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Research on Multidimensional Data Computational Analysis Methods and Teachers' Teaching Competency Assessment Models in the Field of Education

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Abstract Teachers' teaching ability directly determines the quality of high-end talent cultivation, and objectively assessing the status of university teachers' teaching ability is of great significance for improving their teaching ability and boosting the quality of Chinese higher education. This paper defines the abstract attributes and spatial interaction process of heterogeneous network multidimensional data, improves the equilibrium of heterogeneous network data, introduces the decision logic theory, establishes the granularity computation model, and mines to more associated data and hidden data. Using OLAP technology, we construct a multidimensional data warehouse and apply simplified logic mathematical formulas to calculate and solve the multidimensional data model. Using the multidimensional data computational model to assess teachers' teaching competence, the highest value of teaching competence was found in teacher 6 among the subject teachers, and the competence values of the six assessment factors were 56.82, 68.81, 79.21, 89.62, 85.55, and 80.12, respectively. Curriculum development competence was found to be very important, and its importance and recurrence were 3.8 and 3.72, respectively, and emphasis should be placed on the assessment of this teacher's competency should be evaluated.

Index Terms heterogeneous network multidimensional data, decision logic theory, granularity computational modeling, teacher pedagogical competence

I. Introduction

With the development of society and the progress of education, the evaluation of teachers' teaching ability has been paid more and more attention [1], [2]. However, how to effectively assess teachers' teaching ability has become an urgent problem [3]. With the wide application of assessment models, its application in teachers' teaching ability has also been gradually emphasized. Since the assessment of teachers' ability is multifaceted, the assessment model of teachers' teaching ability by multidimensional data computational analysis method is more comprehensive and reasonable [4]-[7].

The research of teacher teaching ability assessment model of multidimensional data computational analysis method needs to consider the teacher's teaching objectives, as well as the interaction between teachers and students [8]. When determining the assessment indexes, teachers' professional knowledge, teaching methods and teaching effectiveness should be considered [9], [10]. Second, the study of assessment modeling requires a combination of qualitative and quantitative methods. Qualitative assessment methods can be conducted through observation, interviews and questionnaires to understand teachers' teaching process and teaching effectiveness [11]. Quantitative assessment methods can be used to evaluate teachers' teaching effectiveness by statistically analyzing indicators such as students' academic performance and engagement [12], [13]. The combined use of qualitative and quantitative methods can assess teachers' teaching ability more comprehensively and objectively [14]. In addition, the study of assessment models needs to consider the teaching environment and student characteristics [15], [16]. Considering the teaching environment and student characteristics can more accurately assess teachers' teaching ability and provide guidance for further optimization of teaching [17], [18]. The assessment model should be scientific, accurate and practical, able to objectively assess teachers' teaching ability and provide a reference for teachers' professional development, and only by continuously improving and perfecting the assessment model of teachers' teaching ability can we better promote teachers' professional development and improve teaching quality [19]-[22].

Literature [23] proposed a teacher instructional ability assessment model based on the gray projection extended random woodland algorithm by introducing the random forest algorithm into the evaluation of teacher instructional ability, revealing that the method exhibits high prediction accuracy and effectiveness, providing a reference for the evaluation of teacher instructional ability. Literature [24] proposed a model for evaluating the adaptive teaching ability of college art teachers, emphasized the necessity of evaluating the adaptive teaching ability of teachers by analyzing the teaching demand for teachers in the knowledge era, and established an evaluation system for adaptive teaching ability, and the results of the study are of great significance in terms of theoretical innovation and practical application. Literature [25] introduces the use of data mining software Clementine and introduces data mining technology into teaching management, by extracting the useful information hidden in teaching evaluation data, it examines the key factors affecting the teaching quality and shows that the method can reflect the real ability of teachers and provide decision-making reference for teaching management. Literature [26] designed a model for evaluating teaching performance based on the domain of students' learning readiness under the framework of teachers' good performance, and the results of the study pointed out that the lower level of teachers' performance was related to learning readiness, and developed a teaching evaluation model integrating new evaluation methods from the perspective of improving their performance. Literature [27] aimed to provide a critical review of the ways in which the performance of university teachers is assessed, describing questionnaires that allow for accurate measurements and emphasizing the fact that if the assessment contributes to the improvement of teaching practices, it is preferable to use a constructivist model that facilitates the required changes through reflection. Literature [28] emphasized that the most important purpose of teacher evaluation is to provide teachers with formative feedback, along with the fact that regardless of the model used, it is able to assess teachers' behaviors and strategies well. Literature [29] constructed a corresponding teacher competency evaluation model based on machine learning and digital twin technology, established a data collection model and a data fusion model for teacher professional competency, and the results of the study revealed that the evaluation model showed good performance.

In this paper, the spatial proportion of association degree and dimension attributes in heterogeneous networks is improved, and the heterogeneous network data are balanced. Decision logic theory is introduced to construct a granularity calculation model to explore more association data and hidden data, and the multidimensional data information table of heterogeneous network is defined based on decision logic theory. Using the granularity and granularity group metrics to obtain the data acquisition probability, and through the granularity computation model, the heterogeneous network multidimensional data is mined adaptively, and the multidimensional data warehouse is designed. The multidimensional data mathematical model is solved by simplified logical mathematical formulas, which represent the topological relationship of multidimensional database and spatial multidimensional data structure. Combining simulation experiments and empirical analysis, the application of multidimensional data model in the evaluation of teachers' teaching ability is evaluated.

II. Computational analysis of multidimensional data in the field of education

II. A. Multidimensional Data Mining for Heterogeneous Networks

II. A. 1) Multidimensional data model for heterogeneous networks

The duty cycle of the association degree and dimension attributes in the heterogeneous network is boosted and processed to equalize the nonlinear and structural characteristics of the heterogeneous network data in different storage devices and data servers [30]. Using the multidimensional data attributes of heterogeneous network such as association degree and dimension, the structural information of heterogeneous network data is weakened to redefine the multidimensional association content in heterogeneous network. Define association as the abstract attribute and spatial interaction process of heterogeneous network multidimensional data, and define dimension as the association class between heterogeneous network multidimensional data and each attribute. Heterogeneous network multidimensional association model, as shown in Figure 1.

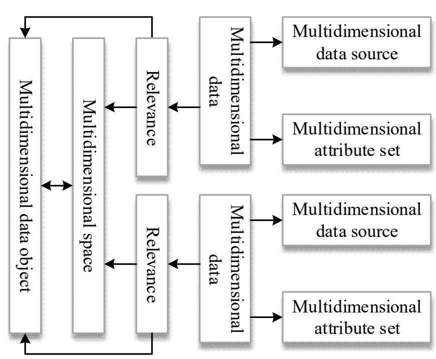

Figure 1: Heterogeneous network multidimensional correlation model

Heterogeneous network multidimensional correlation model with data sharing, storage and management. Taking dimension as the sharing core of heterogeneous network, it improves the uneven duty cycle of server in allocating multi-dimensional data of heterogeneous network. Utilizing the heterogeneous network multidimensional association model to store, query and manage data based on attributes.

The spatial dimension of heterogeneous network multidimensional data is shown in equation (1):

$$\begin{cases} M(D)=\sum_{x=1}^{l(D)} f(x)\,|D|/l(D) \\ D=\{d_1,d_2,\cdots,d_{l(D)}\} \\ f(x)=x\sin\mu \end{cases} \tag{1}$$

where: $M(D)$ denotes the spatial association dimension of the multidimensional data, D denotes the multidimensional data set, $l(D)$ denotes the multidimensional data length, $f(x)$ denotes the multidimensional data association degree, and μ denotes the angle between the dimensions.

The calculation of the multidimensional data association coefficient for heterogeneous networks is shown in equation (2):

$$C=\frac{\sin\mu}{\ln l(D)} \tag{2}$$

where: C denotes the multidimensional data association coefficient.

II. A. 2) Particle size calculation model

(1) Decision Logic Theory

Heterogeneous network structure is complex and multi-dimensional data, in order to mine more associated data and hidden data, decision logic theory is introduced to construct granularity computation model [31], [32]. Decision logic refers to making rational decisions under the uncertainty of future states and expressing them in a classical and unique logic. The decision system Z is described through a two-dimensional numerical table of attributes, which is identified as a unique logic model.

The decision logic formula constraints are:

Condition 1: Define atomic formula (a,v) as a_v, then a_v is a decision logic formula for $\forall a\in A, v\in V_a$. Where: A denotes the concatenation of the set of conditional attributes and the set of decision attributes, V_a denotes the set of attribute values, v denotes the value domain of any attribute a, and $\forall a$ denotes any attribute a.

Condition 2: By expressing the decision logic formulas in terms of φ and ϕ, both $(\phi\vee\varphi),(\phi\wedge\varphi),(\phi\to\varphi),(\phi\equiv\varphi)$ are decision logic formulas.

Condition 3: There are and only have decision logic formulas that satisfy the above qualification condition one and condition two obtained.

(2) Heterogeneous network multidimensional data information table

Define the heterogeneous network multidimensional data information table based on the decision logic theory, as shown in equation (3):

$$Z=(U,A_t,L,\{V_a\mid a\in A_t\},\{I_a\mid a\in A_t\}) \tag{3}$$

where: Z denotes the multidimensional data information table, U and A_t denote the number of multidimensional data objects and the non-empty finite set of attributes, respectively, L denotes the logical theory defined on the basis of A_t, and I_a denotes the heterogeneous network multidimensional data information function.

The heterogeneous network multidimensional data information table contains all the valid information. The atomic formula of L is obtained based on $a=v$, and $a\in A_t, v\in V_a$. The composition formula needs to be realized by logical disambiguation, inverse and ensemble. If the multidimensional data object x conforms to the decision logic formula ϕ, then $x\models\phi$. the set of ϕ in the decision system formula is $m(\phi)=\{x\in U\mid x\models\phi\}$. establish the degree of correlation between a subset of U and the logic theory formula L by means of the characterized multidimensional data object described in $m(\phi)$. In the heterogeneous network multidimensional data information table, the dichotomy of definition $\phi \in L$ is $(\phi, m(\phi))$, and the decision logic theory can be interpreted as the set of objects that conform to ϕ is $m(\phi)$.

(3) Particle size metrics

Particle size metrics include single particle size metrics, double particle size relationship metrics, and particle size and particle size family relationship metrics in three ways.

The single-granularity formula is ϕ, and the single-granularity relative scale $G(\phi)=|m(\phi)/U|$ is obtained by the single-granularity metric $m(\phi)$. The double-granularity formula associated with ϕ and φ is $\phi \to \varphi$, and the strength of the double-granularity formula is quantified to obtain the credibility B_R of the formula ϕ against φ, as shown in Equation (4):

$$B_R(\phi \to \varphi)=|m(\phi \wedge \varphi)|/m(\phi)=|m(\phi) \cap (\varphi)|/m(\phi) \tag{4}$$

The coverage B_C of Eq. φ over ϕ is shown in Eq. (5):

$$B_c(\phi \to \varphi)=|m(\phi \wedge \varphi)|/m(\varphi)=|m(\phi) \cap m(\varphi)|/m(\varphi) \tag{5}$$

Let the family of Eq. φ be $\varphi=\{\varphi_1,\varphi_2,\cdots,\varphi_n\}$, divide it into $\pi(\varphi)=\{m(\varphi_1),m(\varphi_2),\cdots,m(\varphi_n)\}$, and denote the hidden relation between Eq. ϕ and φ as $\phi \to \varphi$. Its probability $P(\varphi|\phi)$ is obtained using the granularity and the granularity group metric as shown in Eq. (6):

$$P(\varphi|\phi)=\left\{\frac{|m(\phi) \cap (\varphi_1)|}{m(\phi)},\cdots,\frac{|m(\phi) \cap (\varphi_n)|}{m(\phi)}\right\} \tag{6}$$

Extending the relational metric of granularity and granularity groups to obtain the metric relation $H(\varphi|\phi)$ for bi-granularity groups as shown in equation (7):

$$H(\varphi|\phi)=\sum_{i=1}^{n} P(\varphi_i|\phi)\lg P(\varphi_i|\phi) \tag{7}$$

Let Eq. ϕ community be $\phi=\{\phi_1,\phi_2,\cdots,\phi_n\}$, divide it into $\pi(\phi)=\{m(\phi_1),m(\phi_2),\cdots,m(\phi_n)\}$, and the cluster of associated families be $\phi \to \varphi$, then the metric relationship $H^{'}(\varphi|\phi)$ of bi-associated communities is shown in Eq. (8):

$$H^{'}(\varphi|\phi)=-\sum_{j=1}^{m}\sum_{i=1}^{n} P(\varphi_i \wedge \phi_j)\lg P(\varphi_i \wedge \phi_j) \tag{8}$$

Mining the multidimensional data of the most interested region in the heterogeneous network by the above formula provides the basis for mining more target data.

II. B.Multidimensional Data Mining for Heterogeneous Networks Based on Granularity Computing

Adaptive mining of heterogeneous network multidimensional data through granularity computational modeling. The bi-granularity group relationship metric algorithm is substituted into the hexadecimal group as shown in equation (9):

$$\phi-\varphi=H\langle U,Z_o,F,R,n,\Lambda\rangle \tag{9}$$

where: H denotes the hexadecimal group, Z_o and F denote the initial state and the granularity space of the structural grain, R and n denote the equivalence constraints and the number of sub-states, respectively, and Λ denotes the data sequence.

Where, the expression of Z_o is shown in Eq. (10):

$$Z_o=\langle A,W,M(\varphi,\phi)\rangle \tag{10}$$

where: W denotes the set of value domains and $M(\varphi,\phi)$ denotes the difference granularity.

Considering the complex structure of the heterogeneous network and multi-dimensional data, when dealing with the structural granularity in the granular information table, the pattern search logarithmic ratio ρ is substituted and ρ is calculated based on the extended formula of the information system as shown in Eq. (11):

$$\rho=\lg|U|^{M_\varphi} \tag{11}$$

where: M_φ denotes the number of patterns in the heterogeneous networked information system.

The search characteristics are obtained by the range of values of ρ. If $0<\rho\leq 1$, then $|M_{\varphi}|\leq|U|$, the rows of the search space are larger than the columns, and the column search effect is superior, and if $\rho>1$, then $|M_{\varphi}|>|U|$, the columns of the search space are larger than the rows, and the row search effect is superior.

Based on the above granularity calculation process, the steps of heterogeneous network multidimensional data mining are as follows:

Step 1: Take the heterogeneous network multidimensional data model as the basis, and substitute into the granularity calculation formula hexadecimal group.

Step 2: Judge the value range of ρ, when $\rho\leq 1$, no need to perform granularity calculation, you can directly output the frequent items set, otherwise, go to the next step.

Step 3: Orderly categorize attribute set A as $P=\{A_1,A_2,\cdots,A_n\}$, substitute sequences $A=\{A_1,A_2,\cdots,A_n\}$ and $A_i=\{A_i,V_i,M(\varphi_i,\phi)\}$ into the granularity algorithm hexadecimal group, and satisfy condition $p_i\leq 1, i=1,2,\cdots,n$.

Step 4: Construct the multidimensional data information table with all sub-states $W_i=H\langle R,U,A_i,V_i,F,M(\varphi_i,\phi)\rangle$, $i=1,2,\cdots,n$, and obtain the compressed object granularity of all sub-states $Z_{G,i}$.

Step 5: Compose the heterogeneous structure granule $OSG(Z_G)=\langle\sigma,V,M,(\varphi,\phi)\rangle$ based on $S_{G,i}$, where σ denotes the compression coefficient.

Step 6: First, reconstruct the heterogeneous network multidimensional data information table to obtain $W'=H\langle R,U,OSG(Z_G),F\rangle$, making $Z_o'=OSG(Z_G)$ in the hexadecimal group of the granularity algorithm, and then, return to the second step to repeatedly mine the multidimensional data to obtain the heterogeneous network multidimensional data mining results.

II. C. Multidimensional database creation

II. C. 1) Data warehouse

Data in a data warehouse is usually extracted from multiple data sources, requiring data conversion and data loading operations. The data sources may be the company's self-developed systems, applications purchased externally, or data from some related departments. The data sources may be about production, advertising, trading, industry trends, etc. The data warehouse regularly extracts data from these applications and systems. Because data may come from multiple data sources, consistency issues such as naming conventions, encoding types, etc. must be addressed. A data warehouse is a database designed to support business intelligence operations. It is primarily used for data mining and analytics, rather than transaction processing, and typically contains historical records derived from transactional data. This helps in maintaining historical records and analyzing data to better understand the business and improve it. In addition, the data in a data warehouse is read-only and it is not possible to update, create or delete data in the warehouse.

II. C. 2) OLAP

OLAP, or Online Analytical Processing, is a subject-oriented computational method for rapid response to multidimensional analytical queries.The implementation of OLAP needs to be carried out on top of data warehouse technology, i.e., a data set is extracted from the data warehouse and a certain amount of data computation is performed to generate a data cube for the front-end visual analytical query.The core of an OLAP system is the OLAP multidimensional dataset, which is composed of metric data that is classified according to dimensionality. The core of an OLAP system is an OLAP multidimensional dataset, which consists of metric data divided by dimension. Multidimensional dataset data is usually created from the star schema or snowflake schema of fact tables in relational databases. Depending on the relationship between the fact table and the dimension tables, when all dimension tables are directly connected to the fact table, it is called a star schema. When there are several dimension tables that are not directly connected to the fact table, but are connected to the fact table through other dimension tables, it is called a snowflake schema

II. C. 3) Data warehouse design

Nowadays, the theoretical research of data warehousing has been relatively mature, and has certain guiding value in the field of database development.OLAP in the process of multidimensional data and storage processing, which mainly relies on the database to realize. The database table can be divided into two categories, one is the related data facts of metrics for the preservation of the fact table, the other is used to describe the dimensional information, the structure of this information is relatively simple. The "fact" can be regarded as the intersection of the dimensions under a certain value, and in the processing, these two tables need to be linked by the main keyword and foreign keyword, so as to provide support for the query results. In the case of more complex dimensions, in order to avoid redundancy in the operation process, it is necessary to expand the dimensional tables into small fact tables, on the basis of which a "hierarchical" region with certain structural characteristics is built up, and this model can provide support for the processing of various aspects of its users' requests.

II. D. Computational model solving for multidimensional data

II. D. 1) Mathematical modeling of spatial multidimensional data

In this paper, various multidimensional databases and spatial multidimensional data structure topology diagrams are represented by simplified logical mathematical formulas, which can be solved computationally by establishing a mathematical model.

The mathematical model of one layer of spatial multidimensional data is obtained from the above equation as:

$$\sum x(i) \xrightarrow{\{h1\}} x(1)x(2)\cdots x(n) \tag{12}$$

$\sum x(i)$ refers to the fact table. $\xrightarrow{\{h1\}}$ means the equation corresponding to the containment relation "1" in the first layer of the dimension table means the first layer, and "$h1$" in the equation means the first layer of the set of spatial distance matrices. Together they are read as "spatial layer 1 distance inclusion dimension table". x is the name of the time dimension table and (n) is the serial number of the dimension table.

Similarly, the mathematical model of two-layer spatial multidimensional data is:

$$\sum x(i) \xrightarrow{\{h2\}} \sum x(i,i) \tag{13}$$

This leads to the n-layer spatial multidimensional data mathematical model equation as:

$$\sum x(i) \xrightarrow{\{hn\}} \sum x(i,\cdots,i) \tag{14}$$

From Eq. (12) to Eq. (14), the mathematical formula for multidimensional data in full architecture space is derived as:

$$\sum x(i) \xrightarrow{\{h1\}} x(1)x(2)\cdots_x (n) \xrightarrow{\{h2\}} \sum x(i,i)\cdots \xrightarrow{\{hn\}} \sum x(i,\cdots,i) \tag{15}$$

II. D. 2) Mathematical Model Decomposition of Spatial Multidimensional Data Merging Equation

Multidimensional databases often have a need to streamline dimension tables or a need to add dimension tables, Figure 2 shows the topology of a single-tier multidimensional database where a reduction in dimension tables occurs.

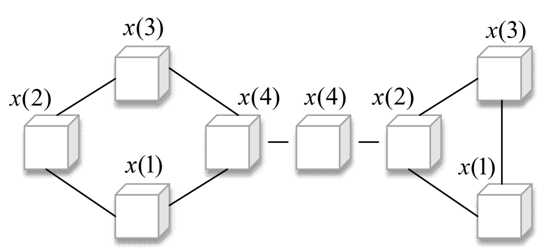

Figure 2: Single-layer multidimensional database dimensional table

The multidimensional database reduces a dimensional table formula is derived as follows:

$$V \xrightarrow{1} \sum y(i) / \sum x(i) \xrightarrow{1} \sum x(i) \pm x(4) / x(1)x(2)x(3)x(4) \tag{16}$$

where $\sum y(i)(i=1,2,\ldots,n)$ is the set of new dimension tables after the change in the multidimensional database.

Correspondingly, the results of the network model deduced by adding a dimension table to a single-tier multidimensional database are shown in Fig. 3:

$$V \xrightarrow{1} \sum y(i) / \sum x(i) \xrightarrow{1} \sum x(i) \pm x(4) / x(1)x(2)x(3)x(4) \tag{17}$$

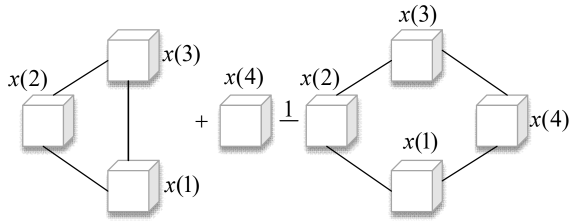

Figure 3: Single-layer multidimensional database adds a dimension

Similarly, decomposition and merging models for multilayer multidimensional databases can be derived:

$$\sum y(i) \xrightarrow{n} \sum x(i,\cdots,i) \pm \sum x(k,\cdots,k) \tag{18}$$

Where: $(k=1,2...n)$ is the number of sets of multidimensional databases that can be added or subtracted for all layers.

Similarly, the decomposition and merging model formulas for spatial multidimensional data can be derived from the decomposition and merging model formulas for multidimensional databases:

$$\sum y(i) \xrightarrow{\{hn\}} \sum x(i,\cdots,i) \pm \sum x(k,\cdots,k) \tag{19}$$

III. Evaluation of Teachers' Teaching Ability under Multidimensional Data Analysis Modeling

III. A. Multidimensional analysis and evaluation system of teachers' teaching ability

III. A. 1) Multidimensional analysis model

Multidimensional data analysis is the observation and analysis of data from multiple dimensions and perspectives. By slicing, dicing, aggregating, drilling, rotating and other analytical operations on data organized in multidimensional forms in order to dissect the data. The assessment system of multidimensional analysis of teachers' teaching ability can be used to establish the analysis of discipline-related dimensions and indicator values, to visually and clearly understand the role of the form and content of the work of the discipline, and to provide a direction for guiding the improvement and optimization of the work of the discipline.

III. A. 2) Data warehouses corresponding to multidimensional data models

In the dimensional model of the data warehouse fact tables and dimension tables, the data to be analyzed is transformed into specific forms based on the actual need to form visual charts.

The dimension tables contain attributes and hierarchies, and four dimension tables were created based on the needs of the analysis: the "Time ___ Dimension Table," the "Teacher ___ Dimension Table," the "Course ___ Dimension Table," and the "Student_Dimension_Sheet", which identifies how each indicator measure is affected by each dimension at the same time granularity and scope through the time dimension. The "Student_Dimension_Sheet" is linked to the "Ideological_Political_Education_Dimension_Sheet". The different dimensions and metrics were continuously observed and adjusted until the data were found to be useful for analyzing the impact of the length and format of subject matter instruction on student achievement and classroom effectiveness.

III. B. Modeling of Teachers' Teaching Competence Assessment

III. B. 1) Preparation of the analytical environment

According to the available hardware resources, the size of the data volume, and the adequacy of the research funds, prepare the appropriate analysis environment. How to choose the analysis environment can be judged based on the following conditions: in the case of limited hardware resources, small amount of data, and lack of research funds, a single PC can be chosen as the analysis environment; in the case of a certain amount of hardware resources, but lack of research funds, a server + open source software can be chosen as the analysis environment; in the case of sufficient hardware resources and research funds, a server + commercial software can be chosen as the analysis environment; in the case of sufficient hardware resources, research funds, and a large amount of data, Hadoop big data can be chosen as the analysis environment. In the case of sufficient hardware resources and research funds and a large amount of data, Hadoop big data platform can be chosen as the analysis environment.

After determining the analysis environment can correspond to the analysis software for data ETL operations and construction of multidimensional models, such as MySQL, PostgreSQL as a representative of the open source database and SQLServer, Oracle as a representative of the commercial database can be selected, you can also choose Excel or use SQL, Python and other computer languages for data analysis and Demonstration.

III. B. 2) Data ETL operations

ETL is used to describe the process of extracting, transforming, and loading data from the source to the target system.The main idea of ETL operation is to identify the available data sources and configure the links to the data sources so that the anomalous data can be found and the data cleansing strategy can be formulated, and then select the mature ETL tools to perform the cleansing and load the cleansed data into the target system.

III. B. 3) Constructing multidimensional analysis models

The data cleaned by ETL operation is the basic data for constructing the multidimensional analysis model, and the construction of the multidimensional analysis model can be completed through four steps: first, linking to the data cleaned by ETL, second, defining the structure of the model dimension table and the fact table, and constructing the relationship between the dimension table and the fact table, third, deploying the multidimensional model in the multidimensional database, and finally analyzing and processing the data in the multidimensional model.

IV. Evaluation of the outcomes of the assessment of teachers' teaching competence using multidimensional modeling

IV. A. Experimental research

IV. A. 1) Experimental preparation

In order to analyze the validity of the teacher's teaching ability assessment model based on multidimensional data computational model, it was compared with the existing model to test the effectiveness of the model application.

Firstly, the experimental analysis platform is built with the following parameters and configurations: the operating system is Windows 10, the programming tool used is Python, and the CPU, memory, hard disk, and graphics card are Intel i5-10400, DDR4 16GB, 256GB SSD + 1TB HHD, and integrated graphics card respectively.

Teachers and teaching competence in this experiment indicate the relationship between the average profile factors. Determine the value of teaching competence of each teacher, as shown in Figure 4, where 1-6 indicate teachers 1-6, respectively, and teacher 6 has the highest value of teaching competence, and the value of competence of the six assessment factors is 56.82, 68.81, 79.21, 89.62, 85.55, and 80.12, respectively. According to the teaching competence of the different teachers, the strength of the influence of the competence indexes was further analyzed, and the weights of each assessment index were determined .

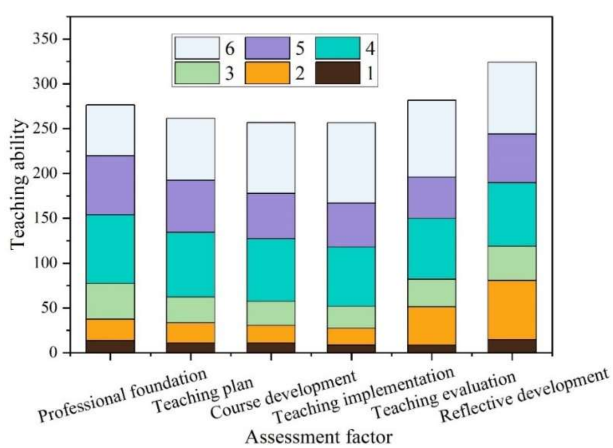

Figure 4: The teaching ability of different teachers is compared

IV. A. 2) Data sources

A total of 320 undergraduate students of the same major, the same grade but different classes taught by teachers of a university course in Sichuan Province were selected from the data warehouse by means of multidimensional data calculation, and 60 full-time professional teachers were selected as the survey samples by means of stratified sampling (four strata of professors, associate professors, lecturers and teaching assistants) and simple random sampling, and subjects rated their teaching ability according to the corresponding indexes of the evaluation index system of teaching ability of teachers of universities, and each index was divided into five grades of “excellent, good, average, poor and poor”. Subjects rated the teaching ability of teachers according to the corresponding indexes in the index system, and each index was divided into five grades of “excellent, good, average, poor, very poor", corresponding to the scores of 100, 80, 60, 40, and 20. Finally, after eliminating the invalid samples, the students evaluated 300 valid samples and categorized them as "good, good, average, poor, and very poor". Finally, after eliminating the invalid sample data, the student evaluation obtained 300 valid test samples, which were divided into 10 data sets with 30 data samples in each group, and the professional teacher evaluation obtained 60 valid test samples, which were divided into 10 data sets with 6 data samples in each group. The statistical results of the basic information of the sample data calculated by multidimensional data are shown in Table 1, the second largest class has the highest number of students with 25.67% of valid percentage.

Table 1: Sample data basic information statistical results

Attribute	Categories	N	Effective percentage /%
Gender	Male	155	51.67%
	Female	145	48.33%
Class	First class	75	25.00%
	Second class	77	25.67%
	Third class	75	25.00%
	Fourth class	73	24.33%
Teacher			
Attribute	Categories	N	Effective percentage /%
Gender	Male	40	66.67%
	Female	20	33.33%
Job title	Professor	15	25.00%
	Associate professor	15	25.00%
	Lecturer	15	25.00%
	Teaching assistant	15	25.00%

IV. A. 3) Effectiveness tests for the assessment of teachers' teaching competencies

In order to analyze the advantages of the assessment model of teachers' teaching ability based on multidimensional data analysis model and compare it with the existing assessment model, the precision of the assessment of teachers' teaching ability in each school was calculated. Normally α takes the value of 1, at which time the same importance is attached to precision and recall, i.e., the larger the value of F1, the more effective the model is. The test results of different models are shown in Figure 5.

This design model has certain advantages in both precision rate and recall rate. Further comparing the F1 value, the F1 value of the model constructed based on multidimensional data analysis is 0.94, which is higher than the existing model by 0.09 and 0.08, which proves that the model output results have higher precision and better quality, and the assessment effect is improved.

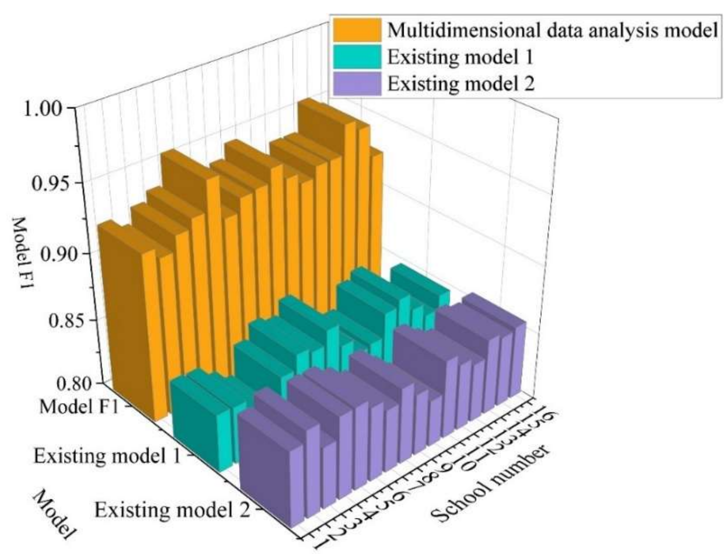

Figure 5: Comparison results of model F1 values

IV. A. 4) Comparison of the accuracy of evaluation results

The evaluation model based on the existing model 1 and the existing model 2 constructed by the evaluation model of teaching ability of college teachers were used to test their sample data respectively, and the results of the calculation accuracy rate of the two different methods were obtained.Fig. 6 shows the comparison of the evaluation accuracy rate, and the average of the student evaluation accuracy rate of the evaluation model of the two different existing machine learning algorithms were 90.7% and 87.12%, respectively, and the multidimensional data analysis model was 3.37% and 6.95% higher than the existing model 1 and 2 evaluation accuracy is 3.37% and 6.95% higher.

The average of the peer evaluation accuracy of the evaluation models of the 2 different available machine learning methods was 90.71% and 88.86%, respectively, and the multidimensional data analysis model was 2.4% and 4.25% higher than the remaining two models

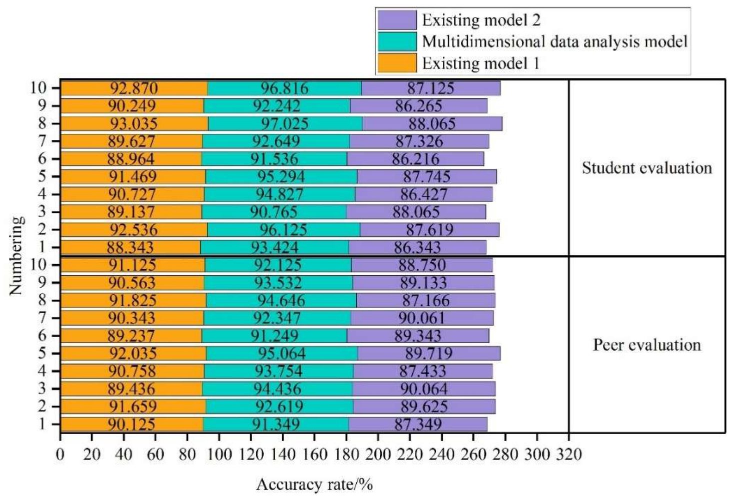

Figure 6: Comparison of evaluation accuracy

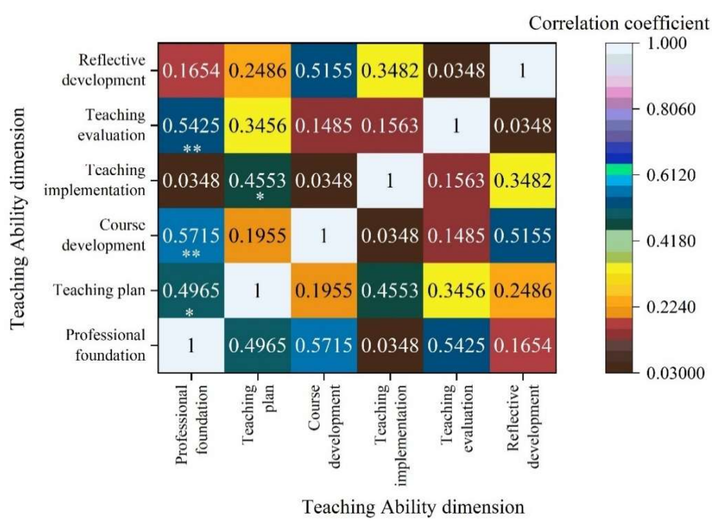

Figure 7: The ability frame six latitude correlation analysis

Note: ** in the figure represents the significance level p<0.01, * represents p<0.05.

IV. B. Assessment of Teachers' Teaching Competence

IV. B. 1) Capability dimension relevance

Pearson's correlation test was conducted to evaluate the importance of the six dimensions of the competency framework, and it was found that among the six dimensions, the correlation between several latitudes is still relatively high.The correlation statistics between the six dimensions are shown in Figure 7.

The correlation between professional foundations and curriculum development (0.57), instructional evaluation (0.54) is high, and the correlation with instructional programs (0.5) is relatively high. The correlation between instructional planning and instructional implementation (0.4553) is relatively high. It can be seen that the development of awareness of educational technology and teaching application is still important. With positive emotional attitudes, it will be transformed into actions, learning knowledge and skills, consciously carrying out teaching design and teaching research, and promoting the development of teachers' teaching ability.

Table 2: The importance and regularity of teaching planning and implementation ability

Serial number	Ability entry	Crit-M	SD	Freq-M	SD
1	Realize the important role of education technology application in optimizing teaching	4.2152	0.8155	3.9452	0.7854
2	Recognizing that education skills are part of the ability of teachers	3.5252	0.7615	3.5165	0.7158
3	Awareness of the application of education technology in teaching	3.8153	0.9548	3.5636	0.8152
4	The application of education technology changes the awareness of existing teaching methods	3.6152	0.8135	3.4415	0.7615
5	The new development of education teaching thought theory	3.9152	0.7528	3.8436	0.8615
6	We will apply new teaching ideas and promote teaching reform	3.7652	0.8736	3.6425	0.8158
7	We have the consciousness of continuous learning and perfecting our own quality structure	3.8153	0.8615	3.7485	0.8435
8	The concept and consciousness of lifelong learning	3.9125	0.8621	3.8436	0.8945
9	Norms and techniques for using related expressions and behaviors	3.8152	0.6615	3.9166	0.7058
10	To learn the relevant laws and regulations and moral knowledge of information technology	3.8423	0.6812	3.8285	0.7612
11	Try to reduce the negative influence of technology and cultivate the students' information literacy	3.9315	0.6135	3.8166	0.6248
12	Promote students to safely use learning resources	3.6486	0.6248	3.5215	0.7158
13	Strive to make all students good	3.6482	0.8138	3.9485	0.7054
14	Promote students to safely use learning resources	3.8165	0.7058	3.7589	0.7348
15	Understanding the definition of education technology	3.6252	0.4725	3.6248	0.5156
16	Understanding the main theoretical basis of education technology	3.7152	0.6512	3.4385	0.6548
17	The main research method of education technology	3.7256	0.5423	3.6848	0.5548
18	Understanding the main basic theories of teaching and learning	3.2485	0.8425	3.2488	0.8313
19	Understanding the main important method of teaching process management	3.7458	0.7348	3.6987	0.6945
20	Understand the evaluation method of student learning	3.4956	0.9154	3.5548	0.9158

IV. B. 2) Analysis of key indicators of capacity

Important competency entries were analyzed for the six dimensions of the competency framework. Table 2 shows the importance and recency of instructional planning and implementation competencies, and Table 3 shows the importance and recency of professional foundations and curriculum development competencies.As can be seen in the above table, there is a slight difference in the ratings of importance and recency, but the overall trend is the same. Overall curriculum development competencies are considered very important, followed by instructional planning and implementation competencies, which have an importance and recency of 3.8, 3.72, 3.74, and 3.68, respectively.The standard deviations in the table are derived from the differences in the competency ratings by the multidimensional data analysis model, and the magnitude of the standard deviation reflects the degree to which the model agrees on the competency.

Table 3: The importance and regularity of professional foundation and course development ability

Serial number	Ability entry	Crit-M	SD	Freq-M	SD
21	Can choose teaching resources according to the teaching of this subject	3.4855	0.5845	3.5152	0.5845
22	To classify and organize the teaching resources	3.6453	0.5752	3.7156	0.6758
23	Teaching resources for technical assistance to help lower education requirements	3.6425	0.4988	3.6248	0.5804
24	Methods of evaluating the application of teaching media and teaching resources	3.4155	0.5655	3.5233	0.6315
25	To master the evaluation method of teaching and learning activities	3.6485	0.6425	3.5563	0.6348
26	The evaluation method of mastering the application of technical teaching	3.5648	0.6348	3.6485	0.6455
27	Skills in teaching management of disciplines with technology	3.4855	0.6525	3.6288	0.7015
28	Familiar with the use of the school's teaching information management system	3.5844	0.5185	3.4285	0.5785
29	Understanding the method of analyzing the process information analysis of the subject	3.4855	0.6515	3.3486	0.6345
30	To understand the method of analyzing the behavior information analysis of students	3.6488	0.7155	3.6485	0.7048
31	Comprehensive consideration of subject characteristics and other factors	4.4158	0.7558	4.0485	0.7468
32	Take into account the characteristics of the subject and so on, take the teaching method	4.2485	0.6425	4.0486	0.6755
33	Fully use various resources and design effective learning activities	4.0455	0.7048	3.8485	0.7048
34	The design is centered on students, which is conducive to the learning environment of interactive interaction	4.2485	0.7348	3.9466	0.7465
35	Full use of various resources to build personalized learning space for students	3.8415	0.7058	3.7155	0.6755
36	To develop the students' initiative and create the learning environment of independent exploration	4.1522	0.6648	4.0452	0.7985
37	Effective teaching method strategy organization to implement teaching and learning activities	3.7855	0.6545	3.6485	0.7455
38	Effective management of teaching resources and teaching activities	3.9655	0.6695	3.8458	0.7045
39	Try to solve the problems encountered in the technical environment	3.8184	0.7455	3.7485	0.6158
40	Actively seek solutions to problems encountered in the course integration process	3.9485	0.6415	3.8485	0.7055

Note: In the table above, Crit-M represents mean importance, Freq-M represents mean frequency, and SD represents standard deviation.

IV. B. 3) Differences in capability dimensions

The six dimensions of the competency framework were used as dependent variables for the analysis of differences in importance and recency, and further univariate F-tests were conducted, Figure 8 shows the differences in importance and recency of the six dimensions of the competency framework, and the results were that there was no significant difference in the mean values of importance and recency for the three items of instructional planning, instructional implementation, and instructional evaluation, and that there was a more significant difference in the mean values of importance and recency for the foundation of professionalism, with an F-value of 10.215. P<0.01, and the difference between the importance and recurrent means of curriculum development and reflective development was highly significant with F-values of 24.486 and 25.448, respectively, and the significance P were less than 0.001.

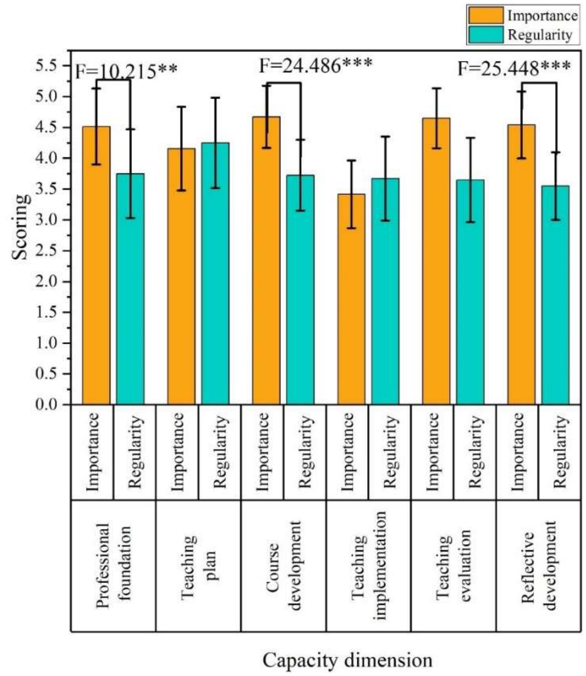

Figure 8: 6 dimensions of the capability frame and the constant differences

Note:*** represents the significance level p<0.001, ** represents p<0.01.

V. Conclusion

In this paper, we utilize the granularity computing model to implement the mining operation on the heterogeneous network multidimensional data, establish a multidimensional data warehouse with the data obtained from multimining through OLAP technology, and solve the multidimensional data computing model by simplifying the logical mathematical formulas.

Constructing the multidimensional analysis and assessment system of teachers' teaching ability, comparing it with the existing model and testing the application effect of the model, among teachers 1-6, teacher 6 has the highest value of teaching ability, and the ability values of the six assessment factors are 56.82, 68.81, 79.21, 89.62, 85.55 and 80.12 respectively.The F1 value of the model constructed on the basis of the multidimensional data analysis is 0.94, which is higher than that of the existing model by 0.09 and 0.08 respectively, indicating that the model output results have higher precision and better quality and the assessment effect is improved.

Implementing the example assessment of teachers' instructional competencies, overall curriculum development competencies were considered very important, followed by instructional planning and instructional implementation competencies, which had an importance and recency of 3.8, 3.72, 3.74, and 3.68, respectively.Assessing the variability of competency dimensions, the difference in the mean values of the importance and recency of curriculum development and reflective development was highly significant, with F-values of 24.486 and 25.448, both significant p less than 0.001.

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