Retraction

Retracted: Application of Internet of Things Architecture in Intelligent Classroom Teaching Analysis in Colleges and Universities

Mobile Information Systems

This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope

(2) Discrepancies in the description of the research reported

(3) Discrepancies between the availability of data and the research described

(4) Inappropriate citations

(5) Incoherent, meaningless and/or irrelevant content included in the article

(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

References

[1] H. Du, "Application of Internet of Things Architecture in Intelligent Classroom Teaching Analysis in Colleges and Universities," *Mobile Information Systems*, vol. 2022, Article ID 4831937, 7 pages, 2022.

Research Article

Application of Internet of Things Architecture in Intelligent Classroom Teaching Analysis in Colleges and Universities

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Smart classroom is based on information technology, and its operation, upgrading, and development need technical support. At present, most of the smart classroom teaching adopts traditional architecture, highlighting the characteristics of disciplines, insufficient data processing, and narrow application fields. Based on this, this paper studies and analyzes the application of Internet of things architecture in college smart classroom teaching analysis. Based on the simple analysis of the development of intelligent algorithms and smart classrooms of the Internet of things, this paper constructs a smart classroom system based on the architecture of the Internet of things, transfers it to information-based teaching, introduces an intelligent service platform, and uses intelligent algorithms to mine and cluster data. The core algorithm is improved based on K-means algorithm and grid algorithm to improve the pertinence and effectiveness of the algorithm. Through the simulation results, the improved clustering analysis algorithm can shorten the running time and improve the clustering effect. At the same time, the application test results of the algorithm also show the superiority of the clustering results, which can provide more strategies for later teaching.

1. Introduction

Compared with the Internet of things, it realizes a variety of information interaction functions through the Internet of things [1]. At present, there are many common technologies, such as intelligent technology and embedded technology [2] . In recent years, there have been many researches on the application of Internet of things in learning. It is generally believed that the introduction of Internet of things technology will help to create a learning mood, improve the pertinence of teaching, and realize the intelligent promotion of resources. In the traditional teaching field, it belongs to the factory processing mode and lacks the interaction between teachers and students. This teaching mode is difficult to improve students' innovation ability [3]. The emergence of smart classroom provides new possibilities for the teaching field. Smart classroom applies Internet of things technologies, such as data mining and intelligent analysis, to realize the intelligent processing of teaching, promote more targeted learning contents for teachers and students, and also facilitate the communication between teachers and students [4].

Based on this background, this paper studies and analyzes the application of Internet of things architecture in college smart classroom teaching analysis, which is mainly divided into four chapters. The first chapter briefly introduces smart classroom teaching and Internet of things technology; Chapter 2 analyzes the data mining algorithms and cluster analysis algorithms related to the Internet of things technology at home and abroad, and summarizes the application and shortcomings of the existing algorithms. Based on the simple construction of the smart classroom based on the Internet of things architecture, the third chapter improves the architecture, introduces the learning system, and introduces the trusted algorithm to improve the intelligence. At the same time, in the selection of the core algorithm, it puts forward the improved clustering analysis algorithm to improve the clustering effect. Chapter 4 tests the performance of the improved clustering algorithm proposed in this paper and analyzes the clustering effect and purity. Compared with K-means algorithm and grid algorithm, the improved algorithm shows advantages in running time and clustering effect, which proves the effectiveness of

the algorithm, and applies the algorithm as the core algorithm to the teaching system. Experiments show that through this algorithm, we can get better clustering conclusions and provide more convenience for the next teaching.

The innovation of this paper is reflected in the architecture design and algorithm improvement. In the design of smart classroom architecture, the future algorithm upgrading and improvement are fully considered, and information technology is introduced. The application scenario is not limited to classroom teaching, but also can be applied to evaluation and possible online teaching in the later stage. In the aspect of algorithm improvement, aiming at the shortcomings of mean analysis and grid algorithm, a new algorithm for calculating the threshold function is proposed and applied to the teaching platform as the core algorithm to improve the effect of cluster analysis and provide more targeted teaching and learning strategies for teachers and students.

2. State of the Art

The development of information technology not only brings changes to daily life, but also has a great impact on teaching. In the research and analysis, Xie and others used tableau software for visual analysis, calculated the classroom schedule of the first teaching building and the maximum capacity of movable tables and chairs in each classroom, and discussed the application of class visualization technology in smart classroom [5]. Cicmil and Gaggiotti explained the curriculum design and teaching method practice of RPME at the university level in the project management course, pursued experiential reflective learning, analyzed the MBA curriculum design, and provided PM module according to the perceptual nature of the field of project management theory and practice [6]. Fernández-Caramés and Fraga-Lamas proposed a use case-based method in the research and analysis to teach students and users to perform such audits, and then make the detected available IOT devices more secure. They introduced how to automate the vulnerability assessment of IOT devices through Shodan script [7]. Many scholars also analyze from a technical point of view. Ros and Guillaume in their research and analysis discussed that the expenditure single link standard is powerful and allows to deal with various shapes and densities, but it is sensitive to noise. They put forward two improvement measures to deal with noise, considering the local density to ensure that the distance involves the core points of each group, and the hierarchical algorithm prohibits merging representative clusters exceeding the minimum size after determination [8]. Anees et al. proposed a new, dynamic, self-organizing, and fuzzy entropy-based opportunistic clustering and data fusion scheme (hfecs), which uses the asynchronous work and sleep cycle of sensor nodes to establish opportunistic connections between sensor nodes in heterogeneous clusters. After the cluster is formed, hfecs uses the same technology to perform data fusion at the first level to reduce the redundant information flow from the first level and the second level. Hfecs is superior to the existing heterogeneous cluster benchmark scheme in terms of half-life, stability period, average residual energy, network life, and packet delivery rate [9]. Om and Jaya proposed a web page prediction method based on two-level matching of weighted support and Bhattacharya distance (WS-BD), which uses weighted support to obtain the sequence pattern of interest. The support filters the sequence pattern obtained by PrefixSpan algorithm according to the frequency, duration, and repeatability of the web page, and clusters the sequence pattern of interest by Bayesian fuzzy clustering based on dice similarity. Experiments are carried out with CTI and MSNBC data to prove the effectiveness of this method. The accuracy, recall, and f measurement are improved by 9.59%, 21.22%, and 10.17%, respectively [10].

To sum up, we can see that there are many pure theoretical studies on intelligent algorithms of the Internet of things, and the improvement strategies are different. However, these studies are rarely applied to the actual field, and all kinds of algorithms also have their own defects, such as long running time and insufficient purity; there may be situations where the results cannot be obtained due to nonconvergence. The relevant research of smart classroom mostly starts from the teaching field and rarely involves the computing field, and the algorithms used are often data mining technology, which cannot meet the increasing demand. Therefore, it is of great significance to carry out the analysis and research of smart classroom teaching based on the Internet of things architecture.

3. Methodology

3.1. Smart Classroom Teaching Platform Architecture. Smart classroom is based on information technology, and its development and upgrading are closely related to the technology platform. In different stages of technological development, the construction of the platform will also focus on different directions [11]. The intelligent classroom teaching platform architecture design adopts the information platform design method, makes use of cloud computing, Internet technology, and big data, and combines mobile terminals with data transmission. The basic architecture is shown in Figure 1. The education platform provides basic information services, covering resources, curriculum design, evaluation system, and learning modules [12]. The network server is used to realize the construction of LAN. The overall construction can be divided into several ports, such as teaching, learning, evaluation, and communication.

In the construction of the platform, in order to make the subject teaching more prominent, we also need to introduce the teaching system into it. In improving the design, we need to highlight the discipline characteristics and increase the resource management platform, covering education management, dynamic resources, question bank, etc. In terms of dynamic resources, in addition to resources, we also need to be able to realize data analysis and evaluation, add communication modules in the teaching content, and fully grasp the learning status of students. In recent years, artificial intelligence technology and big data mining technology have
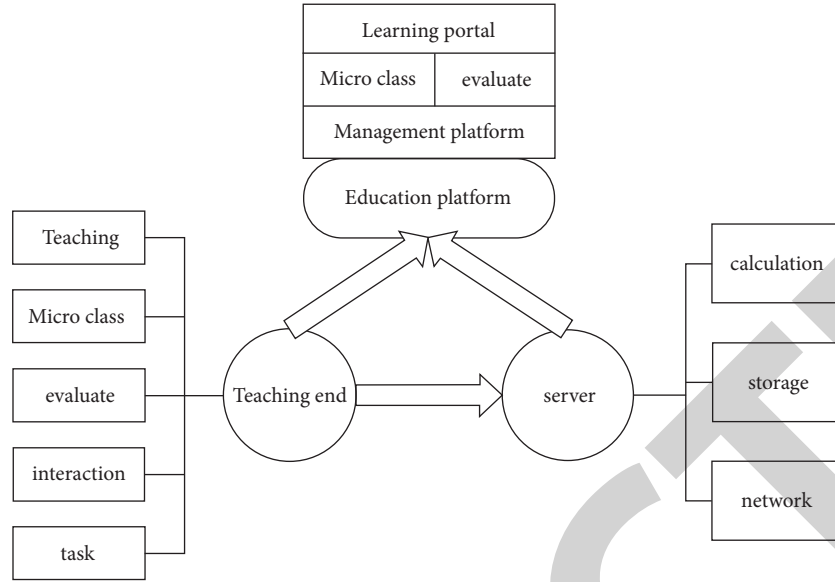
Figure 1: Basic structure of smart classroom.

developed rapidly. In the construction of cloud platform, teachers can only use the platform. At the same time, it can be combined with students' intelligent terminals to provide resource services for teachers and students and facilitate the communication between teachers and students. The learning architecture based on Internet of things technology is shown in Figure 2.

JSP technology architecture is adopted in the system design to realize interactive services. This architecture can handle the application logic of resources, and the development is relatively simple [13]. The server adopts Tomcat 5.0, and the background database adopts SQL server to realize data query and update data technology. The functional modules include login module, retrieval module, resource module, counseling module, evaluation module, e-book module, teacher connection module, communication module, background management, etc. There are intersections between resource module and other modules, that is, avoiding the reconstruction of resources. The background management module mainly realizes the management and modification of resource information. At the same time, it can also search resources and maintain the system. The database is designed for some components. At the same time, the database standard is designed according to the components, without storage, so as to reduce the association between tables. This paper adopts SQL database and designs 25 tables, covering grades, course information, member names, and so on.

3.2. Learning System Design. After the platform architecture is basically completed, it is necessary to analyze students' learning needs and provide more targeted teaching for students. At present, there are many researches on this demand, such as data mining technology, cluster analysis, network security, and virtual data technology. [14]. Among various algorithms, cluster analysis can be applied to personalized learning analysis. Therefore, the core algorithm of this paper adopts cluster analysis algorithm. One of the most important algorithms is data mining [15]. This algorithm examines the similarity of individuals, and the individuals who do not meet the conditions are divided into other groups.

For a given data set, it is divided into different groups according to the similarity, and the formula is expressed as

$$
\begin{aligned}
C_j | j &= \{1, 2, \ldots, k\} \\
C_j &\in V \\
C_j \cap C_i &= \varphi \\
U_{i=1}^k C_i &= V,
\end{aligned}
$$

where V represents the data set, k represents the number of groups, and C represents the class. Cluster analysis is represented by sequence, and the output is a partition, which can be expressed as

$$
\begin{aligned}
G_1 \cup G_2 \ldots \cup U G_k &= X \\
G_i \cap G_j &= \varphi, i \neq j,
\end{aligned}
$$

where G_k represents subset. From the concept of cluster analysis, we can see that the algorithm focuses on the similarity between individuals, stipulates some conditions, and divides the individuals with high similarity into a group, in which the individual similarity is the highest. However, the process of cluster analysis is not a simple calculation of similarity, but the distance of feature space [16]. If the two samples are not similar, the dissimilarity is greatly different, and the similarity measurement is reflexive. The formula is expressed as

$$
\begin{aligned}
\forall x', x &\subset X \\
\forall x', x &\in X.
\end{aligned}
$$
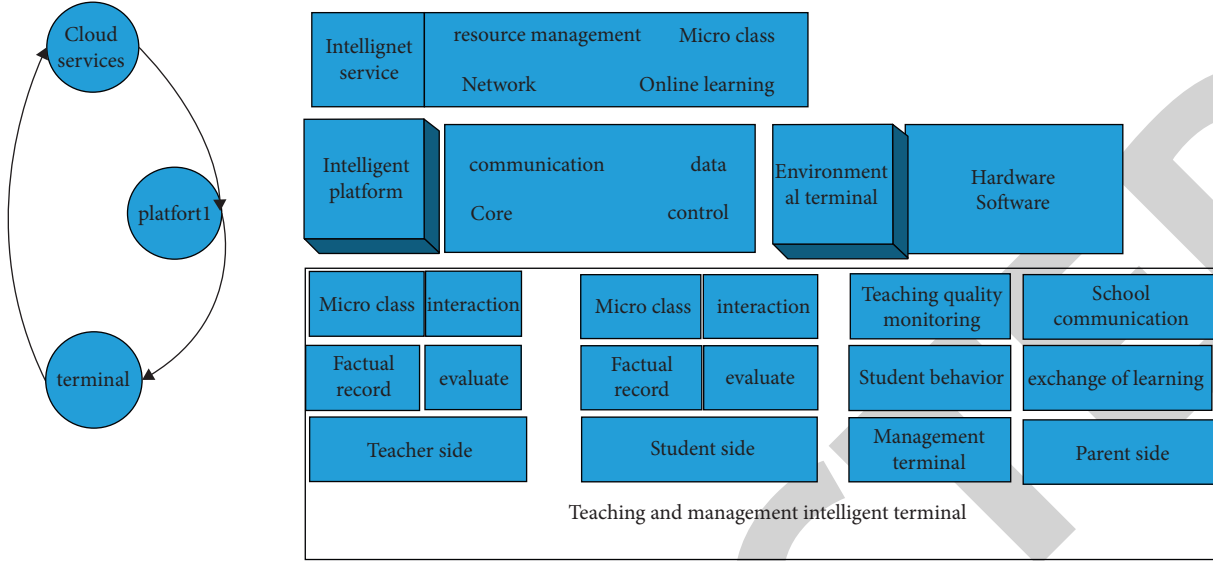
FIGURE 2: Learning architecture based on Internet of things technology.

In general, this metric can be translated into

$$0 \leq s\left(x, x'\right) \leq 1. \tag{4}$$

Since dissimilarity is not often used as a standard, the measurement standard can be expressed as

$$d\left(x', x\right), \forall x', x \in X. \tag{5}$$

Considering the continuity of description value, the degree of dissimilarity can be described by distance. If the similarity of two objects is high, the distance calculation result is small; otherwise, the distance value will be large.

Therefore, scale metrics need to be calculated when describing objects. At present, there are three common distance calculations [17]. Manhattan distance calculation formula is

$$d\left(i, j\right) = \left|x_{i1} - y_{j1}\right| + \left|x_{i2} - y_{j2}\right| + \ldots + \left|x_{im} - x_{jm}\right|, \tag{6}$$

where $d\left(i, j\right)$ refers to the distance of the object piece and x_{im} refers to the attribute of the object. The calculation formula of Euclidean distance is

$$d\left(i, j\right) = \sqrt{\left|x_{i1} - y_{j1}\right|^2 + \left|x_{i2} - y_{j2}\right|^2 + \ldots + \left|x_{im} - x_{jm}\right|^2}. \tag{7}$$

Minkowski's calculation formula is

$$d\left(i, j\right) = \left(\left|x_{i1} - y_{j1}\right|^q + \left|x_{i2} - y_{j2}\right|^q + \ldots + \left|x_{im} - x_{jm}\right|^q\right)^{1/q}. \tag{8}$$

where q is a natural number. If q is equal to 1, the result of Minkowski formula is the same as that of Manhattan. If q is equal to 2, the result of Minkowski formula is the same as that of Euclidean distance.

K-means method is a kind of iterative algorithm, which continuously replaces members in the iterative process. The cluster similarity obtained by this algorithm is calculated by using the mean [18]. Assuming that the clustering is represented by $k_i = \{t_{i1}, t_{i2}, \ldots, t_{im}\}$, the mean formula is expressed as

$$M_i = \frac{1}{m} \sum_{j=1}^{m} t_{ij}, \tag{9}$$

where M represents the mean value, m represents the number of objects, and t represents the distance. Mean algorithm refers to randomly selecting objects, which represent the average value. For the remaining objects, they are divided into different groups according to the calculated distance, and then continue to calculate the average value and repeat until all objects meet conditions. K-means method is most widely used in the current improved methods, and it is also a classical algorithm. However, in the application of this algorithm, the value of K needs to be determined. Therefore, the results obtained by this algorithm are affected by K, with large amount of calculation and low efficiency [19]. At present, there are many improved algorithms, such as the introduction of penalty factor and genetic algorithm. Grid clustering algorithm is also one of the improved clustering algorithms. It has higher efficiency and has no requirements for the shape of clusters. However, it depends too much on the threshold of density. If the value is large, it will lead to cluster loss. If the value is small, it will lead to cluster merging [20].

Although there are many improved methods of cluster analysis algorithm at present, it still needs to be reasonably selected according to the actual situation. Various algorithms also have their own characteristics and application scope, and the improved algorithm itself is also improving. In the research and analysis of this paper, gbkm clustering analysis algorithm is proposed. The algorithm uses iris data to test, and the effect is better in practical application. Based on the improved grid clustering algorithm, this algorithm divides the sample space, then sets the cells, maps them to the corresponding cells, calculates the correlation density, and sets the density threshold. Calculate the data greater

than and less than the threshold to form an intermediate cluster, which does not cover discrete data. Take the center of this cluster as the accident cluster center, calculate the distance, and allocate the data to the corresponding cluster. Recalculate the cluster center data until the algorithm terminates. In this improved algorithm, the biggest difficulty lies in the grid definition itself, which has a great impact on clustering. When meshing with the algorithm, a new function is introduced, which is expressed as

$$\delta = \frac{\sum_{i=1}^{n} \sqrt{l_i}}{n}, \tag{10}$$

where l_i is the length and i is the natural number. Considering that the grid algorithm is highly dependent on the density threshold, a new strategy is proposed in the improvement, and the formula is

$$\text{Minpts} = \frac{\left[\sum_{i=1}^{N} \text{Den}(C_i)^2\right]^{1/2}}{N}. \tag{11}$$

In the formula, the density value N with the highest density is determined according to the actual situation. This algorithm continuously calculates the cluster center and meets the following conditions:

$$\left| Z_i^{(1)} - Z_i^{(0)} \right| \le \varepsilon. \tag{12}$$

End of clustering. Assuming that the bounded definition domain is represented by A, the n dimension space is represented by S, the S dimension is represented by D, the dimension space formation algorithm inputs data and divides each dimension into different lengths, the space is divided into different units, and the interval can be composed of

$$I_{ij} = \left[I_i + (j-1)\delta_i, l_i + j\delta_i \right], \quad j = 1, 2, \ldots, p. \tag{13}$$

It is concluded that δ represents the length of the grid element. $\text{Den}(C_i)$ is used to represent the number of data points and define the density threshold, and those greater than the threshold are dense units and calculate the cluster center. The formula is

$$Z_i = \frac{1}{n_i} \sum_{x,y \in k_i} (x, y)^2, \tag{14}$$

where n represents the number and x, y represents different objects.

Using Java language to realize the clustering algorithm, the first step is to define variables, methods, and classes, the second step is to define GetData method, the third step is to divide the data space into multiple grids, and the fourth step is to analyze and display the clustering results. When the system is implemented, the display pages are all in the form of JSP. In addition to completing data classification, cluster analysis also needs to analyze the performance and display after clustering. The database table design covers the structure, grades, and historical grades. The teststru table controls the test paper structure, that is, the proportion of each chapter. The preanalyzed form records students' courses, examination time, and grades.

4. Result Analysis and Discussion

4.1. Performance Analysis. Iris data are used in the experimental performance analysis, which contains 4 features and 150 records. Using grid clustering analysis algorithm can only deal with high-density data, which is prone to point loss, especially for low-density data. The algorithm proposed in this paper will not have this problem and improves the clustering effect. Compare and analyze the algorithm in this paper with the K-means algorithm. After intermediate clustering and iterative clustering, different results are obtained. The clustering results are shown in Figure 3. From the data changes in the figure, we can see that the algorithm proposed in this paper does not change very much, and the clustering is very fast, which shows that this algorithm can simulate the distribution of dense areas, quickly obtain the clustering center, and quickly complete the clustering analysis.

Analyze the clustering effect of the mean clustering method, as shown in Figure 4. From the data changes in the figure, it can be seen that the initial clustering center obtained by this algorithm is large, the center cannot be obtained well, it is constantly changing and unable to fast bracelet, and the number of iterations is increasing. The ideal clustering results should change naturally, and the results should be close each time. The two algorithms are also tested with data sets. The initial clustering centers are compared and analyzed. Each mean method needs to be reselected, and the results are different. It shows that this algorithm takes more time and the amount of calculation is too large. The improved algorithm proposed in this paper can accurately divide the dense area and determine the center as soon as possible, so it can also save time.

Further compare and analyze the running time of different algorithms. The results are shown in Figure 5. From the data in the figure, it can be seen that compared with grid clustering algorithm and mean method, the running time of the algorithm proposed in this paper has significant advantages, indicating that the convergence speed of the algorithm in this paper is faster.

It is generally believed that the higher the purity of the cluster, the better the clustering effect. Assuming that the cluster size is represented by n, the purity of the cluster can be expressed as

$$\text{Purity} = \sum_{i=1}^{k} \frac{n_i}{n} p_i, \tag{15}$$

where k represents the number of clusters. As shown in Figure 6, there are three algorithms in Figure 6, and the latter two algorithms have higher purity.

4.1.1. Teaching Analysis and Evaluation. Taking the improved algorithm proposed in this paper as the core algorithm, it is applied to the analysis of intelligent classroom teaching. Because there are many contents involved, performance analysis is selected for evaluation. This clustering algorithm can quickly read the corresponding data, cluster, analyze the feature changes, and display the analysis results
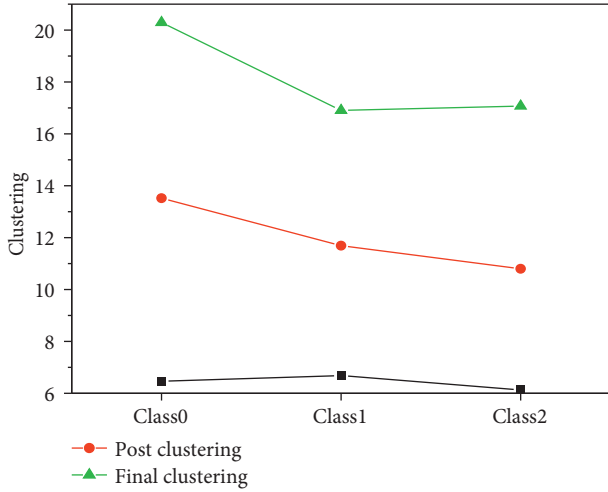
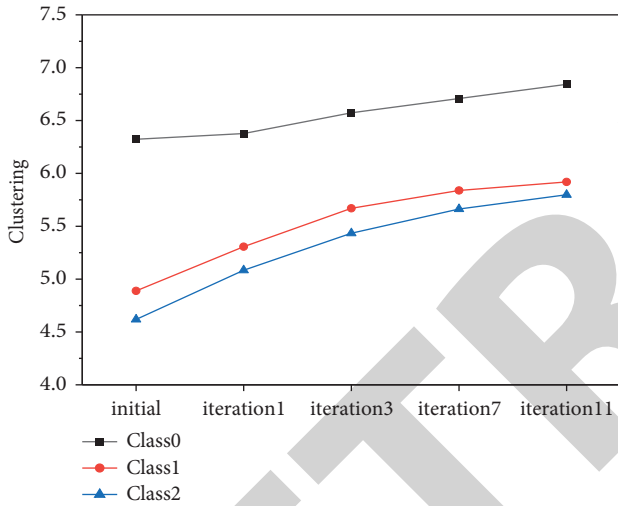FIGURE 3: Clustering results of this algorithm.

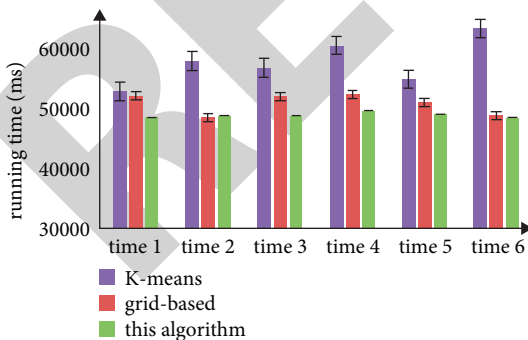FIGURE 4: Clustering results of K-means.

FIGURE 5: Comparison of running time.

on the browser. Store the results in the database to update. By comparing the characteristics of different classes, we can analyze the differences between different classes, as shown in Figure 7. From the figure, we can get the mastery of different knowledge, find out what knowledge deficiencies, and then make more efforts in future teaching.
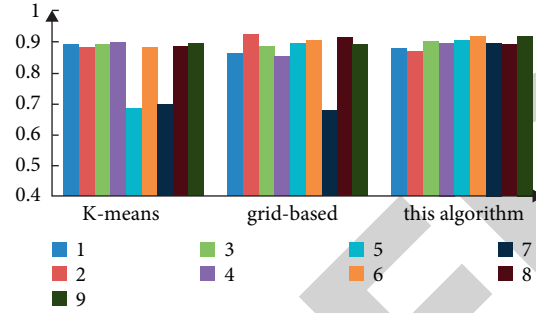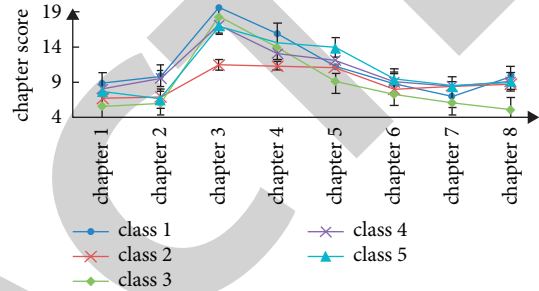

FIGURE 6: Purity comparison.

FIGURE 7: Characteristic analysis of each type.

Because of its fast convergence, the improved algorithm can quickly analyze the characteristics of classes and then provide teachers and students with more targeted teaching suggestions and learning strategies. Similarly, this algorithm can also be used in the question setting of the test paper to incorporate the original question setting data into the database. When there is no assessment result, the score of each chapter is determined according to the proportion of each chapter. After the results are obtained, the database is updated to change the proportion of some chapters and sections, so as to provide more improvement strategies for the next question setting.

5. Conclusions

(1) With the development of big data technology and intelligent technology, the technology and architecture of intelligent classroom are constantly improved. At the same time, it is also accompanied by problems such as technology application, upgrading, and data analysis. This paper studies the intelligent classroom teaching based on the Internet of things architecture, establishes the intelligent classroom architecture, and improves the shortcomings of data analysis and interaction.

(2) In the selection of core algorithm, aiming at the shortcomings of clustering algorithm and corresponding improved algorithm, learn from the improved algorithm and introduce new functions. Through the simulation test, it can be seen that the algorithm proposed in this paper has better clustering effect and more stable data processing, and can quickly analyze the characteristics of classes.

(3) The research results show that the performance analysis and evaluation scores of different chapters vary greatly. The algorithm proposed in this paper needs to be further improved in the selection of threshold and also needs to analyze the wide application of the algorithm in intelligent classroom teaching. By adjusting the content and proportion of curriculum chapters, we can fully excavate the habits and laws of teachers and students, so as to provide more convenience for teaching.

Data Availability

The figures used to support the findings of this study are included in the article.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

Acknowledgments

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