Eco-Environment Construction of English Teaching Using Artificial Intelligence Under Big Data Environment

MAOHUA SUN[1], (Member, IEEE), AND YUANGANG LI[ID][2], (Member, IEEE)
[1]College of Foreign Languages, Dalian Jiaotong University, Dalian 116028, China
[2]Business School, Dalian University of Foreign Languages, Dalian 116044, China

Corresponding author: Yuangang Li (yuangang.li@outlook.com)

ABSTRACT Application of big data and artificial intelligence has become one influence factor of English teaching, which have broken the balance of the teaching Eco-environment for English. In this article, the artificial intelligence and big data are introduced into English teaching to propose a new teaching Eco-environment construction method to meet the needs of the social development and international communication in English. In the proposed method, the characteristics of English teaching under big data environment are analyzed in detail. Then the big data technology is used to construct a new Eco-environment of English teaching to improve the teaching and learning quality. The data mining method is one of artificial intelligence methods, which is used to analyze the relationship of interdependence and mutual restriction among various factors in English teaching in order to build and implement a new Eco-environment with the information sharing, quality teaching and personalized learning of English. Finally, through the practical application of the constructed Eco-environment, the experiment results show that the proposed method can help students update their learning concepts, methods and contents of English, inspire their interest and initiative by comparing with some existed teaching methods, so as to improve their learning effects and application ability of English. Therefore, the constructed Eco-environment provides a new idea and direction for English teaching reform by application of big data and artificial intelligence.

INDEX TERMS Eco-environment, English teaching, big data, data mining, influence factor, comprehensive ability.

I. INTRODUCTION

With the rapid development of big data, artificial intelligence, mobile Internet and other modern information technologies, these technolgies have become important forces to promote the teaching reform [1]–[3]. The popularity of mobile Internet has created an English learning environment for students, the big data technology has opened the personalized intelligent teaching, and the artificial intelligence technology has promoted the innovation of English teaching concepts and learning methods. Under the influence of flipped classroom, massive open online courses, micro class and other modern teaching technologies, English teaching needs to improve the traditional teaching methods, reverse the relationship between teachers and students, and make teachers change from leaders to guides, while students become the main factor

The associate editor coordinating the review of this manuscript and approving it for publication was Vivek Kumar Sehgal [ID].

to affect the effectiveness of English teaching [4]. Under the influence of multimedia classroom and Internet, the teaching environment in colleges and universities has changed from a closed environment to an open environment with intelligence, network and digitalization. Therefore, English teachers must consider the reform and promotion of traditional English teaching by using modern information technologies in order to deeply study a new perspective reform on the direction of English teaching.

Teaching ecosystem is a relationship between teaching resources and elements. It is a symbiotic relationship formed by all kinds of organisms. Its core is the symbiosis, evolution and optimal utilization of resources. After this system is introduced into English teaching, its teaching resources will become the main body to construct the symbiotic relationship, among which the mutual influence and orientation are the key to maintain the teaching ecosystem. The teaching ecosystem of English regards many factors as interrelated

variables, such as students, teachers, textbooks, multimedia, resources, classrooms, schools and society and so on. The traditional English teaching methods cannot meet the ever-changing technology and culture. The new teaching ecology of English must be reconstructed. In recent years, some researchers have proposed a lot of improved methods for English teaching in order to improve the teaching quality and level of English [5], [6]. Pitkajarvi *et al.* [7] presented a research teachers' experiences of the English-Language-Taught Degree Programs. Martinez *et al.* [8] presented three big ideas of effective and collaborative practices that promote English reading achievement for students to improve the English reading ability. Volk *et al.* [9] presented an English teaching method based on artificial intelligence to improve students' English achievement. Xiao [10] presented a set of English auxiliary teaching system in view of the inefficiency and improper teaching method. Wang and Zeng [11] studied the effect of the English corpus on English teaching reform and the improvement of students' vocabulary competence. Wu [12] presented the use of advanced multimedia technology and network technology to construct an ecological teaching model for English. Huang and Jin [13] presented an innovative teaching mode based on big data technology, and takes professional English teaching as a supplement to ordinary English teaching. Maimaiti [14] presented an innovative path model of English teaching mode based on ant colony algorithm to improve the efficiency of the best way to choose innovative English teaching mode. Bin and Mandal [15] presented an implementation plan of English assisted instruction system based on artificial intelligence technology to improve the quality and effect of English teaching. Lu [16] presented an artificial intelligence writing evaluation system to reduce teacher's working load and improve the students' English writing level. Juinn and Tan [17] utilized the technology acceptance model to explore the learning attitudes of college students with respect to English e-tutoring websites. Cheng and Wei [18] examined the controversy around the predominant status of English and the resulting adjustments that have been made in a new English teaching policy. Zhao [19] presented a new research program, which applies decision tree technology in the English teaching evaluation system. Ji [20] presented some Einstein information aggregating operators with intuitionistic trapezoidal fuzzy information. Liu [21] presented an ecological foreign language teaching model to improve the accuracy of push information. Wang and Zhan [22] evaluated students' online English learner beliefs, learning anxiety, learning motivation and online self-regulated English learning. Chang *et al.* [23] developed a Kinect-based somatosensory English learning system to plan and design learning activities and content. The other algorithms are also proposed in recent years [24]–[29].

Through analyzing these literatures, it can be found that these researches mainly focus on the teachers' experiences, collaborative practices, teaching method, innovative teaching mode, ecological teaching model, assisted instruction system, Kinect-based somatosensory learning system and so on, so to

improve the teaching quality and level of English. In terms of teaching methods and means, the guide points out that English teaching should abide by the learning rules, fully consider individual differences and learning styles according to the characteristics of teaching contents, use appropriate and effective teaching methods, embody the teaching concept, and make teaching activities change, and form a teaching normal characterized by guidance and inspiration, and active participation. The improvement of teaching methods should also pay attention to absorbing the latest research results in the field of applied linguistics, constantly update the concept and use the methods that meet the students. In the modern information technologies, students are at a loss in the face of a large number of learning resources. Although these students spend a lot of time, they have little learning effect. Therefore, how to coordinate the relationship among students, techers, learning environment and learning strategies is an urgent problem in English teaching. Therefore, based on analyzing the characteristics of English teaching and the current development, artificial intelligence method and big data technology are introduced into English teaching to propose a new Eco-environment construction method and realize a new Eco-environment of English teaching, which can improve the teaching and learning qualities and application ability of English.

The rest of this article is arranged as follows. Section 2 introduces basic theory and method. Characteristics of English teaching under big data environment are analyzed in Section 3. Section 4 proposed an new Eco-environment construction method of English teaching. Realization of Eco-environment of English teaching is deeply studied and described in Section 5. Section 6 realizes an application of Eco-environment of English teching. Finally, the conclusions and future work are given in Section 7.

II. BASIC THEORY AND METHOD
A. ECO-ENVIRONMENT
Teaching ecology is a subject that studies the relationship between biology and its environment. It studies the development law of teaching and human by using ecological methods, focus on ecological balance, environment and adaptation, population distribution and composition, interpersonal relationship and other issues to establish a reasonable Eco-environment for school and improve teaching efficiency. The teaching Eco-environment is a multi-element environmental system, which takes teaching as the center and restricts and regulates the production, existence and development of teaching [30]. The teaching Eco-environment includes factor collection, framework compilation, dynamic rule and reproduction mechanism, and so on. The factor collection mainly integrates various teaching resources, including students, teachers, teaching contents, learning materials and other contents. The framework compilation combines various elements. The dynamic rule studies the basic rule of the essential and inevitable relationship between teaching and

the external Eco-environment, as well as the internal links and levels of teaching from the perspective of ecology. The reproduction mechanism is the chemical reaction after the elements are met. Comprehensive analysis shows that the teaching Eco-environment is a symbiotic relationship formed by all kinds of organisms. Its core is the symbiosis, evolution and optimal utilization of resources. After this environment is transplanted into the teaching, the teaching resources will become the main body of symbiotic relationship, in which the mutual influence and positioning are the key to maintain the teaching Eco-environment.

B. BIG DATA

Big data technology is an information technology proposed in 2008. It needs new processing mode to take on stronger decision-making ability, insight and discovery ability and process optimization ability, which can adapt to massive, higher growth rate and diversified information resources [31]. The big data has four characteristics of massive data scale, rapid data flow, diverse data types and low value density. Technically, the big data and cloud computing are inseparable. Its characteristic is the distributed data mining for massive data. It is usually used to describe a large number of unstructured data and semi-structured data, which will cost too much time and money when these data are downloaded to a relational database for analysis. Big data analysis is often associated with cloud computing, because real-time large data analysis requires a MapReduce framework to allocate the works to dozens, hundreds or even thousands of computers.

Big data technology is the means to embody the value of big data and the cornerstone to advance. It includes data collection, data access, infrastructure, data processing, statistical analysis, data mining, model prediction and result presentation. The framework of big data is shown in FIGURE 1.

C. DATA MINING

Data mining is an interdisciplinary branch of computer science. It is a combined method using artificial intelligence, machine learning, statistics and database to find hidden patterns in large-scale data. It has a wide range of application scenarios in retail, logistics, tourism and other industries [32]–[34]. In the era of data explosion, how to use the data resources to improve the efficiency and quality of the industry has become the concerned problem of many enterprise decision makers [35], [36]. Data mining has gradually become one of the current hot research fields.

Data mining can automatically search for hidden data and information in large-scale data, which is transformed into computer-readable structured representation. At present, the main functions of data mining include concept description, association analysis, classification, clustering and deviation detection and so on. Generally, the process of data mining includes five steps, which are mining purpose, data preparation, data mining, result analysis and knowledge assimilation. The basic steps of data mining are shown in FIGURE 2.

D. THE COUPLING EFFECT ANALYSIS BETWEEN BIG DATA AND ECO-ENVIRONMENT

With the continuous development of modern information technology, the application of big data continues to expand, which has an important impact on the field of education. Information is the carrier of knowledge, and knowledge is the working object of education department, so the information technology will have a direct impact on education. Big data serves for network information. When big data appears, the teaching mode will inevitably change, the position and flow of teaching resources will also change, and the teaching Eco-environment will be affected. Therefore, it can be seen that there is a close interaction between big data and teaching Eco-environment.

III. CHARACTERISTICS OF ENGLISH TEACHING UNDER BIG DATA ENVIRONMENT

With the development of artificial intelligence and big data in English teaching, the platform optimization, guidance and other aspects of teaching, the artificial intelligence and big data technologies bring new creativity to teaching and learning space, greatly improve teaching efficiency, and optimize learning experience and effect. They have become the main driving force in the development of teaching information modernization. Therefore, the characteristics of English teaching under big data environment are and analyzed and described in detail.

A. THE TEACHING EFFICIENCY

In the preparation stage of English, the artificial intelligence and big data are introduced into teaching platform to bring a natural free resource database. At the same time, teachers can share teaching plans at any time and place through time and space intervals, and realize the optimal utilization of resources based on big data. In the communication process of English, students can communicate with teachers one-to-one at any time and place by the mobile terminal, and solve the problems encountered by each student in learning English process. It can also realize communication of one-to-many and reduce time cost. After class evaluation of English, the teaching based on artificial intelligence does not worry about face problems. Whether it is teachers' evaluation for students or students' evaluation for teachers, it is a hidden one-to-one process, which can show more fair, and is more conducive to find and correct the existed problems in time.

B. THE TEACHING INDIVIDUALIZATION

Traditional English teaching is a training mode for students, while modern teaching tends to export more innovative, personalized and comprehensive talents to the society, which conflicts with the limited vigour of teachers. The teaching individualization of English requires teachers to understand the psychological characteristics and interests of students. Then the strategies of personality development is determined for students. Under the artificial intelligence, the big data
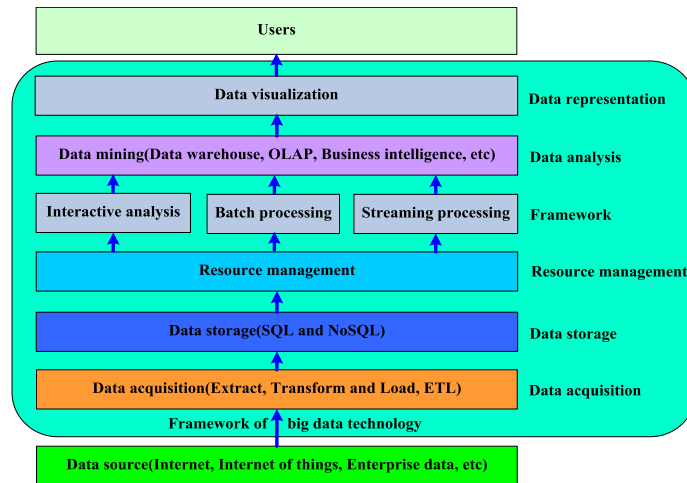
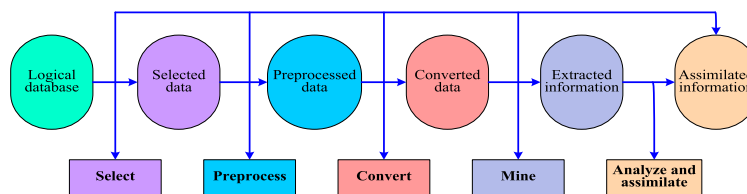**FIGURE 1.** The framework of big data technology.

FIGURE 2. Basic steps of data mining.

solves the massive data processing problem. According to the learning preferences, learning abilities and the actual learning conditions, a series of learning plans are set for each student. On this basis, the database will collect the learning dynamics in time, the curriculum is dynamically adjusted according to their learning to truly achieve the individualized teaching and realize the personalized development.

C. THE QUANTITATIVE EVALUATION

The English teaching based on artificial intelligence mainly relies on the abundant data resources, which provides information and designs some English teaching means. Teachers can use the mobile terminal to check in students, so as to determine the attendance of students in class, use the data terminal to generate exercises, and effectively check students' answers according to their answer records, so as to prevent the traditional teaching deficiency. It can also release the daily necessary words through the mobile terminal, so as to check students' word storage. This is equivalent to quantizing the teaching work of teachers and the learning amount of students. At the same time, after the intelligent platform is introduced, English test questions are composed of database, which are basically based on the requirements, and the test methods are diversified. The test questions can be intelligently composed according to the online learning records, and the students can be monitored purposefully, so that these students can find out the knowledge points. This method is

more conducive to finding out the missing, filling up the missing and issuing. In addition, after these students have finished the examination, the artificial intelligence system can mark the papers, which can reduce the workload of teachers. It also provide a good quantitative reference for English teaching evaluation.

IV. A NEW ECO-ENVIRONMENT CONSTRUCTION METHOD

The development of big data and artificial intelligence provides a new way for reforming English teaching. They are introduced into English teaching to construct a new Eco-environment of English teaching, which are expected to help students update learning concepts, methods and contents, stimulate learning interest of students, and improve English learning effect. It is a novel teaching model based on the theory and practice to design a new learning environment. From the view of teaching ecology, English teaching is an organic micro ecosystem, which is a complex and multi-field topic. It includes the main body and intermediary in teaching and learning activities, the conditions or situations needed for effective teaching. In the era of artificial intelligence and big data, English teaching is facing new changes in the Eco-environment. Data mining can analyze students in depth and make personalized learning plans and contents. The teachers can design and carry out intelligent classroom to make hybrid teaching. The human-computer coupling can improve learning efficiency and interest. Big data analysis

can provide accurate assessment and evaluation for English learning effect. Therefore, it can be seen from the comprehensive learning, teaching, learning intermediary and teaching situation that the artificial intelligence and big data have injected infinite possibilities into English teaching process.

Therefore, the big data and artificial intelligence are used to improve the Eco-environment and analyze the relationship between English teaching and mine the internal rule and interaction mechanism, so as to propose a new Eco-environment construction method of English teaching, and realize a teaching ecological teaching mode and promote the teaching development. The constructed Eco-environment of English teaching is shown in FIGURE 3.

This constructed Eco-environment applies the big data mining for learning requirements, habits, hobbies and so on as the breakthrough point, and combines the textbook writers, teachers, information support institutions, students and other members in English teaching ecosystem to implement English teaching and learning, model design, resource development, evaluation mechanism and management mechanism. The distributed file system HDFS and MapReduce model of Hadoop framework are used to construct the Eco-environment of English teaching with compatible, harmonious coexistence and dynamic development of all subsystems. The HDFS is mainly responsible for the distributed storage and management of big data, and MapReduce model is mainly responsible for the calculation and processing of large-scale data. Hadoop uses HDFS to achieve its storage capacity, and MapReduce to achieve its computing capacity.

The each step workings of the constructed Eco-environment of English teaching are explained in greater detail as follows.

Step 1 (The Big Data Acquisition): The working of this step is to collect data from corse content, teaching design, teaching process, learning behaviour, learning evaluation, network resourse and Engloshi corpus and so on in order to construct a big data of English teaching for providing a data base to analyze.

Step 2 (The Big Data Storage): The working of this step is to preprocess the acquired big data by cleaning data, archiving and compression, so as to realize the data storage. At the same time, the data of various kinds of English teaching and learning data are processed, summarized and sorted by using data warehouse techlogy and HDFS distributed file system.

Step 3 (The Big Data Analysis): The working of this step is to achieve the goals the data mining by using statistical analysis and artificial intelligence in order to obtain a dynamic comprehensive evaluation for English teaching, and provide an on-line learning program.

Step 4 (The Big Data Application): The working of this step is to realize these systems of learning customization and recommendation, knowledge association, on-line interactive, entertainment on-line and so on by using classification, valuation, forecast, association rule and clustering, which can improve the effect of English teachning and learning.

V. REALIZATION OF ECO-ENVIRONMENT

The Eco-environment of English teaching mainly includes big data acquisition subsystem, big data storage subsystem, big data mining subsystem and big data application subsystem. The realizaton process of the Eco-environment is described in detail as follows.

A. REALIZATION OF DATA ACQUISITION SUBSYSTEM

Data acquisition system is to collect data from data source to the Eco-environment that can support big data architecture, so as to realize data acquisition and establish data warehouse in the later stage. Big data acquisition methods mainly include the off-line acquisition method, real-time acquisition method, Internet acquisition method and the other data acquisition methods. The acquisition data of English teaching mainly includes the textbooks, PPT or multimedia courseware, case teaching, exercise database, test database, real-question database and other content teaching materials. The acquisition data includes the compilation of teaching syllabus, teaching purpose, learning content and so on in the teaching design, the emotional attitude, context construction, and so on in the teaching process, the self-test, learning time, approach, motivation and attitude and so on in the learning behaviour, the evaluation data of learning strategy, style, ability, process, result and so on in the learning evaluation, the English teaching and learning materials in the network resources, the English textbooks, English auxiliary materials, English and American novels, essays, scripts, press releases and other corpus in the English Corpus.

In the Eco-environment of English teaching, the acquisition data mainly includes structured data and unstructured data, such as words, numbers, graphics, images, videos, animations, audio, and so on, which are used to realize data acquisition and sharing. The big data acquisition subsystem integrates various structured data and unstructured data to provide data base for the efficient use of teaching data resources. Therefore, in order to realize the big data acquisition subsystem, we developed an adaptive interface. The corresponding interface module is developed to interface with various information systems for the existing information system. The realized subsystem can realize the data sharing interface. The SQL server 2018 is selected to realize the unified storage and management of data. We developed the relevant interface to obtain the relevant data information according to the data situation in order to complete the data acquisition and extraction.

B. REALIZATION OF DATA STORAGE SUBSYSTEM

In the Eco-environment of English teaching, the big data storage subsystem mainly preprocesses the acquired massive structured data and unstructured data, including data cleaning, archiving and compression, so as to realize the integration of data storage. The deep integration of English teaching data can solve the problem of information island caused by different countries, regions and schools, as well as different data storage structures and operating systems. Data ware-
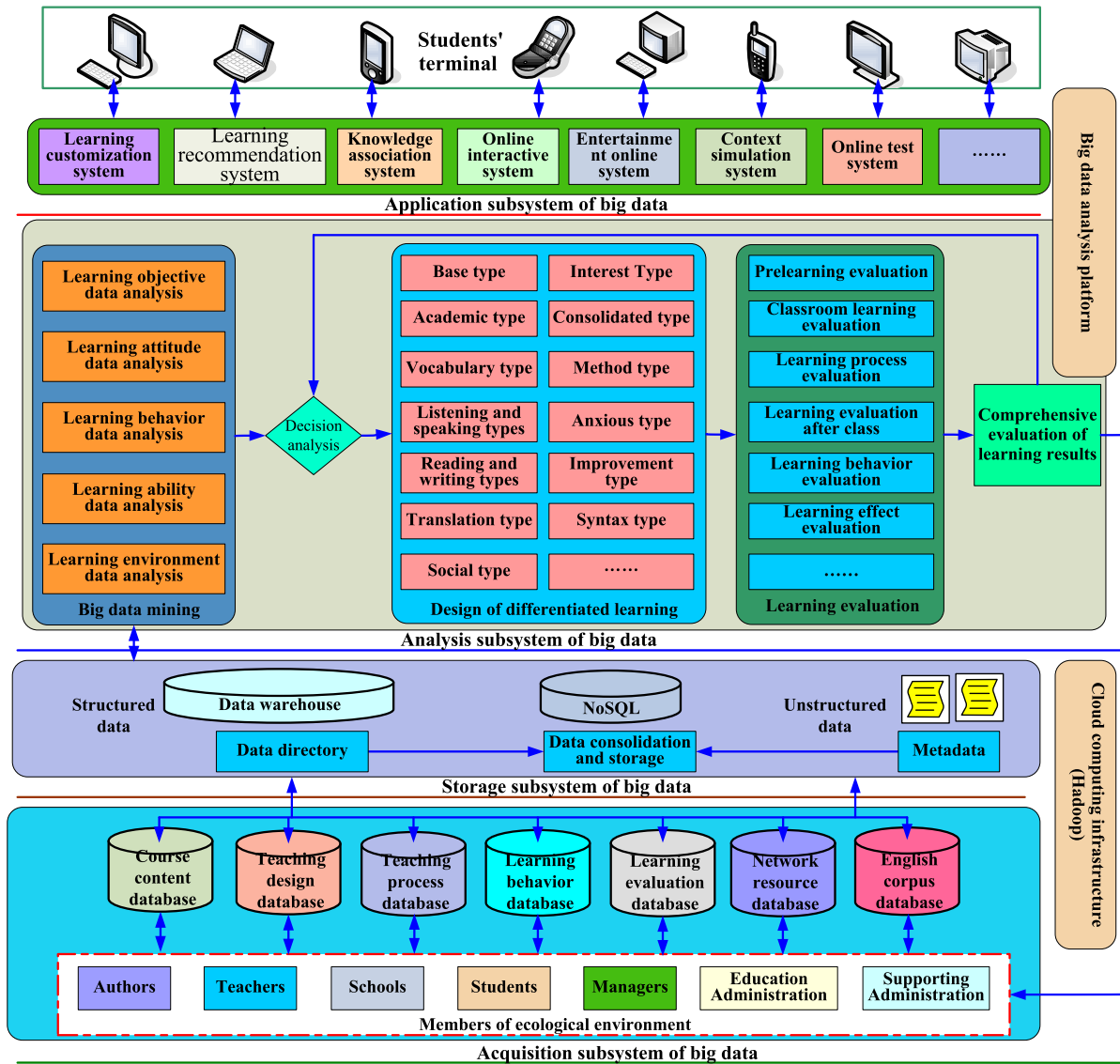
FIGURE 3. Eco-environment of english teaching.

house is used to support the management decision-making process. It is a general term for integrating operational data into a unified environment in order to provide decision-making data access. The data warehouse of English teaching is organized according to a certain theme. It is to process, summarize and sort the data of various kinds of original and scattered data of English ecological teaching and learning, in order to eliminate the inconsistency between various kinds of English ecological teaching and learning data. Therefore, the data warehouse of English teaching is the consistent data of teachers, students, institutions and other overall situations. These data are stored in the cloud database through cloud platform, which can provide data support for the analysis and application of big data. HDFS is an effective tool to real-ize distributed storage and management of large-scale data. It adopts a typical master/slave structure, which greatly sim-

plifies the system architecture, makes the system to be more concise and convenient for system management. The data node in the file system mainly stores the actual data, and is mainly responsible for the storage management on the phys-ical node. From the internal structure of the distributed file system, we divided data files into multiple data blocks, which are stored in each data node. Each data node stores data blocks from multiple files. Therefore, the HDFS of Hadoop is used to store all kinds of collected data in a unified method to improve the scalability and fault tolerance of data storage. According to the corresponding rules, the acquired data is stored as a set of complete data file set and forms a data warehouse.

C. REALIZATION OF DATA MINING SUBSYSTEM
In the Eco-environment of English teaching, data mining is the process of searching and hiding information from a large

number of data by algorithms. We use statistics, information retrieval, machine learning, expert system and pattern recognition to achieve the goals the data mining. In the Eco-environment of English teaching, the regression analysis is used to analyze the individual English learning behaviour factors accoring to the English learning objectives. The learning motivation, attitude, interest, perseverance, ability, method, habit and other factors of students are analyzed in detail by using statistic analysis method. The mined results are classified, valued, predicted and clustered by using clustering algorithm, association rules, neural network algorithm and so on. According to the learning behaviours and attitudes of students, these students will be divided in order to determine the similar learning requirements of different students, as well as the differences of learning requirements of students in different learning stages. At the same time, the big data mining subsystem will make a dynamic comprehensive evaluation of teaching process, learning process and learning results, and determine the advantages and disadvantages of the teaching program according to the learning evaluation results. Finally, we adjusted the on-line and off-line learning programs. In the Eco-environment of English teaching, the data mining mainly includes classification, valuation, forecast, association rule and clustering.

1) CLASSIFICATION

It selects the training set that has been classified from the data, uses data mining method to construct a classification model on the training set, and then the model is used to classify the unclassified data.

2) VALUATION

It is similar to classification, but the final output of valuation is a continuous value, and the amount of valuation is not predetermined. The valuation can be used as preparation for classification.

3) FORECAST

It is carried out by classification or valuation. A model is obtained through the training of classification or valuation. If the model has a high accuracy for the test sample group, the model can be used to predict the unknown variables of new samples.

4) ASSOCIATION RULES

It reflects the interdependence and relevance between one thing and other things. It is an important technology of data mining, which is used to mine the correlation between valuable data items from a large number of data.

5) CLUSTERING

It is a method of automatically finding and establishing grouping rules. It divides the similar samples into a cluster by determining the similarity between samples.

D. REALIZATION OF DATA APPLICATION SUBSYSTEM

In the Eco-environment of English teaching, the big data application subsystem mainly includes the learning customization system, learning recommendation system, knowledge association system, on-line interactive system, entertainment on-line system, context simulation system, on-line test system, and so on. By connecting the learning terminal to the relevant application system, these students can learn English knowledge. The learning customization system meets the requirements of these students to customize the learning information according to their own learning demands. The learning recommendation system automatically recommends learning information to the students. The knowledge association system automatically associates and recommends the corresponding extended knowledge. The on-line interactive system communicates with teachers, and solves these problems in the process of English learning. At the same time, it can communicate with other students and share learning experiences. The entertainment on-line system can learn English knowledge and improve English level by watching English movies, entertainment programs, news and so on. The context simulation system realizes the on-line simulation of English learning circumstances, and lets students practice English communication in the English language circumstances with the closer to the real environment. The on-line test system takes a true or simulate examination online or practice to enhance the ability of active learning for English.

E. THE CHARACTERISTICS OF THE CONSTRUCTED ECO-ENVIRONMENT

The constructhed Eco-environment is conducive to make full use of big data technology and artificial intelligence method. It also can effectively promote the deep integration of big data technology, artificial intelligence method and teaching process, content, means, methods and evaluation. The big data technology analyzes the relationship between English teaching and constructs Eco-environment. The data mining method explores the internal rules and interaction mechanism. In the value orientation of ecosystem, the constructed Eco-environment of English teaching promotes the comprehensive development, and emphasizes the demand oriented-personalized teaching model. In the effect evaluation, the constructed Eco-environment enhances the evaluation of learning process and emphasizes the process evaluation and result evaluation. At the same time, the constructed Eco-environment fully analyzes the individual differences and learning potentiality, develops English learning habits and attitudes. The modern information technology is used to fragment, contextualize and visualize English knowledge in order to realize the online communication by combining the teaching information push, association, recommendation and customization. It can provide personalized and customized English teaching and learning services, and improve initiative and enthusiasm of students, enhance the participation sensef

in learning, which improve the quality of teaching and propose a new English teaching experience.

VI. APPLICATION OF ECO-ENVIRONMENT
A. TEACHING STRATEGIES

The traditional teaching method is that teachers lead teaching, students are completely in a passive position and become the object of accepted knowledge. Although teachers use multimedia, courseware demonstration as teaching aid tools, they are only to improve the effect and means of classroom teaching. The constructed Eco-environment of English teaching provides vivid, real and rich language environment and create virtual scene. To stimulate students' interest in English learning, we should make full use of the characteristics of Eco-environment to give full play to the main role of students, guide students to learn independently and actively explore. Through the integration of online real-time and non-real-time, classroom discussion and group cooperative learning, and teachers can answer questions and solve doubts in real time.

In addition, some existed methods(Zhang's and Maimaiti's methods) [5], [14] are also selected to compare with the constructed Eco-environment in order to test and prove the effectiveness of the constructed Eco-environment.

B. EXPERIMENTAL DESIGN

In order to test the effectiveness of the Eco-environment of English teaching, first of all, 372 students are selected in here. The traditional method is used for 92 students of them, Zhang's method is used for 93 students of them, Maimaiti's method is used for 94 students of them,the constructed Eco-environment teaching method is used for 93 students of them. After the course is done, the experiment data is compared to verify which teaching mode is more feasible and efficient.

C. EXPERIMENTAL RESULTS AND ANALYSIS

According to the results of the usual learning, final examination, and CET-4 and CET-6 by using the traditional method, Zhang's method [5], Maimaiti's method [14] and our method, the statistics and analysis methods, such as correlation analysis, regression analysis, cluster analysis, and so on are used to calculate and analyze these results in detail. Then the percentage of the learning objective, learning attitude, learningbehaviour, learning ability, learning environment and learning effect, listening training, conversation training, translation training, reading training, simulated test, communication, collaborative training and E-learning of English teaching are obtained. The obtained experiment results are shown in TABLE 1, TABLE 2 AND TABLE 3. The compared results for four methods are shown in FIUGURE 4, FIGURE 5 AND FIGURE 6.

As can be seen from TABLE 1, TABLE 2, FIUGURE 4 and FIGURE 5, the learning objectives of the traditional method, Zhang's method, Maimaiti's method and our method are 2.816%, 2.283%, 2.284% and 2.857%, respectively. The
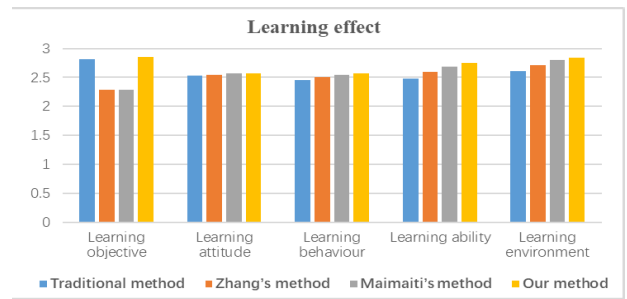

FIGURE 4. The comprehensive learning effect and the mean value of each method.
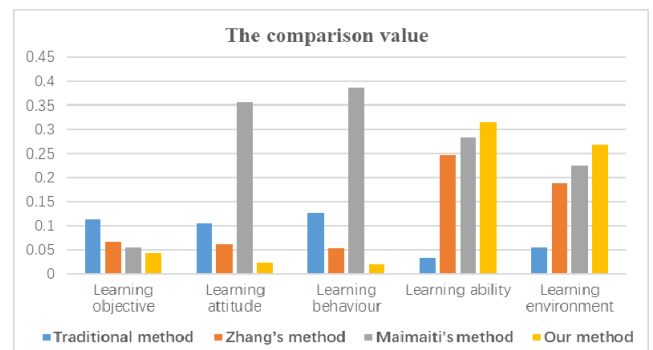

FIGURE 5. The comparison value of the mean value of each method with the beginning.

learning attitudes of the traditional method, Zhang's method, Maimaiti's method and our method are 2.536%, 2.543%, 2.566% and 2.569%, respectively. The experiment results shows that the initial learning wishes and goals of these students are basically the same, and their mean values of four methods are similar. However, the learning behaviours of the traditional method, Zhang's method, Maimaiti's method and our method are 2.452%, 2.507%,2.543% and 2.564%, respectively. The learning abilities of the traditional method, Zhang's method, Maimaiti's method and our method are 2.486%, 2.593%, 2.685% and 2.749%, respectively. The learning environments of the traditional method, Zhang's method, Maimaiti's method and our method are 2.607%, 2.714%, 2.801% and 2.838%, respectively. The learning effects of the traditional method, Zhang's method, Maimaiti's method and our method are 57.116%, 65.967%, 68.452% and 70.348%, respectively. The differences among the traditional method, Zhang's method, Maimaiti's method and our method show that the behaviour of autonomous learning has been greatly improved and the learning ability and learning environment are significantly different by using the constructed Eco-environment method.

As can be seen from TABLE 3 and FIGURE 6, the reading trainings of all kinds of English articles of the traditional method, Zhang's method, Maimaiti's method and our method are 16.881%, 16.639%, 16.406% and 16.324%, respectively. The experiment results shows that the use of Eco-environment of English teaching has not played a significant
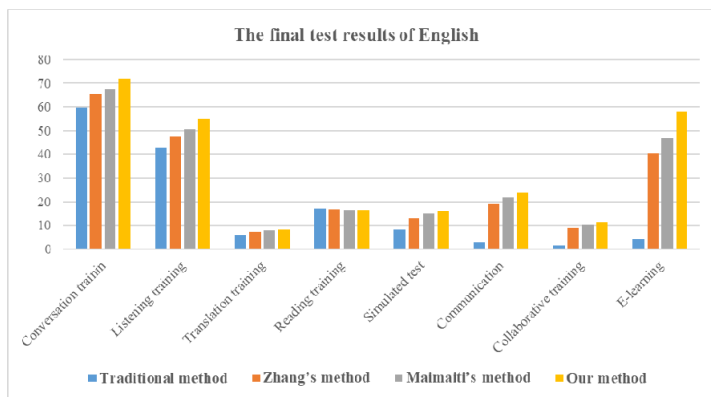
FIGURE 6. The final test results of English teaching for four methods.

TABLE 1. The comprehensive learning effect and the mean value of each method.

Methods	Learning objective(%)	Learning attitude(%)	Learning behaviour(%)	Learning ability(%)	Learning environment(%)	Learning effect(%)
Traditional method	2.816	2.536	2.452	2.486	2.607	57.116
Zhang's method	2.283	2.543	2.507	2.593	2.714	65.967
Maimaiti's method	2.284	2.566	2.543	2.685	2.801	68.452
Our method	2.857	2.569	2.564	2.749	2.838	70.348

TABLE 2. The comparison value of the mean value of each method with the beginning.

Methods	Learning objective	Learning attitude	Learning behavuor	Learning ability	Learning environment
Traditional method	0.114	0.105	0.127	0.032	0.054
Zhang's method	0.067	0.061	0.053	0.245	0.189
Maimaiti's method	0.054	0.355	0.386	0.283	0.226
Our method	0.042	0.024	0.021	0.315	0.267

TABLE 3. The final test results of english teaching for four methods.

Methods	Listening training(%)	Conversation training(%)	Translation training(%)	Reading training(%)	Simulated test(%)	Communication (%)	Collaborative training(%)	E-learning (%)
Traditional method	59.821	42.490	6.065	16.881	8.035	2.841	1.403	4.052
Zhang's method	65.304	47.385	7.193	16.639	13.074	19.052	8.947	40.438
Maimaiti's method	67.750	50.482	7.836	16.406	15.245	21.645	10.520	46.597
Our method	71.754	54.872	8.157	16.324	16.206	23.936	11.313	58.106

role. In the listening training, conversation training, translation training, simulated test for CET-4 and CET-6 and so on, the constructed Eco-environment method obtains much higher values than the other compared methods, which shows that the Eco-environment of English teaching promotes the improvement of these aspects. In particular, the percentage of the traditional method is almost zero in terms of online communication with students and teachers, collaborative training and E-learning tasks. The experiment results show that the traditional method is relatively backward, and it is no longer suitable for the development of modern information technology and educational technology, which brings great enlightenment to English teaching. Therefore, it is necessary to reasonably integrate modern network technology, artificial intelligence technology and big data technolgy to construct a dynamic development of Eco-environment of English teaching, in which the student-centered English teaching mode under the big data environment and artificial intelligence technology can be truly realized to improve the learning effects and application ability of English.

VII. CONCLUSION

In the current era of big data and artificial intelligence, the key to improve the quality of English teaching is to construct a positive, healthy, harmonious and open Eco-environment of English teaching. The application and development of big data technology and artificial intelligence method have changed the balance among the factors in the traditional English teaching ecosystem. At the same time, the existence of big data technology and artificial intelligence method promotes the construction of a new Eco-environment of English teaching. By applying big data and artificial intelligence to English teaching ecosystem, teachers can enrich teaching resources and realize resource sharing within the system. With the help of big data system, the knowledge of students can be enhanced, the orientation of teachers and students will be improved, the advanced teaching methods can be applied, and the teaching atmosphere and language environment can be optimized. On the one hand, the database supported by massive learning materials provides strong support for English teaching. On the other hand, the existence of big data technology and artificial intelligence technolgy enable the English teaching environment to develop a more comprehensive, balanced and reasonable direction. An Eco-environment of English eaching is constructed with interdependence, mutual restriction and rebalancing of all factors by using the distributed file system HDFS and MapReduce model of Hadoop framework. A new teaching mode and method of English based on combining big data and artificial intelligence is obtained. It has an important guiding role in improving the teaching quality of English teaching. The Eco-environment of English eaching is applied in 93 students. The experiment results show that the Eco-environment of English eaching obtains better learning effects and application ability of English by comparing with the traditional method, Zhang's method andMaimaiti's method. Therefore, the deep integration of artificial intelligence, big data and English teaching process will become the new normal of language teaching, and modern teaching will further realize individualization, autonomy and ecology.

REFERENCES

[1] F. Schneider and C. Weillner, "Big data and artificial intelligence," *Nervenarzt*, vol. 89, no. 8, pp. 859–860, 2018.

[2] Y. Liu, Y. Mu, and K. Chen, "Daily activity feature selection in smart homes based on Pearson correlation coefficient," *Neural Process. Lett.*, vol. 51, pp. 1771–1787, Jan. 2020, doi: 10.1007/s11063-019-10185-8.

[3] W. Deng, J. Xu, Y. Song, and H. Zhao, "Differential evolution algorithm with wavelet basis function and optimal mutation strategy for complex optimization problem," *Appl. Soft Comput.*, early access, Sep. 15, 2020, doi: 10.1016/j.asoc.2020.106724.

[4] Y. S. Jeong and J. H. Park, "Advanced big data analysis, artificial intelligence & communication systems," *J. Inf. Process. Syst.*, vol. 15, no. 1, pp. 1–6, 2019.

[5] H. Y. Zhang, "A flipped classroom-based teaching system for English teaching," *Int. J. Emerg. Technol. Learn.*, vol. 14, no. 16, pp. 120–129, 2019.

[6] Y. Liu, X. Wang, Z. Zhai, R. Chen, B. Zhang, and Y. Jiang, "Timely daily activity recognition from headmost sensor events," *ISA Trans.*, vol. 94, pp. 379–390, Nov. 2019.

[7] M. Pitkajarvi, E. Eriksson, and P. Kekki, "Teachers' experiences of English-language-taught degree programs within health care sector of finnish polytechnics," *Nurse Edu. Today*, vol. 31, no. 6, pp. 553–557, Aug. 2011.

[8] R. S. Martínez, B. Harris, and M. B. McClain, "Practices that promote English reading for English learners (ELs)," *J. Educ. Psychol. Consultation*, vol. 24, no. 2, pp. 128–148, Apr. 2014.

[9] H. Volk, K. Kellner, and D. Wohlhart, "Learning analytics for English language teaching," *J. Universal Comput. Sci.*, vol. 21, no. 1, pp. 156–174, 2015.

[10] C. Y. Xiao, "English assistant teaching system of higher vocational teaching based on expert system," *Agro Food Ind. Hi-Tech*, vol. 28, no. 3, pp. 2357–2360, 2017.

[11] S. Wang and X. Zeng, "Effect of English corpus on reform of English teaching and the improvement of students' vocabulary competence," *Teach. Sci.-Theory Pract.*, vol. 18, no. 6, pp. 3493–3499, 2018.

[12] B. Wu, "Construction of ecological teaching model for English course under the background of Internet plus," *Teach. Sci.-Theory Pract.*, vol. 18, no. 6, pp. 3515–3521, 2018.

[13] Y. H. Huang and X. R. Jin, "Innovative English teaching modes based on big data," *Teach. Sci.-Theory Pract.*, vol. 18, no. 6, pp. 3428–3434, 2018.

[14] K. Maimaiti, "Modelling and analysis of innovative path of English teaching mode under the background of big data," *Int. J. Continuing Eng. Teach. Life-Long Learn.*, vol. 29, no. 4, pp. 306–320, 2019.

[15] Y. Bin and D. Mandal, "English teaching practice based on artificial intelligence technology," *J. Intell. Fuzzy Syst.*, vol. 37, no. 3, pp. 3381–3391, Oct. 2019.

[16] X. Lu, "An empirical study on the artificial intelligence writing evaluation system in China CET," *Big Data*, vol. 7, no. 2, pp. 121–129, Jun. 2019.

[17] P. Tan, "An empirical study of how the learning attitudes of college students toward english E-Tutoring websites affect site sustainability," *Sustainability*, vol. 11, no. 6, p. 1748, Mar. 2019.

[18] J. Cheng and L. Wei, "Individual agency and changing language education policy in China: Reactions to the new 'guidelines on college English teaching,'" *Current Issues Lang. Planning*, early access, Dec. 11, 2019, doi: 10.1080/14664208.2019.1700055.

[19] X. Zhao, "Application of deep learning algorithm in college english teaching process evaluation," *Behaviour Inf. Technol.*, early access, Nov. 21, 2019, doi: 10.1080/0144929X.2019.1690579.

[20] J. Xu, "Model for evaluating the teaching effect of the college english public speaking course under the flipped classroom hybrid teaching mode with intuitionistic trapezoidal fuzzy numbers," *J. Intell. Fuzzy Syst.*, vol. 37, no. 2, pp. 2051–2058, Sep. 2019.

[21] J. Liu, "Ecological foreign language teaching model applied in college public English teaching," *J. Environ. Protection Ecol.*, vol. 20, pp. S587–S593, 2019.

[22] W. Wang and J. Zhan, "The relationship between english language learner characteristics and online self-regulation: A structural equation modeling approach," *Sustainability*, vol. 12, no. 7, p. 3009, Apr. 2020.

[23] Y.-H. Chang, P.-R. Lin, and Y.-T. Lu, "Development of a Kinect-based english learning system based on integrating the ARCS model with situated learning," *Sustainability*, vol. 12, no. 5, p. 2037, Mar. 2020.

[24] Y. Xu, H. Chen, J. Luo, Q. Zhang, S. Jiao, and X. Zhang, "Enhanced moth-flame optimizer with mutation strategy for global optimization," *Inf. Sci.*, vol. 492, pp. 181–203, Aug. 2019.

[25] W. Deng, J. Xu, H. Zhao, and Y. Song, "A novel gate resource allocation method using improved PSO-based QEA," *IEEE Trans. Intell. Transp. Syst.*, eraly access, Oct. 1, 2020, doi: 10.1109/TITS.2020.3025796.

[26] W. Deng H. Liu, J. Xu, H. Zhao, Y. Song, "An enhanced MSIQDE algorithm with novel multiple strategies for global optimization problems," *IEEE Trans. Syst., Man, Cybern. Syst.*, to be published, doi: 10.1109/TSMC.2020.3030792.

[27] A. A. Heidari, S. Mirjalili, H. Faris, I. Aljarah, M. Mafarja, and H. Chen, "Harris hawks optimization: Algorithm and applications," *Future Gener. Comput. Syst.*, vol. 97, pp. 849–872, Aug. 2019.

[28] R. Chen, S.-K. Guo, X.-Z. Wang, and T.-L. Zhang, "Fusion of multi-RSMOTE with fuzzy integral to classify bug reports with an imbalanced distribution," *IEEE Trans. Fuzzy Syst.*, vol. 27, no. 12, pp. 2406–2420, Dec. 2019.

[29] W. Deng, H. Liu, J. Xu, H. Zhao, and Y. Song, "An improved quantum-inspired differential evolution algorithm for deep belief network," *IEEE Trans. Instrum. Meas.*, vol. 69, no. 10, pp. 7319–7327, Oct. 2020.

[30] Z. M. Bolshakova, L. A. Bezborodova, and N. A. Litvinenko, "Mechanisms and conditions for ecological safety provision in University teaching environment," *Ekoloji*, vol. 28, no. 28, pp. 517–524, 2019.

[31] Z. Zhang, K. Barbary, F. A. Nothaft, E. R. Sparks, O. Zahn, M. J. Franklin, D. A. Patterson, and S. Perlmutter, "Kira: Processing astronomy imagery using big data technology," *IEEE Trans. Big Data*, vol. 6, no. 2, pp. 369–381, Jun. 2020.

[32] W. Deng, J. Xu, Y. Song, and H. Zhao, "An effective improved co-evolution ant colony optimization algorithm with multi-strategies and its application," *Int. J. Bio-Inspired Comput.*, pp. 1–10, 2020.

[33] H. Lou, "Design of college english process evaluation system based on data mining technology and Internet of Things," *Int. J. Data Warehousing Mining*, vol. 16, no. 2, pp. 18–33, Apr. 2020.

[34] H. Chen, A. A. Heidari, H. Chen, M. Wang, Z. Pan, and A. H. Gandomi, "Multi-population differential evolution-assisted Harris hawks optimization: Framework and case studies," *Future Gener. Comput. Syst.*, vol. 111, pp. 175–198, Oct. 2020.

[35] R. Kern, "Perspectives on technology in learning and teaching language," *TESOL Quart.*, vol. 40, no. 1, pp. 45–48, 2014.

[36] A. Sams and J. Bergmann, "Flip your students' learning," *Educ. Leadership*, vol. 70, no. 6, pp. 16–20, 2013.

MAOHUA SUN (Member, IEEE) received the B.S. degree in English from Mudanjiang Normal University, Mudanjiang, China, in 2003, the M.S. degree in English teaching from Liaoning Normal University, Dalian, China, in 2007. She is currently an Associate Professor with Dalian Jiaotong University, Dalian. Her research interests include English teaching and artificial intelligence.

YUANGANG LI (Member, IEEE) received the B.S. degree in computer science and technology from the Dalian University of Technology, China, in 1997, the M.B.A. degree from the Dongbei University of Finance and Economics, China, in 2006, and Ph.D. degree in management science and engineering from the Shanghai University of Finance and Economics, China, in 2018. He was a Lecturer with the Business School, Dalian University of Foreign Languages, Dalian China. His research interests include complex system modeling, signal processing data mining, and data analysis.

• • •