio, and videos.

Organization and classification: The database needs to design corresponding data structures and relational models to effectively organize and classify learning courseware and question banks. This can be achieved through the use of labels, classifications, and directories. In this way, students can quickly find and access relevant learning resources based on their learning needs and interests.

User permission management: The database should support user permission management to ensure that only specific users (such as teachers and administrators) can upload, edit, and delete learning courseware and question banks. This can be achieved by associating the user's identity and permission information with the data in the database. Only users with corresponding permissions can perform related operations.

Data backup and recovery: In order to ensure the security and reliability of data, the database needs to provide data backup and recovery functions. Regularly backup the database to avoid accidental data loss. In the event of a failure or data corruption, backup data can be used for recovery to ensure the normal operation of the platform.

Performance and scalability: In order to meet the needs of a large number of users and data, databases need to have good performance and scalability. This can be achieved through reasonable database optimization, index design, and distributed storage techniques to ensure that users can quickly retrieve, access, and update courseware and question banks.

4.2 System Implementation

The software server of the system takes Java as the platform and adopts Geronimo 2.1 and Axis2 of Apache, a free and open source organization_ 1.3 build a web server to give full play to the cross platform advantages of Java. In this way, it not only further reduces the operation cost of the server, but also provides more flexibility and selectivity for the deployment of the server under different operating system platforms; The client is completed using visual studio. Net 2003 c# development. Practice has proved that using Java platform as server is a good choice.

In the actual traditional teaching, English teaching means are diversified and teaching materials resources are rich [15]. To use computer multimedia technology to simulate this process, the primary task is to have components that can represent various information fragments, and these components can be combined and applied flexibly.

The client is essentially a process of user-defined serialization and deserialization of component objects represented by various information fragments. The specific process is as follows:

- (1) The teaching assistant client serializes the various information fragment representation objects set according to the teaching needs, and then stores them in the server in the form of XML file;
- (2) The student client reads the XML file in actual use, deserializes the information stored in it into an object of information fragment, and then presents it on the client.

5 Conclusion

Ant colony algorithm provides a new idea for the design of computer software; The maturity of related implementation technology of ant colony algorithm makes it possible for the idea of ant colony algorithm to be applied in software. It increases the diversity and flexibility of learning methods; It not only improves students' learning interest and learning quality, but also reduces the workload of teachers and counselors in lesson preparation. The English learning platform based on ant colony algorithm provides a stage for English teaching assistants to display their talents, but it is only a software platform. Its strength is that it can flexibly and vividly combine multimedia technology with English teaching situations, provide learners with more, better and reasonably organized learning materials, and stimulate learners' visual and auditory systems. The internal rules of English learning and the use of relevant teaching methods also need to be added by teaching assistants in the design of course teaching materials.

References

1. Tang, N., Li, B., Tsai, S.B., et al.: A practical exploration of constructive English learning platform informatization based on RBF algorithm. *Math. Probl. Eng.* **2021** (2021)
2. Shang, F., Liu, C., Guan, Y.: Improved Quantum Ant Colony Algorithm-Based Spark Platform Task Scheduling Method, EP3907609A4 (2022)
3. Tang, J.: Optimization of English learning platform based on a collaborative filtering algorithm. *Complexity* **2021** (2021)
4. Liu, T., Li, X.: Design of English video learning platform based on FPGA system and sobel algorithm. *Microprocess. Microsyst.* 103992 (2021)
5. Wen, H., Zhang, C.: Innovative exploration and practice of Internet plus's blended teaching mode based on blue ink cloud class platform in the course of mechanical drawing and computer drawing CAD. Francis Academic Press (2) (2021)
6. Ge, J., Yu, D., Fang, Y.: Multi-dimensional QoS cloud computing task scheduling strategy based on improved ant colony algorithm. *J. Phys.: Conf. Ser.* **1848**(1), 012031– (2021)
7. Huang, Y.: Design of personalised English distance teaching platform based on artificial intelligence. *J. Inf. Knowl. Manag.* (2022)
8. Gao, J.: Information system of constructive English teaching platform based on RBF algorithm. In: *The International Conference on Cyber Security Intelligence and Analytics*. Springer, Cham (2022)
9. Qingduan, F., Zhongtuan, Z., Guoqiang, W.: Exploration and practice of college mathematics teaching based on STEM education concept (2021)
10. Zhang, L., Huseyin, K.: Exploration of English Learning in Cloud Classroom APP Based on Information Technology Platform. Springer, Singapore (2022)
11. Qi, B.: Mobile English Learning Platform Based on Collaborative Filtering Algorithm. Springer, Singapore (2023)
12. Du, L.: Research on the evaluation of constructive English teaching model based on RBF algorithm (2023)
13. Bharti, P.K., Ghosal, T., Agarwal, M., et al.: BetterPR: a dataset for estimating the constructiveness of peer review comments. In: *International Conference on Theory and Practice of Digital Libraries*. Springer, Cham (2022)
14. Zhu, M.: The curriculum design of SPOC-based online and offline blended teaching model of English linguistics in flipped classroom. *Engl. Linguist. Res.* **11** (2022)
15. Li, J., Yang, Y., Qu, X.: Exploration and practice of network training and teaching platform based on virtual simulation technology (2022)