Evaluation Index System of Ideological and Political Teaching in Colleges and Universities Based on Data Mining under the Background of Big Data

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The big data age has given rise to a new approach for evaluating PIE in colleges and institutions. It is conducive for promoting the development of teaching evaluation in universities and colleges, as well as improving the overall quality of political and ideological education (PIE) in universities and colleges, by using the big data idea and data mining theory to study the Evaluation Index System (EIS) of PIE in universities and colleges. The PIE EIS in universities and colleges is a critical component in achieving PIE Evaluation. It is the main carrier and intuitive manifestation of the evaluation standards of teaching. It clearly defines the content, scope, and scale of the evaluation of political and ideological theory teaching. By using the decision tree algorithm in data mining, it can help process data, complete the data feedback, and determine the indicators of each level of EIS for PIE in universities and colleges. Finally, the effect of this EIS is judged by experiment. The result shows that more than 40% of students are satisfied with the quality of political and ideological course teaching, 36.8% are satisfied with the analysis of the implementation of political and ideological classes in schools, and overall are satisfied with the political and ideological teaching in universities and colleges.

1. Introduction

The advent of the big data age is a powerful force for progress in our country’s politics, business, education, and science and technology. Because of the massive quantity of data available in the era of big data, the way people gain information has changed. As a result, universities and colleges should adapt their own ideas and concepts to fit this environment, and use big data to assess and address problems. This research uses a data mining method to investigate the EIS of PIE in universities and colleges, in which more decision tree algorithms are used.

Decision tree algorithm is the sub-branch of the well-known era of computation and intelligence, i.e., artificial intelligence, which has been developed to boost the process of understanding and intelligence to another level. Based on the training dataset, this method creates a classification model. The root node is used as the beginning node in the decision tree method, and the branching strategy is used to determine the best branching characteristic from top to bottom [1]. During the creation of a complete EIS of PIE in universities and colleges, a decision-making algorithm is used to continuously dig and find evaluation indexes of PIE in universities and colleges, build a complete EIS of PIE in universities and colleges on the basis of defining each teaching index.

The innovations of this paper are as follows: (1) When studying the EIS of PIE in universities and colleges, the data mining is introduced briefly, and decision tree algorithm in data mining is used to collect and analyze the data of PIE in universities and colleges, which serves as an important data basis for building the EIS of PIE in universities and colleges. (2) Define the evaluation process of PIE in universities and colleges, choose four indicators as the criterion layer to build the EIS of PIE in universities and colleges, further subdivide the criterion layer to determine the index layer indicators, and create a complete EIS of PIE in universities and colleges [2].

The remaining sections of the paper and their working mechanism are briefly described below.
In the following section, an extensive review of the already published paper is reported where problem with each and every scheme is highlighted along with its advantages and scenarios where it is best suited. Then in the next section, that is, Section 3, data mining algorithms are described and how these are useful in resolving the issue at hand. In Section 4, EIS of PIE in universities is reported. Results and discussion related to the results are reported in Section 5 of the paper. Finally, concluding remarks are provided.

2. Related Work

At present, with the rapid development of data mining, there are many applications in University teachers’ teaching evaluation and teachers’ performance evaluation. Domestic and foreign experts have also started to study this aspect [3]. Foreign scholar Amir et al. pointed out that the purpose of teacher evaluation is to improve the teaching effect of teachers without putting pressure on individual evaluation subjects.[4] Mahmud et al. stated that during the period of teaching evaluation, teachers’ teaching level should be improved as the core, and a system with full feedback mechanism as the goal, which fully reflects rewards, punishments, and development [5]. Thamburaj pointed out that it is necessary to determine the objectives of PIE evaluation and clarify the prerequisites for the quality of teaching evaluation [6]. Chen proposed the teaching evaluation of political and ideological classes in universities and colleges. The key point is to clarify the purpose of the activities as an important basis for the follow-up evaluation [7]. Nowadays, the theory of education and teaching evaluation is becoming more and more mature, mostly related to the evaluation methods. Hu advocated that rather than a fixed and single assessment approach, evaluation and evaluation activities should be changed to match the demands [8]. Shi emphasized the need for selecting clear and appropriate evaluation subjects as well as determining each subject’s standing in the evaluation [9]. Sun said that the construction of an evaluation index should be based on the criteria of a scientific system and should result in a full and thorough assessment index [10]. Zhang presented a multi-dimensional assessment method for political and ideological courses in universities and colleges with flawless functions, stressing the dominating position of professors and students, and taking into consideration the conditions of operating schools [11]. From the teaching effect and teaching process, the index system is defined, and the logical relationship between the indicators at all levels is explained [12]. Zhou proposed that formulating a reasonable and scientific EIS will effectively promote and improve the political and ideological classroom teaching effect in universities and colleges, which has a certain positive role, and the contrary will have a negative impact [13]. Huang et al. pointed out that the lack of scientificity and guidance in the design of evaluation index results in poor measurability and low accuracy of evaluation results [14]. Yang specialists have made in-depth research on the evaluation object, subject, evaluation principle, methods and basis, and continuously improved them to build a complete university political and ideological teaching evaluation system [15]. Meng points out that starting from reality, standardizing objects, expanding subjects, and optimizing standards make the evaluation system of political and ideological courses in universities and colleges scientific, and promote the theoretical construction of political and ideological courses in universities and colleges [16]. Shen carries out an analysis from the subject in the teaching and evaluation of political and ideological theory courses in universities and colleges, analyzes the problems such as the deviation of evaluation index from teaching practice, externalization of teaching process, evaluation result, etc. Based on the diversified teaching evaluation system, the teaching process and evaluation result are unified [17].

3. Data Mining-Based Algorithms

Data mining is the action of filtering through the massive datasets such that correlation and patterns of interest are identified or highlighted. These findings may have the potentials to improve the respective business model in such a way to resolve the challenges especially through the extensive analysis of data. A company may be interested in utilizing this approach, i.e., data mining, for making more informed and practical decision along with effective future forecasting of the respective trends. Usually, these approaches are utilized in scenarios where massive data values, specifically those which are important to an organization, are generated and need to evaluate to provide timely decisions.

3.1. Data Mining Process. The core of data mining is to discover knowledge in the data; extract noisy, incomplete, and fuzzy data using artificial intelligence algorithm; and use data mining algorithm to dig deeply into the potential and the valuable hidden information process [18]. The purpose of data mining is to extract valuable and new data from a variety of data of different types, and to further analyze the data to find out the relationship between individual data and the latter, and to establish a decision support model. The basic process of data mining is to first identify problems, then collect data information, then preprocess data, further mine data, and finally express and interpret models. Figure 1 is a data mining flowchart:

3.2. Decision Tree Algorithms. A decision tree is a hierarchical or flowchart-like graphical representation or structure where each and every node (particularly internal) denotes a “test” on an attribute and if that test or condition is satisfied then the children or successor nodes can be traversed (such as whether a coin that is flipped by an individual will either come up with a head or tail and nothing else as there is no other alternative), each branch replicates the test’s conclusion, and each leaf node represents a class label (decision taken after computing all attributes). Decision Tree algorithm is an ideal way to generate classification models based on training datasets. This algorithm has been used for a long time and has become increasingly mature. The decision tree algorithm uses the concept of nonbacktracking to classify data based on irregular, out-of-order, well-known class-
labeled training sample sets and derives tree rules. The root node is the top node in the decision tree, and the leaf node is used to represent the class label, that is, the number of leaf nodes is large, while the internal node is used to represent the attribute logical judgment, and the edge of the tree is used to represent the branch result of the logical judgment.

The decision tree algorithm starts with the root node, uses the branching strategy from top to bottom within the tree, selects the best branching attributes, and divides the original data into different attributes. All the remaining attributes are determined by recursive branching of the divided self-dataset, and this record is concluded on the leaf nodes of the decision tree. There is only one path from the root node to each leaf node, and this path corresponds to a classification rule, so a decision tree corresponds to a set of classification rules, and the decision tree can be used to classify data. However, the decision tree generated from the training sample set is more accurate than the characteristics of the training sample, which leads to over-fitting problem. For this problem, the decision tree can be pruned to ensure high classification accuracy and simplify the structure of the decision tree. Figure 2 is the most representative decision tree, which is used to classify and predict the evaluation of PIE in universities and colleges. In Figure 2, the nonleaf nodes of the decision tree are represented by rectangles and ellipses by leaf nodes.

C4.5 algorithm is a decision tree algorithm based on the improved ID3 algorithm, so the basic principle of ID3 algorithm should be studied and analyzed first. Initially, ID3 algorithm introduced Shannon information theory into the decision tree algorithm. The ID3 method selects branch characteristics on nodes based on information gain, and tiny information is expected to equate to high purity and high information gain. Basic idea: Starting from the root node, perform statistical analysis of all attribute information gains, select the highest attribute in this information gain as the branch attribute, then construct the decision tree using the top-down recursive method until all sample data types are the same in all subsets, or until the attribute branching ends and the corresponding subset class labels are more, in which case the high frequency classes in the subset can be well selected as the leaf nodes.

The following is the basic process for ID3 classification algorithm to select branching attributes:

1. The entire set of training samples on the marked N root node is represented by $S$ and $|S|$ is the total number of sample data. Suppose there are $n$ class label types on the sample data $i$ in the $S$ set, which can be represented by $C_i$ ($i = 1, 2, \ldots, n$). The set of $C_i$ class principles in $S$ is represented by $S_{cn}$ and the number of samples stored in $S_{ci}$ is represented by $|S_{ci}|$

   \[
   \text{entropy}(S) = -\sum_{i=1}^{n} p_i \log_2 p_i. \tag{1}
   \]

   The nonzero probability of the class label $C_i$ of the $S$-sample data in the formula is expressed by $p_i$, and the actual application value is predicted by $|S_{ci}|/|S|$. The higher the uniformity of sample data distribution according to the formula, the greater the entropy($S$) value, the more difficult it is to distinguish and classify the corresponding sample data. It is assumed here that the sample data on the $S$ sample dataset is branched with the value of the $A$ attribute. If the number of values in the $A$ attribute has $m$, it can be represented by $A_m(1, 2, \ldots, m)$, divided into $m$ subsets of the $S$
dataset, that is, \( \{S_1, S_2, \ldots, S_m\} \), and the value of the attribute A in the \( S_i \) sample data is represented by \( A_i \). This subset corresponds to the N nodes and generates branches according to the A attribute. The branching subsets are expected to be “pure” in the ideal state, meaning that the sample data within the subset originates from each individual class, but the number of samples obtained from a single subset after branching originates from multiple classes. The following formula information is derived from attribute A branching

\[
\text{entropy}_A(S) = \sum_{j=1}^{m} \frac{|S_j|}{|S|} \times \text{entropy}(S_j). \quad (2)
\]

In the above formula, the number of all samples in \( S_j \) is represented by \( |S_j| \), and the information entropy in \( S_j \) subset is represented by entropy \( (S_j) \). The more the information entropy, the higher the purity of the novel’s clear subset.

Define the information gain as the information entropy before subtracting the information entropy branched by attributes. The following is the calculation expression:

\[
\text{Gain}(A) = \text{entropy}(S) - \text{entropy}_A(s). \quad (3)
\]

The Gain \( (A) \) information gain is high, proving that the selected A branch attribute has a lot of information in the dataset branch, and the sub-nodes are more “pure” after the branch. The essence is to select the highest A attribute in Gain \( (A) \) as the branch attribute of this node, similar to the best classification attribute selected, which is the basic branching strategy using ID3 algorithm in the branching process.

4. EIS of PIE in Universities

4.1. Evaluation Process of Political and Ideological Teaching in Universities and Colleges. When studying the evaluation of political and ideological teaching in universities and colleges, this paper first analyses its current situation, and constructs the evaluation system of political and ideological teaching in universities and colleges based on data mining under the background of big data [19]. As the main body of political and ideological teaching in universities and colleges, teachers, managers, and students mainly collect political and ideological teaching data in universities and colleges and output evaluation results, i.e., feedback results, which are shown in Figure 3:

4.1.1. Data Collection. The first thing to do after creating a new project is to collect data, analyze according to different project types and evaluation methods, and input all the evaluation data. Teachers, students, and university leaders of political and ideological courses can evaluate the effectiveness of PIE in universities and colleges during the research process, and store the evaluation results in the database, which is conducive to subsequent evaluation and judgment.

4.1.2. Data Processing Analysis. The evaluation of PIE in universities and colleges should collect and process all types of data information about big data, and use big data technology in the evaluation of PIE in universities and colleges, given the background of big data. We can gain a lot of relevant data for in-depth mining by integrating and analyzing the obtained data information, making the assessment findings more objective, scientific, and of high application value.

Data mining methods are now being utilized for data mining and processing in massive datasets. At the same time, data mining employs a variety of methods, including the decision tree algorithm, support vector machine, and A priori algorithm, among others. In this paper, decision tree algorithm is used to implement the evaluation of PIE in universities and colleges. The data mining process is summarized as three processes, that is, data preparation, data mining, and analysis results.

4.1.3. Output and Feedback Results. Feedback link is the most important part of the evaluation process, so when conducting effective PIE evaluation, it also uses feedback to obtain the evaluation results given by each subject. If there is no feedback link in physical education, the evaluation will have no effect and value [20]. Therefore, when evaluating
PIE in universities and colleges, make full use of the convenience of the network and the simplicity of the operation of the smart terminal in the era of big data, use the network feedback method to master the evaluation content of PIE, and provide the feedback information to students, political and ideological teachers, and university administrators to improve the teaching method, so as to significantly improve the evaluation effect of PIE.

4.2. Building EIS of PIE in Universities. By combining quantitative and qualitative analysis, this paper establishes an EIS for PIE in universities and colleges, and uses the qualitative analysis method to form an index system, which is the system’s basic component and should be completed according to relevant principles when selecting the index. In order to evaluate the quality of different links in PIE teaching and improve the overall level and ability of PIE teachers, the selected index hierarchical analysis and progressive statistics are introduced. Building an index evaluation system of PIE in universities and colleges is an important reference for "measuring" the political and ideological courses in universities and colleges. One of the main parts of higher education is the ideological and theoretical courses in universities and colleges, which contains multiple dimensions. Therefore, when evaluating PIE in universities and colleges, it involves subject evaluation, course evaluation, and teaching evaluation, which is a comprehensive evaluation formulated as a whole. Based on this, the evaluation system of PIE in universities and colleges is constructed as four subsystems, namely, design, organization, effect, and management of teaching. Its structure is shown in Figure 4.

4.2.1. Instructional Design. The teaching design in the evaluation system of PIE in universities and colleges is divided into two sub-criteria layers, that is, theoretical and practical teaching design. The contents of the index layer in the theoretical teaching design are selected calibration, teacher preparation, teaching environment, and teaching documents. The index level in the practice teaching design includes the construction of bases, the arrangement of school hours, and the formulation of goals. Table 1 provides an evaluation index framework for instructional design:

4.2.2. Teaching Organization. The teaching organization is separated into two subcriteria levels in the assessment system of PIE in universities and colleges, namely, theoretical teaching organization and practical teaching organization. Teaching content, teaching techniques, and teaching means are among the index levels of theoretical teaching organization. Staffing, subject orientation, and protection are indicators in practical teaching organizations, and the assessment framework for teaching organizations is provided in Table 2.

4.2.3. Teaching Effectiveness. The teaching effect in the evaluation system of PIE in universities and colleges is divided into two sub-criteria layers, that is, theoretical teaching organization and practical teaching organization. The index layers of theoretical teaching organization mainly include teaching objectives, students’ learning quality, and social response. The evaluation criteria and student feedback are the indicators in the practical teaching organization. The evaluation framework of teaching effect is listed in Table 3.

4.2.4. Evaluation of Teaching Management. The evaluation of teaching management in the evaluation system of PIE in universities and colleges is divided into three sub-criteria layers, namely, system construction, system implementation, and reward and punishment mechanism. Among them, the indexes in the system construction include the system of

| Rule layer | The rule layer | Index layer |
|------------|---------------|-------------|
| The teaching design (A1) | Theoretical teaching effect (B1) | Select test checking |
| Practical teaching effect (B2) | Teaching environment |
| | Teaching documents |
| | Base construction |
| | School hours |
| | Goals |

Figure 4: EIS of PIE in universities.

Table 1: Evaluation index framework of instructional design.
Table 2: Evaluation framework for teaching organizations.

| Rule layer               | The rule layer            | Index layer             |
|-------------------------|--------------------------|-------------------------|
| Teaching organization   | Theoretical teaching effect (B3) | Teaching content        |
|                         |                          | Teaching method         |
| Practical teaching effect (B4) |                          | Teaching means          |
|                         |                          | Staffing                |
|                         |                          | Content orientation     |
|                         |                          | Safeguard measures      |

Table 3: Framework for evaluation of teaching effects.

| Rule layer               | The rule layer            | Index layer             |
|-------------------------|--------------------------|-------------------------|
| The teaching effect     | Theoretical teaching effect (B5) | Teaching objectives    |
|                         |                          | Student learning quality|
|                         |                          | Social response         |
| Practical teaching effect (B6) |                          | Assessment criteria     |
|                         |                          | Student feedback        |

Table 4: Evaluation framework for teaching management.

| Rule layer               | The rule layer            | Index layer             |
|-------------------------|--------------------------|-------------------------|
| Teaching management     | Institutional development (B7) | Preparing system        |
|                         |                          | A class system          |
|                         |                          | Exchange training system|
|                         |                          | Monitoring and control system |
|                         |                          | There is               |
|                         |                          | departmental            |
|                         |                          | collaboration           |
|                         |                          | Effective implementation|
|                         |                          | Teaching reward system  |
|                         |                          | Teaching punishment     |
|                         |                          | mechanism              |

were chosen at random for this experiment, with 198 girls and 302 guys. The impact of this EIS was assessed in two ways: students’ appraisal of the quality of political and ideological courses, and students’ execution of political and ideological courses.

5.1. Student’s Analysis of Teaching Quality of Political and Ideological Course

5.1.1. An Analysis of Students’ Satisfaction with the Teaching Contents of Political and Ideological Course. This paper sets four options when analyzing the results of students’ satisfaction with political and ideological teaching content. By analyzing the results of political and ideological teaching content satisfaction shown in Figure 5, we get to know that 45.6% of the students are basically satisfied with the content of political and ideological teaching, 28.5% of the students are generally satisfied with the content of political and ideological teaching, of which 18.5% are very satisfied and only 7.4% are very dissatisfied.

This experiment collects data from students to analyze their satisfaction with the form of political and ideological teaching. The data in Figure 6 shows that 42.5% of the students are basically satisfied, 19.4% of the students point out that their satisfaction is average, 28.5% are very satisfied, and 9.6% are not satisfied.

5.2. Analysis of Classroom Implementation Results of School Political and Ideological Course

5.2.1. Teaching Content Results of Political and Ideological Teachers. In this experiment, the teaching content of political and ideological course teachers is analyzed from the aspects of political and ideological course development, new trends, theory, and practice. The results show that 32.1% of students express very good results, 36.8% of students express good results, 23.5% of students express general results, and 7.6% of students express very poor results. The results are shown in Figure 7.

5.2.2. Results of Teaching Methods for Political and Ideological Teachers. In this experiment, students examine whether instructors’ teaching programmes can stimulate students’ individual thinking by analyzing the teaching methods used by political and ideological teachers. According to the results of this experiment, 32.1% of students express very good results, 36.8% of students express good results, 23.5% of students express general results, and 7.6% of students express very poor results. The results are shown in Figure 8.

5.2.3. Practice Teaching of Political and Ideological Course in Schools. In this experiment, for the analysis of the effect of practical teaching of political and ideological course in schools, it is up to students to evaluate whether it is useful to participate in the practice activities of political and

preparing lessons, listening to lessons, the system of exchange and training, and the system of monitoring. The indicators in the implementation of the system include department collaboration and practical implementation. The indicators of the reward and punishment mechanism are teaching reward mechanism and teaching punishment mechanism, and the evaluation framework of teaching management is listed in Table 4.

5. Analysis Results of EIS of PIE in Universities and Colleges

This study develops a system of PIE assessment indexes for universities and colleges. Based on data mining, this project examines the impact of political and ideological teaching in universities and colleges. 500 individuals from M University
Teaching content satisfaction results of political and ideological courses

**Figure 5:** Results of content satisfaction of political and ideological course.

**Figure 6:** The satisfaction result of political and ideological teaching form.

**Figure 7:** Experiments on teaching contents of political and ideological teachers.
ideological course teaching. The results show that 10.5% of the students are useless, 14.8% are indifferent to taking part in the practice activities of the political and ideological course, and 21.7% are eager to participate. However, 42.8% of the students indicate that they can improve themselves better due to the limitations of practical teaching conditions. The specific results are shown in Figure 9.

6. Conclusion

The quality of PIE is related to the development of a university and has a great impact on the students’ personal values. Therefore, universities should establish a complete PIE system, formulate a number of evaluation indexes to analyze the political and ideological teaching problems in universities from various means and contents, in order to further improve the PIE system. This paper uses data mining algorithm to collect relevant data when constructing EIS of PIE in universities and colleges. Firstly, the data mining algorithm is introduced briefly, and the decision tree algorithm in data mining is introduced in detail. Then, the evaluation process of PIE in universities and colleges is listed. According to this process, the index of EIS of PIE in universities and colleges is explored, and the PIE in universities and colleges is promoted.
in an all-round way. Teaching design, teaching organization, teaching effect, and teaching management evaluation are the criteria levels in the ontology system. Finally, 500 students from a university were chosen at random for analysis. The result shows that students’ basic satisfaction in the evaluation of political and ideological course teaching quality accounts for a higher proportion of teaching, and students who are good and very good in the analysis of political and ideological course classes in the school account for a disproportionately high proportion of teaching.

**Data Availability**

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

**Conflicts of Interest**

The authors declare that they have no conflicts of interest.

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