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Construction of E-Learning English Wisdom Classroom Based on Educational Big Data Mining

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Abstract. With the continuous growth of science & tech, education should also apply big data in the teaching process as a more advanced industry in society. Through statistical analysis of all kinds of data appearing in the teaching process, providing personalized service for teaching is conducive to the further implementation of teaching reform. This paper expounds on the basic theory and implementation method of Data Mining (DM) technology based on a data warehouse. It explores the application of educational DM in English Language Teaching (ELT) management to realize the construction of English wisdom classrooms and help administrators better manage and improve schools' competitiveness. Experiments show that, compared with traditional methods, the algorithm in this paper has apparent advantages in the middle and late stages of operation, and the error is reduced by 36.23%. The algorithm in this paper is used to recommend English instructional resources, which have good optimization characteristics and fast convergence speed. The related functions of DM technology can obtain meaningful information from massive teaching data, give full play to the role of various school resources, and provide a more scientific policy decision basis for ELT administrators, thus effectively improving the instructional level.

Keywords: English language teaching; Wisdom classroom; Data mining; Instructional level; E-Learning.
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1 INTRODUCTION

With the growth of education, the era of curriculum reform has come; traditional curriculum teaching can no longer meet the needs of the times, and new teaching tools and teaching systems are emerging[19]. With the advent of the network background and AI and the deepening of educational informatization, the disadvantages of traditional classroom teaching have become increasingly prominent, and students' access to information and collaborative learning has yet to be improved

[4]. Applying DM technology to school teaching management will inevitably enhance it, and the multi-level and multi-angle analysis of the data generated in the examination process and teaching links will undoubtedly help the teaching decision [10],[21].

In education, big data has distinctive features while consolidating the overall trend of extensive data development. University teachers must change their educational concepts, constantly reform classroom teaching, and shift from simply imparting knowledge to cultivating wisdom [22]. In the current education system, with the enrollment expansion of universities, the scale of education is constantly expanding, which makes students more and more like consumers, and they put forward higher requirements for various rules and regulations of schools. Strengthening the connotation construction of universities and improving their popularity and competitiveness have become urgent concerns for all universities [11]. Under the background of the rapid growth of IT, the amount of data accumulated in the information system of educational institutions is increasing, which makes the managers of the academic industry unable to get practical and high-quality information when selecting resources, resulting in some adequate information not being explored and utilized [5]. This paper expounds on the basic theory and implementation method of DM technology based on a data warehouse. It explores the application of educational DM in ELT management to realize the construction of the English wisdom classroom learning model and help administrators better manage and improve schools' competitiveness.

With the deepening of educational informatization, the research on college English wisdom classrooms includes how to use educational data to build a learning system, collect and analyze data to solve the problems that are difficult to solve in the traditional English classroom teaching process, and then effectively improve students' active and autonomous learning ability [8]. It is generally believed that educational data has essential application value. Still, it takes work to exert the great value of academic data and use it to drive educational reform [9]. This paper uses DM technology to mine the data in the educational administration system to extract valuable information that improves the instructional level and student quality. Students can freely choose their favorite major and significant direction while the school implements the major and minor course selection system. Students can choose their academic progress and favorite courses independently. The educational administration system provides freedom of registration, prompting and persuasion, graduation qualification examination, etc. In education, it is hoped that we can acquire knowledge through DM technology to help improve teaching decisions and instructional levels. The main innovations of this paper are as follows:

1. Starting with the value and significance of educational data, this paper discusses the construction strategy of the wisdom classroom learning model of college English.

2. The research has gained valuable information through mining in the teaching model, which is of great guiding significance to the mastery of students' performance and the teaching of courses.

2 RELATED WORK

The related functions of DM technology can help educators obtain meaningful information from massive teaching data, give full play to the role of various school resources, and provide a more scientific policy decision basis for ELT administrators, thus effectively improving the instructional level.

In online education, Qian et al. provided targeted learning resources for different learners to improve learning effects [16]. Shi combines association rule mining with statistical analysis to conduct association analysis on library loan data, find out some associations between books and between readers and books, and use it to improve the quality of book purchases and provide Corresponding suggestions are put forward for library improvement [17]. Thody et al. made teaching plans for universities through DM technology, which realized the rationality of making teaching plans, which provided a brand-new and effective way to adjust teaching plans in universities [18]. Wang et al. applied association rule mining to the quality assessment of middle school students and gave some essential factors closely related to students' quality through correlation analysis [20]. Mai et al. found that the traditional clustering algorithm using distance as a measure is unsuitable for processing classified attributes or Boolean data [14]. Based on analyzing the dataset's characteristics, Long et al. proposed a new clustering algorithm [12]. This new clustering algorithm has good clustering and scalability and has guiding significance for universities that implement the credit system in automatically classifying students' majors. Maiorana et al. preprocessed the student achievement data by studying the K-means clustering algorithm and combining the DM process [15]. Then, this algorithm is applied to analyze the students' test papers so that the students' scores are clustered according to a certain number, and the results of the cluster analysis are used to guide the students' study and future teaching work. Delibasic et al. applied the grey clustering method, combined with the characteristics of university library data statistics and the requirements of comprehensive assessment. They realized the scientific weighting of multi-assessment indexes for the calculation method of a thorough evaluation of university libraries and the classification and ranking of libraries [6]. Baker established the performance assessment index system of universities by using the cluster mining method, and on this basis, divided the schools with similar assessment indexes into one class to build a favorable decision support environment for the performance assessment of universities [3]. Ma applied the improved Apriori algorithm to the assessment data of teachers' instructional level and conducted correlation analysis on the instructional level monitoring and analysis system to determine the factors that significantly influence teachers' instructional level [13].

Universities need to learn more about the relationship between teachers' information, assessment information, student achievement information, and employment information. As a simple backup, the information in the database can't provide a good solution and guide decisions for educational administrators to improve teaching. This paper analyzes the importance of educational data in intelligent education, explores the development status of academic data, and explores the application of educational DM in ELT management, thus realizing the construction of an English wisdom classroom.

3 ENGLISH WISDOM CLASSROOM CONSTRUCTION

3.1 Concept and Connotation of Wisdom Classroom

Wisdom classroom, also known as wisdom classroom, is the inevitable result of school education informatization: teaching-centered, classroom-centered, and teacher-student activities-centered. The core idea of Wisdom Classroom is to improve and optimize classroom teaching mode through new technical means [2]. The application of data analysis is conducive to the continuous improvement of the curriculum system in wisdom classrooms. In traditional classrooms, teachers' judgments of students' behavior and instructional design are usually based on individual teachers' teaching experiences and subjective impressions. The architecture of the college English wisdom classroom is shown in Figure 1.

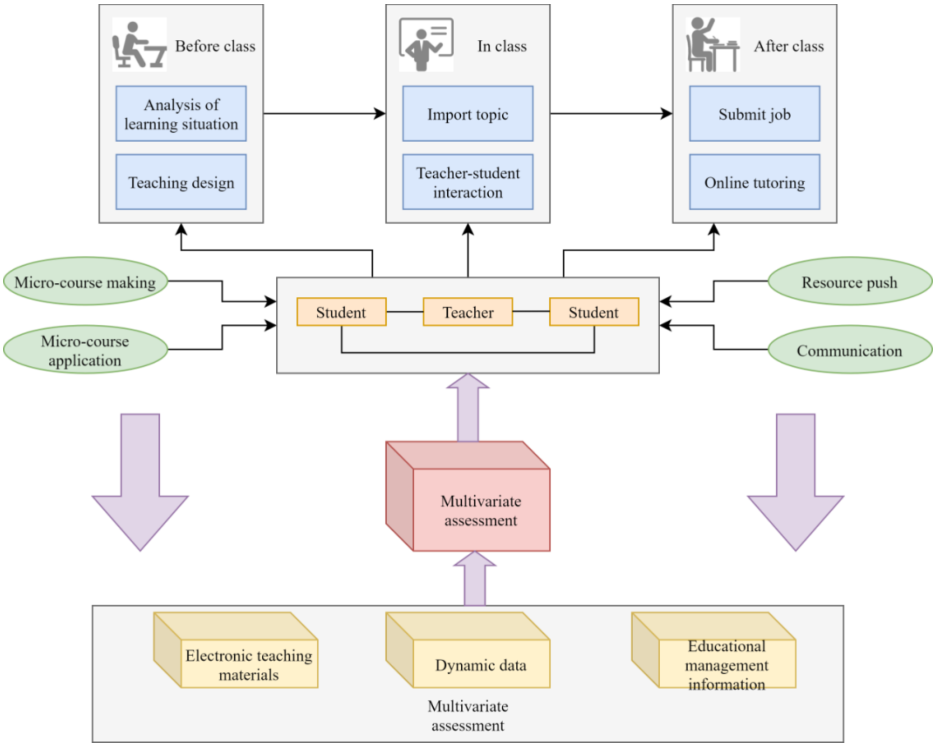

Figure 1: College English wisdom classroom architecture.

In the wisdom classroom, which is based on big data, everything depends on data to speak, and data has become an important indicator to reflect the teaching effect. According to the record and analysis of students' learning behavior data, learning resources such as micro-courses and homework can be intelligently pushed to meet students' individualized and diversified learning needs. Wisdom teaching is developed based on the application of IT. It can rely on advanced information-based media to realize the intelligentization of the classroom teaching process and create a sensible classroom teaching environment, which contrasts with traditional classroom instructional methods. It is an inevitable requirement for the growth of education in the new era to introduce advanced technology and ideas into schooling continuously. Therefore, applying wisdom education in the network background is also an inevitable measure to promote socialist education to keep up with the trends of the times. The application of big data in wisdom education can realize the individuation of schooling.

3.2 Current Situation of English Classroom

The research focuses on studying big data in education or educational issues under the network background. The research goal and thinking could be more precise and often stay on the educational data's concept and concept level. Applying academic data and solving practical problems in education should be more focused [1]. In the collection of educational data, most of them adopt the form of reporting. In this data collection mode, regardless of whether educators and students use paper or information equipment to fill in the report, the primary behavior of users is to report data rather than actual teaching.

The application of data analysis in wisdom classroom education should focus on the needs of teaching and learning and be reflected in the service for teaching and learning. For example, based on the data of classroom students' learning behavior and interaction between educators and students, the teaching process and teaching quality are assessed and fed back. In the value mining of educational data, most of them focus on the analysis of the data itself, needing more regression of the analysis of educational value. In the study and application of educational DM, it is necessary to focus on a particular professional application field, closely follow the specific problems in education and teaching, collect accurate data based on actual use, and build and analyze models. At the level of student learning, big data records the learning resources, learning paths, learning time, learning environment, and interactive data used by students in the learning process. These data objectively and honestly describe students' learning rules and cognition. Students can choose the learning materials, make the learning plan, and plan the learning path.

3.3 Wisdom Classroom User Model and Behavior Data

The essence of "Smart Classroom" is based on analyzing extensive data learning and using mobile learning terminals. Through real-time learning assessment feedback, three-dimensional interactive communication, and intelligent resource promotion, the classroom instructional content and structure are changed in an all-around way, and a new smart teaching mode in the network background is constructed. With the ubiquitous sensor devices and computing power, data analysis and mining can realize the study and application of complex network data in the real world, virtual world, and virtual reality world. Big data makes it possible to conduct educational process investigations [7]. The introduction of the wisdom classroom is the product of the deep integration of IT and classroom teaching and the result of the continuous growth of information teaching in the network background. Its core is based on extensive data learning and analysis and the use of mobile learning terminals, and it uses modern analysis tools and methods to process, mine, and analyze the mega data generated in the teaching process.

Big data provides a technical basis for accessing a significant quantity of educational data, but the original educational data is only the basis of educational data. We can only build a learning analysis model by effectively collecting and mining the educational data, finding the relationship between the academic variables, and turning it into useful information. Let S be the set of s data samples. If the class label attribute has m distinct values, define m special classes $C_i(i=1,\ldots,m)$. Let S_i be the number of samples in class C_i. for a given sample amount. The expected information needed to classify a given sample is as follows:

$$I(S_1,S_2,\ldots,S_m)=-\sum_{i=1}^{m}p_i\,log_2(p_i) \tag{1}$$

Where p_i is the probability that any sample belongs to C_i, let A attribute have v different values $\{a_1,a_2,\ldots,\ a_v\}$. S can be divided into subsets $\{S_1,\ \ S2,S_3,\ldots,\ S_v\}$ by attribute A. In which the sample in S_j has the value $a_j(j=1,2,\ldots,v)$ of the phase on the attribute A. If A is chosen as the test attribute, these subsets correspond to the branches grown from the nodes containing the set. Let S_{ij} be the number of examples of class C_j in subset S_j, then the entropy or information expectation divided by A is:

$$E(A)=\sum_{j=1}^{v}\frac{S_{1j}+\cdots,+S_{mj}}{S}I(S_{1j},\ldots,S_{mj}) \tag{2}$$

The term $(S_{1j}+\cdots,+S_{mj})/S$ acts as a weight for the j th subset. It is equal to the number of samples in the subset divided by the total amount of samples in S. The more minor the entropy value, the higher the purity of the subset division. For a given subset S_j:

$$I(S_{1j},S_{2j},\ldots,S_{mj})=-\sum_{i=1}^{m}p_{ij}\,log_2(p_{ij}) \tag{3}$$

The probability that a sample in S_j belongs to class C_i is:

$$P_{i,j} = \frac{s_{ij}}{|s_j|} \tag{4}$$

The encoded information that the branch will obtain is:

$$Gain(A) = I(S_1, S_2, \ldots, S_m) - E(A) \tag{5}$$

As the primary service object of students, the school aims to provide quality services for students. At the same time, the workload of the distribution of school teaching tasks, the management of teaching and research projects, and the training of young teachers is increasing daily. The wisdom classroom user model is shown in Figure 2.

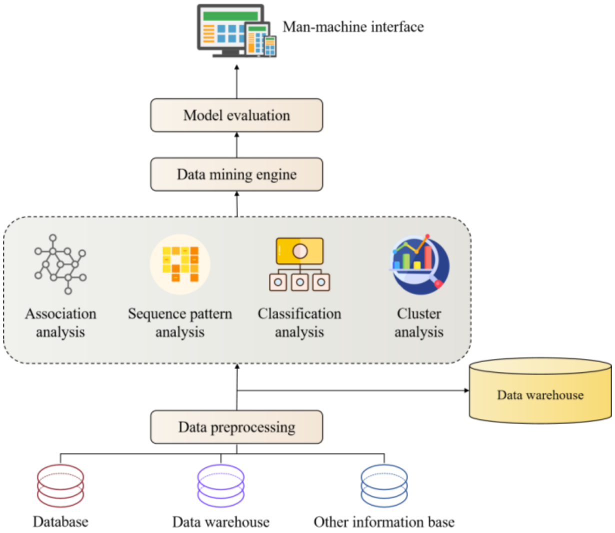

Figure 2: Smart classroom user model.

We can seek the correlation between the different educational elements by statistical methods and get the data to support some academic conclusions. Modeling learners' learning behavior focuses on the relationship between students' learning effect and learning state. In addition, we can model and analyze learners' learning experiences, which can be used as the basis for investigating learners' learning satisfaction.

Students can freely choose their favorite major and significant direction while the school implements the major and minor course selection system. Students can choose their academic progress and favorite courses independently. We must first extract information and knowledge with educational value from a significant quantity of educational data to use educational data. However, when searching and integrating specific educational data, different data types and applications need other methods to analyze and manage the data. In practical application, it is necessary to organically organize the research content and form a specific application mode by combining the application requirements and application scenarios of specific professional fields.

3.4 Data Mining Process

Wisdom classroom emphasizes student-centered and students' active exploration of knowledge, which is entirely consistent with constructivism theory. In the wisdom classroom teaching, a large quantity of process data and behavior data are generated. Mining and analysis based on these data are essential in accurately grasping the learning situation and teaching effect, analyzing the learning influencing factors, and then adopting targeted teaching improvement strategies. The architecture of DM in the English wisdom classroom is shown in Figure 3.

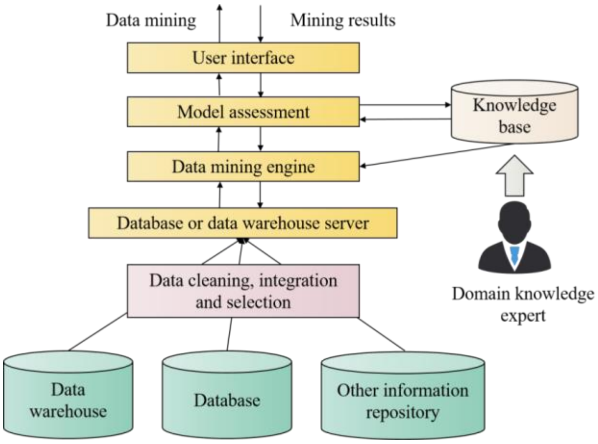

Figure 3: DM architecture.

When introducing the curriculum, teachers have different ways to introduce new topics, with preview feedback as the majority, and it also includes aspects such as students' examination exercises, preview exams, and creating scenarios to remind or elaborate on the problems in the preview. Students express their learning feelings before class and teach or share their opinions with the new lesson guidance, especially for the content that is difficult to understand in the preview; they should focus on listening and actively participate in interactive teaching activities. The analysis of educational data in wisdom classrooms is the method and stage of DM and learning analysis of educational data generated in wisdom classroom teaching. At present, wisdom classrooms have been applied in some primary and secondary schools, and the data generated in the whole stage of wisdom classroom and regular application constitute multidimensional education big data, including teachers, students, and administrators, covering the entire stage of pre-class, in-class, and after-class teaching.

Use u_{ij} to represent the results of the English classroom comparison. After comparing all elements at each level pairwise, a pairwise comparison judgment matrix is obtained, and the matrix is expressed as follows:

$$U = (u_{ij})n * n = \begin{bmatrix} u_{11} & u_{12} & \dots & u_{1n} \\ u_{21} & u_{22} & \dots & u_{2n} \\ \dots & & & \\ u_{n1} & u_{n2} & \dots & u_{nn} \end{bmatrix} \tag{6}$$

Calculate the weight of each sub-factor and verify the consistency by solving the maximum eigenvalue of the judgment matrix. First, calculate the normalization for each column:

$$\overline{u_{ij}} = \frac{u_{ij}}{\sum_{k=1}^{n} u_{kj}} \tag{7}$$

Second, average the normative columns to determine the final weights:

$$\widehat{w} = \frac{1}{n} \sum_{j=1}^{n} \overline{u_{ij}} \tag{8}$$

The feature vector is the weight of each factor:

$$\hat{w} = (\hat{w}_1, \hat{w}_2, \dots, \hat{w}_n) \tag{9}$$

Compute the consistency metric for the constructed matrix:

$$CI = \frac{\lambda_{max}}{n-1} \tag{10}$$

Compute the largest eigenvalue of the judgment matrix:

$$\lambda \frac{1}{n} \sum_{i=1}^{n} \frac{(U\hat{W})_i}{\hat{W}_i}{}_{max} \tag{11}$$

$(U\hat{W})_i$ indicates that the W -th element of vector i is used.

Teachers ' new knowledge points can be consolidated quickly through the flexible and hierarchical learning tasks teachers assign. After completing the homework assigned by the student's teachers, they hand it to the teachers, enabling them to grasp the students' learning situation of objective problems accurately. To carry out data analysis in a wisdom classroom is to process, analyze, and model based on the whole process and all-around multidimensional big data in the wisdom classroom.

4 RESULT ANALYSIS AND DISCUSSION

Students' curriculum arrangement is gradual in universities, and many courses are related. When students study, they must follow a specific sequence before and after, and before learning a particular professional course, they must first understand some introductory professional courses. Moreover, if the advanced courses offered first are not well-learned, it will affect the study of the follow-up courses. The instructional level is the lifeline of education. By mining these two aspects of information, we can find effective ways and methods to guide the whole teaching management process. The information provided by the data significantly enables the educated to grasp the development trend of students from the macro level. Figure 3 shows the students' subjective rating results of resources recommended by traditional instructional resource acquisition methods and educational DM methods.

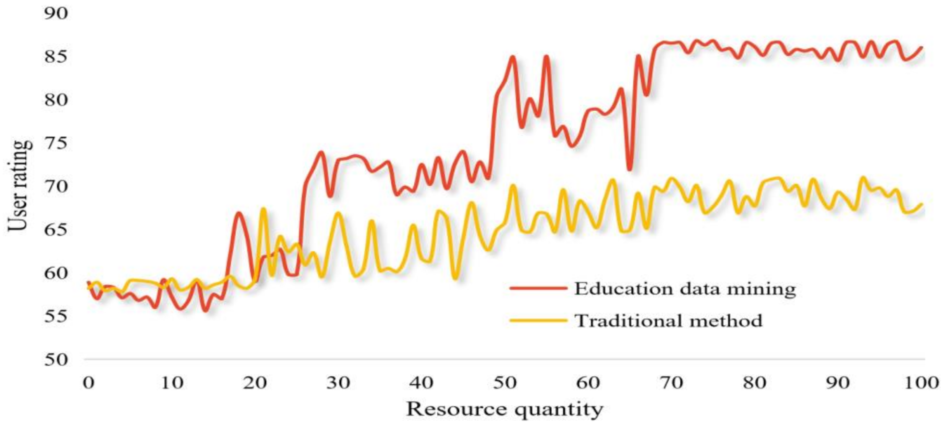

Figure 3: Students' subjective scores.

Most students said the English wisdom classroom model can help them quickly locate the information they need in the vast resources, meet their individual needs, and tap students' potential interests.

Making full use of the instructional resources stored in the education cloud can make building an English wisdom classroom model easier and provide the cloud resources to every student through the instructional platform. Table 1 shows the changes in the recommendation accuracy of this English wisdom classroom model when different iterations are selected. Select eight data groups with iteration times between 4,000 and 20,000 and observe the change in model accuracy.

Iterations	*Accuracy*
4000	*31.8%-67.5%*
6000	*43.4%-70.5%*
8000	*61.6%-75.1%*
10000	*72.4%-85.3%*
12500	*80.1%-91.8%*
15000	*82.4%-92.1%*
17500	*91.6%-93.36*
20000	*91.2%-92.89*

Table 1: Students' subjective scores.

The algorithm in this paper can achieve a high recommendation accuracy rate of 93.36% after continuous iteration. Therefore, applying this model to the teaching management of English wisdom classrooms is of positive significance.

With the continuous expansion of the teaching scale, it is difficult for educational administrators and teachers to determine the relationship between the early courses and the follow-up courses directly according to the distribution of students' achievement data as before and make decisions on the teaching process accordingly. In this case, we can use the association rules in DM to mine and analyze the curriculum data, discover the hidden curriculum-related rules or patterns, and provide necessary and accurate theoretical support for policy decisions. The traditional database adopts online transaction processing for specific applications, while the data warehouse adopts online analytical processing for subject-oriented; that is to say, the subject boundary is determined after analyzing a subject. Taking the accuracy of English instructional resource recommendation as the test index and selecting the literature method [13] as the contrast object, the experimental results are shown in Table 2 and Table 3.

Sample size	*Resource recommendation accuracy (%)*
15	*92.28*
30	*92.25*
45	*91.64*
60	*91.33*
75	*90.85*
90	*90.48*
105	*90.36*

Table 2: The recommendation accuracy of English instructional resources of this method.

Sample size	*Resource recommendation accuracy (%)*
15	*90.21*
30	*86.3*
45	*81.25*

60	*77.65*
75	*73.26*
90	*71.65*
105	*70.34*

Table 3: The recommendation accuracy of English instructional resources in literature [13].

According to the experimental data, when the quantity of test samples increases, the accuracy of resource recommendations of different teaching management methods shows a downward trend. However, compared with the process in the literature [13], the resource recommendation accuracy of this method is higher. Before the data warehouse is created, it is necessary to define the relationship between systems and their subject areas clearly. The school's student management database contains all students' course selections, personal information, and other related information. Wisdom Classroom uses cases and data analysis to break the traditional experience of teachers. In every DM and analysis link, students' knowledge levels are presented one by one through data, which shows the differences and uniqueness of individual learning, thus having significant application value and significance. Teachers can use the information in the school's existing database to classify students according to cluster analysis and use the association rules in DM to make predictions. In the actual instructional stage of the school, teachers teach courses to students, and students feed back the knowledge they have learned to teachers. Students, teachers, and courses constitute three major themes by taking the test scores as the measurement values. The convergence comparison results between the method in literature [13] and the algorithm in this paper are shown in Figure 5.

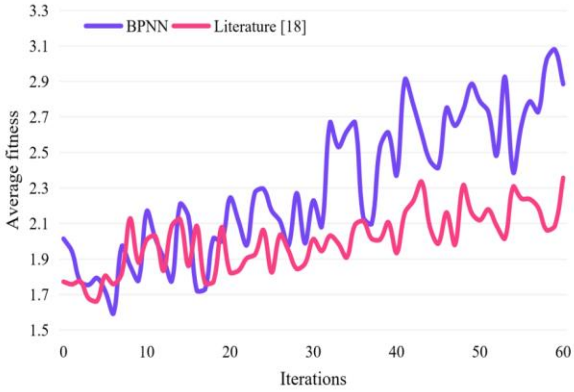

Figure 5: Convergence comparison results.

The results show that this paper's algorithm can obtain a more reasonable, feasible, and scientific teaching management effect than the teaching management method in the standard literature [13]. The algorithm in this paper is used to recommend English instructional resources, which have good optimization characteristics and fast convergence speed.

Data preparation is the most time-consuming and complicated part of the DM process, but it is essential. If there is less noise in the data, it will affect modeling accuracy. The more complete and accurate the data, the higher the reliability of the data rules discovered on this basis, and the better the goal of DM can be achieved. The comparison of the average absolute errors of the algorithms is shown in Figure 6.

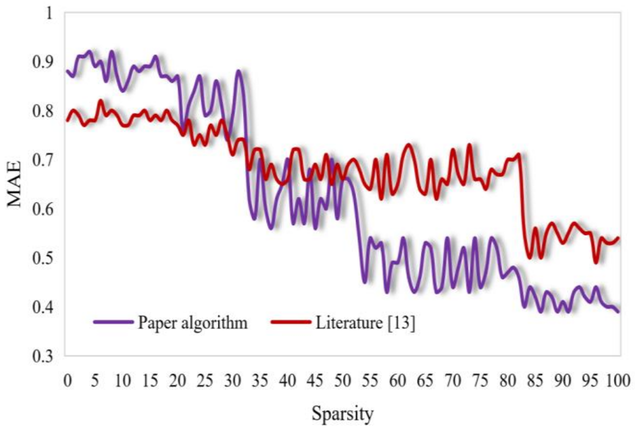

Figure 6: Comparison of the mean absolute error of the algorithms.

Compared with the method in the literature [13], the algorithm in this paper has apparent advantages in the middle and late periods of operation, and the error is reduced by 36.23%. Data quality is the key to DM, and the quality of data determines the quality of the mining model. Data preparation includes data collection, establishment of mining database, and data preprocessing, which refers to the necessary conversion, cleaning, filling, and merging of the determined primary data, covering all activities from preliminary rough data to construction of the final data set, including the selection of table and record attributes, and data trimming and conversion according to the requirements of DM model building tools.

In building a model, you can select and apply various DM tools and technical methods, compare and assess different models built, choose a good DM model selection, and correct their parameters according to the training set to obtain more applicable knowledge. For the same DM problem, it is optional to stick to a single DM technology but to analyze a variety of mining technologies; we should choose technologies and methods aimed at different data forms for mining. The scatter diagram of the predicted value (PV) and the actual value of the test sample tested using the model of literature [13] is shown in Figure 7. The scatter diagram of the PV and the actual value of the test sample tested by the English course recommendation model algorithm in this paper are shown in Figure 8.

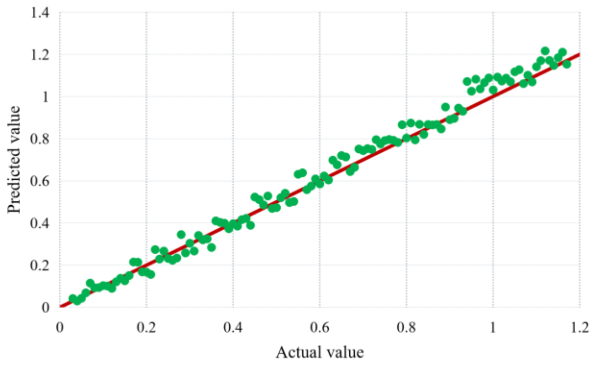

Figure 7: Scatter plot of actual value and PV in literature [13].

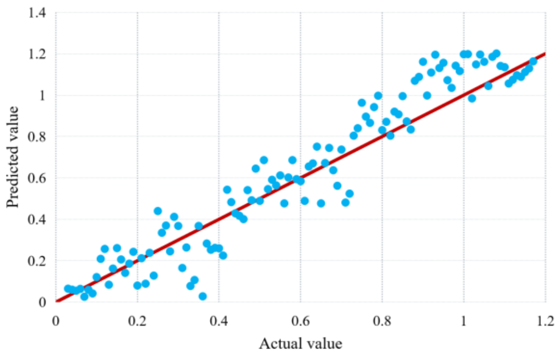

Figure 8: Scatter plot of actual value and PV of the algorithm in this paper.

It can be analyzed that the English course recommendation model based on this algorithm is better than that of the literature [13] in both accuracy and efficiency. When preparing for DM, we must assess the existing data and determine whether it is possible to solve the problem through DM, what kind of problems can be solved through DM, and what purpose can be achieved. The problem to be solved by DM is converted into a problem definition of DM, the prediction target, what kind of information is expected to be obtained, a DM plan, and the process to be taken to realize it is determined.

5 CONCLUSIONS

Under the network background, the application of IT and intelligent education cloud platform provides a brand-new learning method and unprecedented rich resources for college ELT, which makes the instructional methods modernized, diversified, and convenient, and also makes the instructional ideas, instructional contents, and instructional methods change. This paper expounds on the basic theory and implementation method of DM technology based on a data warehouse. It explores the application of educational DM in ELT management to realize the construction of the English wisdom classroom learning model and help administrators better manage and improve schools' competitiveness. Compared with traditional methods, this algorithm has obvious advantages in the middle and late stages of operation, and the error is reduced by 36.23%. The algorithm in this paper is used to recommend English instructional resources, which have good optimization characteristics and fast convergence speed. Wisdom Classroom uses cases and data analysis to break the traditional experience of teachers. In every DM and analysis link, students' knowledge levels are presented one by one through data, which shows the differences and uniqueness of individual learning, thus having significant application value and significance.

The application of data warehouse and DM technology to teaching management and educational administration provides a good decision for making teaching plans and a reference for school policy decision managers. The functions realized by this system at present have specific requirements for the professional background of managers, and the DM module needs to be further simplified in the follow-up to simplify the operation process and mode of managers. The E-Learning English Wisdom Classroom can offer tailored learning recommendations, adaptive content delivery, and comprehensive performance evaluation. This data-driven approach enhances learning outcomes, empowers educators with actionable insights, and fosters a culture of continuous improvement in English language education.

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