Computer-Aided Teaching System Design Method for Information Design Specialty

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Abstract. Due to the differences between college students, students' personalized needs can not be met, which exposes the disadvantages of traditional classroom teaching. This paper takes the computer-aided teaching of information design as the research goal. According to the needs of enterprises and students, through the combination of cluster analysis and computer-aided teaching, this paper studies the teaching content and student characteristics of "information design", and integrates it into apt teaching mode. Different students have different learning characteristics, the index system of College Students' personalized learning characteristics is constructed. Through cluster analysis, the students in the "information design" class of the school are divided into stable students with excellent performance, sub excellent expansion students, middle potential students and general promotion students. Four categories. Combined with the teaching contents and students' different needs in the computer-aided teaching of "information design", the apt information teaching mode is introduced, and the teaching objectives, teaching resources, teaching methods and teaching evaluation are preliminarily analyzed to explore the computer-aided teaching based on apt.

Keywords: Computer-Assisted Teaching; Colleges and Universities; Cluster Analysis; APT Teaching Model.
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1 INTRODUCTION

The national school administration has issued the requirements for the future development planning of educational information, which pointed out that the cultivation of students' learning ability should be combined with information design [1]. Facing managers, big data platforms can use data mining, text analysis and algorithm models. Schools, educational institutions and other

managers use big data technology to realize information management innovation [2]. The development of farmers is inseparable from the development strategies formulated by the party. In the past analysis of rural development and reform, there are often different reform paths [3]. The implementation of rural revitalization requires vocational education to provide talent support, which can not only promote the innovative development of vocational schools, but also help vocational education achieve high-quality development in the future. In order to cultivate students' subjective initiative, according to different teaching contents and characteristics of students, taking into account the individual differences of students, comprehensive assessments are carried out, learning performance, practical application, independent learning and collaborative innovation, so as to promote students Personalized development. Therefore, it can be found that it is of great significance to implement computer-aided teaching for the "Information Design" course for secondary vocational schools [4].

2 STATE OF THE ART

The earliest computer-aided teaching theory in my country comes from Confucius' "Teaching students according to their aptitude". He pointed out that in addition to differences in age, gender, source, etc., students also have differences in intelligence and ability. In modern times, Li et al. [5] also promoted the idea. The above two famous domestic educators pointed out that we should start from the actual situation of students, conscientiously implement the characteristics of students, and realize the development of individuality. Maïano et al. [6] found that China pays more and more attention to computer-assisted instruction research. The content of domestic Cai research mainly focuses on teaching reform, teaching application, educational data and teaching design, rising from theoretical research to practical application research. In terms of teaching reform, Li and Liao [7] aimed at the contradiction between large-scale teaching in traditional classrooms and the individual needs of learners, and effectively used Internet technology in educational practice to carry out education supply-side reforms both horizontally and vertically8. In terms of teaching application, Romlah et al. [8] applied electronic schoolbags in junior high school physics classroom teaching, carried out innovative research, and carried out hierarchical teaching. The quality of education and teaching has been improved; Coley et al. [9] explored the computer-aided instruction design based on the multi-level scoring rule space model for the problem that students' knowledge mastery cannot be accurately evaluated, and found through the result analysis that it can effectively improve the teaching effect. In terms of educational data, Guo et al. [10] collected and analyzed the relevant data of learners, predicted and optimized teaching, so as to provide effective technical support and implement computer-aided teaching". In terms of teaching design, Aguilar et al. [11] designed a "three-stage ten-step" teaching process, which was integrated into three stages, as well as ten teaching steps such as performing learning situation analysis, so as to build a personalized learning model for smart classroom students.

Aiming at the problem of university teaching platform, according to students' personalized learning needs and teachers' computer-aided teaching evaluation needs, online teaching for teachers and students [12], a computer-aided teaching system was designed and implemented; [13] Combined with the teaching practice of colleges and universities, it provides computer-aided teaching services by using educational data, constructs and applies a personalized learning environment, and improves the learning effect of students. Aiming at the phenomenon of different levels of college students' learning situation, according to the characteristics of students, starting from multiple dimensions, in-depth research on the types of college students' learning behaviors, and based on learning analysis, a computer-aided teaching model is constructed.

3 METHODOLOGY

3.1 Overview of Research-Related Theories and Technical Applications

With the help of information design, the APT teaching model deeply integrates technology and courses, based on teaching content and student characteristics, with evaluation as the leading role, teaching method as the basis, and information design as the support, combining teaching evaluation (Assessment), teaching method (Pedagogy) and Modern technology (Technology) has been fully and organically integrated to carry out teaching. Helps to develop students' learning initiative; helps to extend learning time and expand the role of collaborative learning; helps to increase and is conducive to the diversification methods; helps to integrate teaching resources and is conducive to Improve the teaching evaluation system.

3.2 Factor Analysis

Factor analysis is a multivariate simplification technique. Its specific method is to analyze the original variables, summarize some unpredictable, irrelevant but dominant common factors, and rotate the common factors to reduce the mutual influence between the factors. Factor models describe the original set of predictable correlated variables whose purpose is to reasonably explain the correlations between the original variables. The formula for factor analysis is as follows:

$$X_i = a_{i1}F_1 + a_{i2}F_2 + \cdots + a_{im}F_m + \varepsilon_i, i = 1, 2, \cdots, p. \tag{1}$$

It can be represented by a matrix as:

$$X = AF + \varepsilon \tag{2}$$

In formula (1), F_1, $F_2, \ldots,$ F_m is a common factor, and in formula (2), ε_i is X_i a special factor of

$$h_i^2 = \sum_{j=1}^{k} a_{ij}^2 (\mathrm{i} = 1, 2, \ldots, \mathrm{p}) \tag{3}$$

h_i^2 is the common degree of variables, which represents the contribution of all main factors to the variance of the original variable $\left(\mathrm{Var}\left(X_i\right)\right)$, and measures F_j the degree of influence on X_i ;

$$g_j^2 = \sum_{i=1}^{p} a_{ij}^2 (\mathrm{j} = 1, 2, \ldots, \mathrm{k}) \tag{4}$$

g_j^2 represents the variance contribution rate of the main factor F_j to the original variable $x1, x2, \ldots, xp$

3.3 Cluster Analysis

Cluster analysis is to distinguish different types of data objects through the feature similarity between data objects, but to accurately obtain the feature similarity between data objects, it is necessary to measure the similarity between data objects to obtain features quantified results. At present, there are three main similarity measures, namely distance measure, similarity measure and matching measure, and the most widely used is distance measure. The distance measure uses the distance between the data objects as the feature similarity measure of the data objects. Assuming that there is a dataset D containing n data objects, $D = \left\{x_1, x_2, \ldots, x_n\right\}$, the dimension of the data objects is M dimension, the following are several commonly used distance measurement formulas:

(1) Euclidean Distance

$$d\left(\mathbf{x}_i,\mathbf{x}_j\right)=\left\|\mathbf{x}_i-\mathbf{x}_j\right\|=\sqrt{\sum_{m=1}^{M}\left(x_{im}-x_{jm}\right)^2} \tag{5}$$

(2) Manhattan Distance

$$d_{\text{man}}\left(\mathbf{x}_i,\mathbf{x}_j\right)=\sum_{m=1}^{M}\left|x_{im}-x_{jm}\right| \tag{6}$$

(3) Chebyshev Distance

$$d_{che}\left(\mathbf{x}_i,\mathbf{x}_j\right)=\max_{1\le m\le M}\left(\left|x_{im}-x_{jm}\right|\right) \tag{7}$$

(4) Minkowski Distance

$$d_{mk}\left(\mathbf{x}_i,\mathbf{x}_j\right)=\left(\sum_{m=1}^{M}\left(x_{im}-x_{jm}\right)^p\right)^{\frac{1}{p}} \tag{8}$$

Among them, the "Minkowski distance" is the "Manhattan distance"; the "Minkowski distance" is the "Euclidean distance"; at that time, the "Minkowski distance" ” is the “Chebyshev distance”.

The main function of the internal validity index is to describe the close relationship between the internal structure of the data set and the data, and to evaluate the effectiveness of the algorithm by calculating the clustering results through a specific objective function. Several common clustering effectiveness metrics are described below.

(1) DB Index

$$\text{DBI}=\frac{1}{k}\sum_{i=1}^{k}\max_{j\ne i}\left(\frac{\text{avg}\left(C_i\right)+\text{avg}\left(C_j\right)}{d\left(v_i,v_j\right)}\right) \tag{9}$$

avg(C,) represents the average distance between data sample points in the ith cluster, C, represents the ith cluster in the clustering result, v, represents the ith class The cluster center of the cluster.

(2) Dunn index:

$$\text{DI}=\min_{1\le i\le k}\left\{\min_{j\ne i}\left(\frac{d_{\min}\left(C_i,C_j\right)}{\max_{1\le 1\le k}\delta\left(C_l\right)}\right)\right\} \tag{10}$$

(3) COP indicator

$$\text{COP}=\frac{1}{n}\sum_{C_i\in C}\frac{\sum_{x_j\in C_i}d\left(\mathbf{x}_j,\mathbf{v}_i\right)}{\min_{x_l\notin C_i}\max_{x_j\in C_i}d\left(\mathbf{x}_l,\mathbf{x}_j\right)} \tag{11}$$

(4) CH Index

$$\text{CHI}=\left(\frac{\sum_{i=1}^{k}\left|C_i\right|d\left(\mathbf{v}_i,\mathbf{v}\right)^2}{k-1}\right)\Big/\left(\frac{\sum_{i=1}^{k}\sum_{x\in C_i}d\left(\mathbf{x},\mathbf{v}_i\right)^2}{n-k}\right) \tag{12}$$

(5) Silhouette Coefficient

$$\text{SIL}=\frac{1}{n}\sum_{i=1}^{n}s(i) \tag{13}$$

$$s(i)=\frac{b(i)-a(i)}{\max\{a(i),b(i)\}} \tag{14}$$

$$a(i)=\frac{\sum_{i\neq j,x_j\in C_i} d\left(\mathbf{x}_i,\mathbf{x}_j\right)}{\left|C_i\right|},b(i)=\min_{1\le j\le k,j\neq i}\left\{\frac{\sum_{l\in C_j} d\left(\mathbf{x}_i,\mathbf{x}_l\right)}{\left|C_j\right|}\right\} \tag{15}$$

Among the above five clustering effectiveness indicators, DBI and cop belong to the minimum indicators.

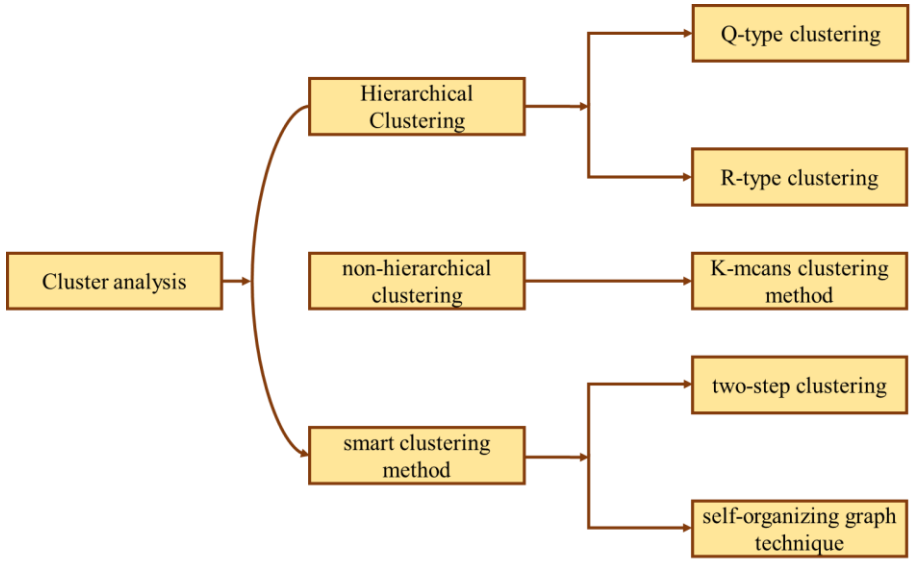

Figure 1: Cluster analysis method.

As shown in Figure 1, there are three types of cluster analysis methods. The first type is hierarchical clustering method, which is divided into Q-type clustering and R-type clustering according to the method of clustering individuals or variables; the second type is non-hierarchical clustering method. Class method, namely K-means clustering; the third type is intelligent clustering, namely two-step clustering method and self-organizing graph technology.

4 RESULTS

4.1 The Application of Cluster Analysis in Student Differences

Through the above analysis of the learning characteristics of college students and discussions with front-line teachers and off-campus experts, we have selected 6 first-level indicators as the content of the survey, reflecting the personalized learning characteristics of college students, including learning motivation, learning foundation, Learning interest, autonomous learning ability, collaborative learning ability and students' mastery degree can better reflect the differences of college students. By using the Likert five-point scale, the "Investigation and Research on the Influence of Student Differences on Computer-Assisted Teaching in Colleges" was compiled, see Table 1.

Learning motivation	*Students' personalized learning characteristics*	*Very eligible*	*Eligible*	*Generally eligible*	*Ineligible*	*Very ineligible*

Learn basic	The secondary indicators			√	
Learning motivation	Enters a higher school		√		
	Textual research				√
	employment			√	
	entrepreneurship			√	
Learning motivation	Mid-term exam achievement	√			
Learning motivation	To be in a good mood				√
	Full of energy			√	
	Pay attention to the information		√		
Autonomous learning ability	A study plan			√	
	Preview before class			√	
	Strengthen practice			√	
	Review after class				√
	Self-assessment				√
	Resource utilization	√			
Collaborative learning ability	Collaborative attitude			√	
	Collaboration will		√		
	Expressing opinions				√
	Listen to the opinions			√	
	Coordinate the task				√
	To share information		√		
Student mastery level	Information technology at the beginning				√
	Advanced information technology		√		

Table 1: Investigation and research on the impact of student differences on computer-aided teaching in colleges.

The Cronbach Alpha coefficient of the student questionnaire is 0.937, which shows that the reliability of the questionnaire is very ideal and the reliability is very high.

KMO and Bartlett tests	
KMO sampling suitability quantity	0.94

Bartlett's sphericity test,	The approximate chi-square	5181.524
	Degrees of freedom	276
	significant	0

Table 2: KMO and Bartley test of Student Difference Questionnaire.

As shown in Table 2, the coefficient of KMO is 0.94>0.7, and the significance is 0.000<0.05, indicating that the validity of the student difference questionnaire is very high.

4.2 Cluster Analysis Based on the Characteristics of Personalized Learning of College Students

The task of university information design course is the country for the training strategy of information talents, to cultivate students into all-round development of technical talents, and to the employment of students after graduation. Therefore, cluster analysis is carried out in combination with the characteristic variables of students' personalized learning. The key technology of the two-step clustering algorithm is shown in Figure 2.

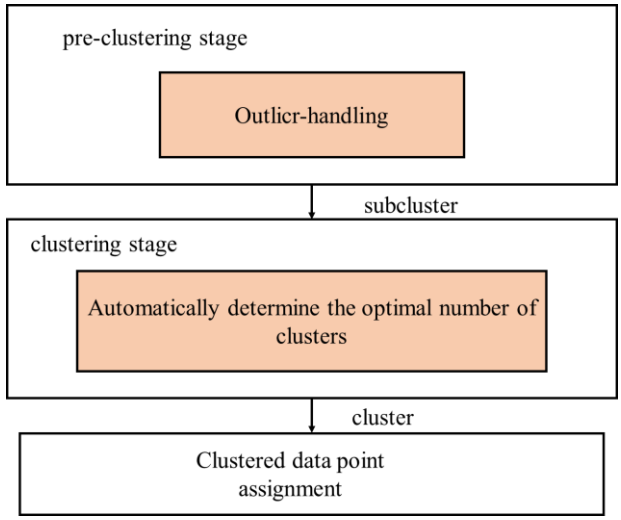

Figure 2: The key technology and process of two-step clustering.

In the application stage of students' personalized data, a two-step clustering method is used to classify the students, and the categories of students after the application of the clustering algorithm classification process are obtained. The results of the two-step clustering are now displayed as a model, and you can see that the 239 students are clustered into 4 categories and view the detailed results of the two-step clustering through the model browser window.

Figure 3 shows the parameter information under different model states. Through the cluster analysis of different states, the two-stage state is obtained. The main model reference series have different references for quality analysis.

Figure 3: Main view model of two-step clustering.

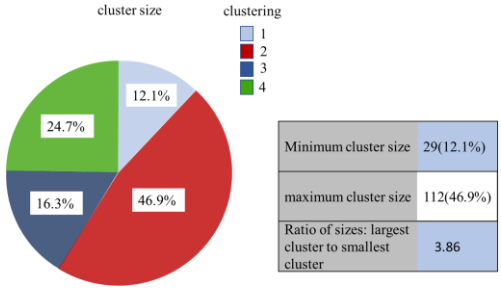

Figure 4: Auxiliary view model for two-step clustering.

As shown in Figure 4, the auxiliary view cluster size is clustered into 4 categories. The proportion of the first type of cases in the valid sample is 12.1%, the second type is 46.9%, the third type is 16.3%, and the fourth type is 24.7%.

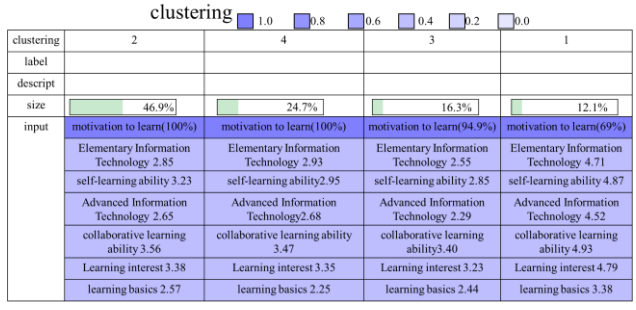

Figure 5: Main view clustering features of two-step clustering.

As shown in Figure 5 is the main view clustering feature description, give the center points or distributions of each class on different indicators, and give the main distribution characteristics of each variable in each class.

		The case number	*Percentage of the portfolio*	*Percentage of the total*
clustering	1	29	12.10%	12.10%
	2	112	46.90%	46.90%
	3	39	16.30%	16.30%
	4	59	24.70%	24.70%
	combination	239	100%	100%
Total		239		100%

Table 3: Student cluster distribution.

As shown in Table 3, 239 university students were divided into four categories. The first class has 29 students, the second class has 112 students, the third class has 39 students, and the fourth class has 59 students.

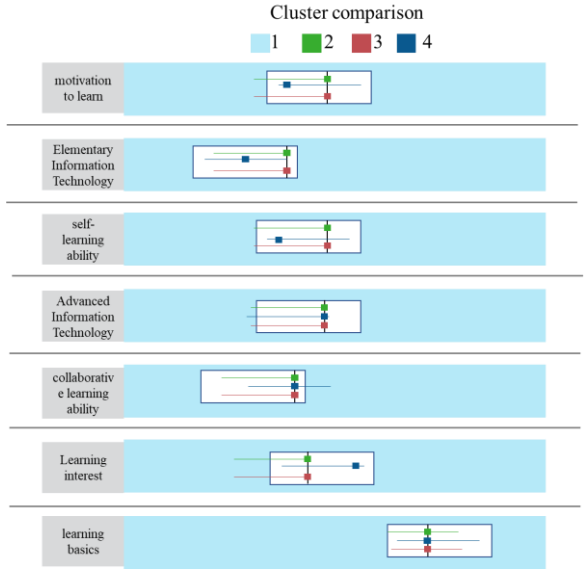

Figure 6: Clustering characteristics of students.

As shown in Figure 6, it is the characteristics of the four categories of students in terms of learning foundation, learning interest, autonomous learning ability, collaborative learning ability, primary information design and advanced information design, which can better reflect the relationship between students. Table 4 shows the learning motivation of each type of students.

		Study hard and move up to a higher position		*Get certificates and develop professional skills*	
		frequency	percentage	frequency	percentage
clustering	1	20	15.20%	9	13.20%
	2	12	84.80%	0	0.00%

3	0	0.00%	0	0.00%
4	0	0.00%	59	86.80%
combination	132	100.00%	68	100.00%
	Get a good job		Start my own business and serve the rural revitalizati	
	frequency	percentage	frequency	percentage
1	0	0.00%	0	0.00%
2	0	0.00%	0	0.00%
3	37	100.00%	2	100.00%
4	0	0.00%	0	0.00%
combination	37	100.00%	2	100.00%

Table 4: University Students' Learning Motivation.

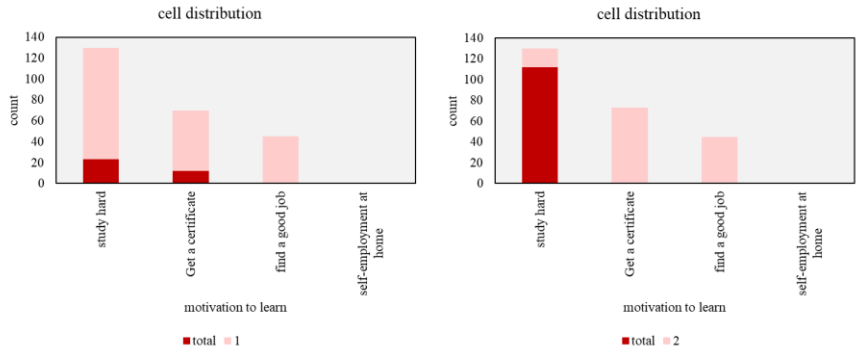

Figure 7: Learning motivation of different types of students.

As shown in Figure 7, the first type of students is examination and further education, the second type of students' learning motivation is to enter a higher school, the third type of students' learning motivation is employment and entrepreneurship, and the fourth type of students' learning motivation is research.

4.3 Design of Computer-Aided Teaching Process Based on APT

In the preliminary analysis stage, the main work includes accurately grasping the of teaching and accurately understanding students' cognitive level and learning characteristics.

According to the above needs analysis results, teachers take the student categories as an important reference, formulate different types of teaching objectives for different students, and design targeted teaching resources. Combined with APT model, comprehensive evaluation, teaching methods and technical tools, a computer-aided teaching model based on apt is constructed. Among them, the teaching evaluation method selects the three-level evaluation mechanism of teaching evaluation, self-evaluation and mutual evaluation; Teaching methods include lectures, demonstrations, situations, problem driving and inspiration; This technical tool selects teaching evaluation, teaching methods and technical tools such as mobile terminal equipment and course teaching platform to explore computer-aided instructional design.

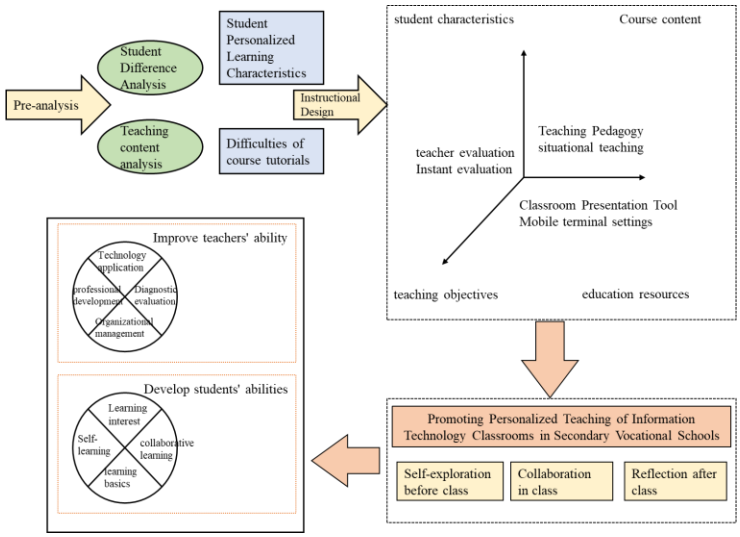

Figure 8: The process of computer-assisted teaching based on APT.

5 CONCLUSION

This chapter investigates the problems existing in the traditional information design by issuing questionnaires. According to the data analysis, it is concluded that the teaching content is the computer-aided teaching of information design classroom. At the same time, it is necessary to the characteristics of students, so it is necessary to clarify the needs of teaching content and students' differences. According to the different in the college information design class, for the college information design course, it takes students' learning motivation, learning foundation, learning interest, autonomous learning ability, collaborative learning ability, and the content of information design as the first and advanced teaching content. Based on the personalized learning characteristics of mastery, an index system of personalized learning characteristics of college students is constructed. Through cluster analysis, the students in the "information design" class of the school can be divided into four categories, namely, the most stable students and the second best expanding students, medium potential students and general progressive students.

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