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Article

A Strategic Study on the Enhancement of the Effect of Data Analysis Technology on Student Management and Civic and Political Education in Colleges and Universities from an Interdisciplinary Perspective

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Abstract: Data analysis technology brings new historical opportunities for the innovative development of student management work in colleges and universities in the new era. This paper relies on the K-prototypes clustering algorithm to construct a student portrait method that serves the precise work of ideological and political work, proposes the index system and modeling method of student portrait, and carries out the clustering division of students in a university. Based on the results of student portrait, we discuss the optimization strategy of Civic Education, construct the Civic Education Effect Evaluation Model, and evaluate the effect of Civic Education before and after the experiment. The study divided the sample students into six categories: "weak awareness", "leading progress", "exemplary leader", "silent effort", "innovative practice" and "poor discipline", among which "guiding progress" and "silent effort" had the largest number of students, accounting for 36.7% and 23.3% respectively. After the implementation of the optimization strategy of the ideological education, the effect of the ideological education was improved from the average level to the better level, and the overall score was improved by 10.39%, which confirms the improvement effect of the student portrait and optimization strategy based on cluster analysis on the ideological education. Data analysis technology can help the development of ideological education in colleges and universities and improve the quality and efficiency of student management through the collection, organization and analysis of student-related data.

Keywords: data analysis technology; K-prototypes; student portrait; evaluation of the effect of civic and political education; student management

1. Introduction

From an interdisciplinary perspective, there is a mutually reinforcing and influential relationship between ideological and political education and student management in the process of talent cultivation in higher education institutions. Ideological and political education lays the groundwork for student management, facilitating the orderly conduct of such work, while student management enhances the effectiveness of ideological and political education, making it an indispensable means of improving the overall educational outcomes of higher education institutions [1-3]. Therefore, to effectively conduct student management and ideological and political education, it is essential to integrate their knowledge and methods organically through interdisciplinary learning and research, fostering students' comprehensive abilities and promoting their long-term development. In higher education management, ideological and political education and student management are indispensable means and methods for

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talent cultivation, and their digital transformation is an inevitable trend.

Educational digitization can provide new directions for school education, promote the sharing of educational resources, optimize educational processes, and offer valuable references and insights for the formulation of comprehensive educational reform strategies. The digital transformation of education has become a critical task in current educational development [4-6]. From the perspective of higher education digital transformation, the most critical breakthrough lies in innovating educational models. By fully leveraging information technology and digital technology, institutions should capitalize on the advantages of all parties involved in the knowledge dissemination process—including subjects, objects, and media—to actively explore new pathways, approaches, and models for education, thereby laying a more solid foundation for digital education [7-10].

As the digital transformation of education progresses, an increasing amount of data is being generated. Higher education institutions should fully utilize this data to provide scientific support for educational management. Literature [11] suggests that higher education management should fully utilize the multidimensional data of college students, combine big data concepts and advanced technologies, and organically integrate data to provide students with cutting-edge, timely, interactive, and personalized management. Currently, higher education management generally faces challenges such as outdated traditional student management models, insufficient utilization of student-related data, and over 50% of ideological and political education materials being disconnected from reality, leading to suboptimal teaching outcomes [12]. Literature [13] uses the K-means algorithm to classify student behavior data from various campus applications, and combines the Apriori algorithm to analyze the correlation between these behavioral features and academic performance, thereby implementing differentiated management of students, improving their academic performance, and enhancing management efficiency. Literature [14] analyzes student behavioral data generated in learning management systems using big data-based statistical and association rule processing technologies to identify limitations in system usage, thereby promoting improvements in student learning management. Literature [15] constructs a higher education student affairs management information system that enhances communication efficiency and depth among students, schools, and teachers, providing support for the implementation of ideological and political education work. Literature [16] applies information technology to university student management and ideological and political education, improving the management efficiency of both, and uses this form of ideological and political education to construct a path for improving student management efficiency. Therefore, it is necessary to comprehensively analyze student management and ideological and political education through data analysis technology to improve the effectiveness of student management and ideological and political education.

The study is based on data analysis technology for student management in colleges and universities, using it for classroom teaching, career planning, civic education, precision poverty alleviation, comprehensive assessment, psychological counseling and other student management. Focusing on its application in civic education, the index system of student portrait is constructed from six dimensions: moral, intellectual, physical, aesthetic, labor and future-oriented. The K-prototypes algorithm is used as a prototype, on the basis of which a new metric distance formula is defined, so as to improve the clustering effect and accuracy of the algorithm. The optimized K-prototypes algorithm is used to analyze the clustering of students of a certain major in a university and obtain the student portrait. On this basis, the optimization measures of Civic and Political Education and the assessment model of Civic and Political Education effect are proposed, the evaluation indexes are standardized through the direct method in cluster analysis, the data of standardized evaluation indexes are clustered and fused to analyze, and the optimal assessment model is derived through the method of common factor analysis. Finally, the assessment model is used to compare the effect of Civic Education before and after the implementation of Civic Education Optimization Measures to explore the enhancement effect of Civic Education.

2. Data-Analysis-Based Applications for Student Management in Higher Education

Data analysis technology can widely collect data related to students in the information system of colleges and universities, combined with the needs of ideological education, psychological counseling, comprehensive assessment, poverty alleviation, employment guidance, public opinion guidance and other student management work in colleges and universities, to collect, store, organize and mine data in a targeted manner, providing reference value data information for student management work in colleges and universities, and realizing scientific prediction of student management work, Accurate decision-making. The application of data analysis technology in college student management is shown in Figure 1.

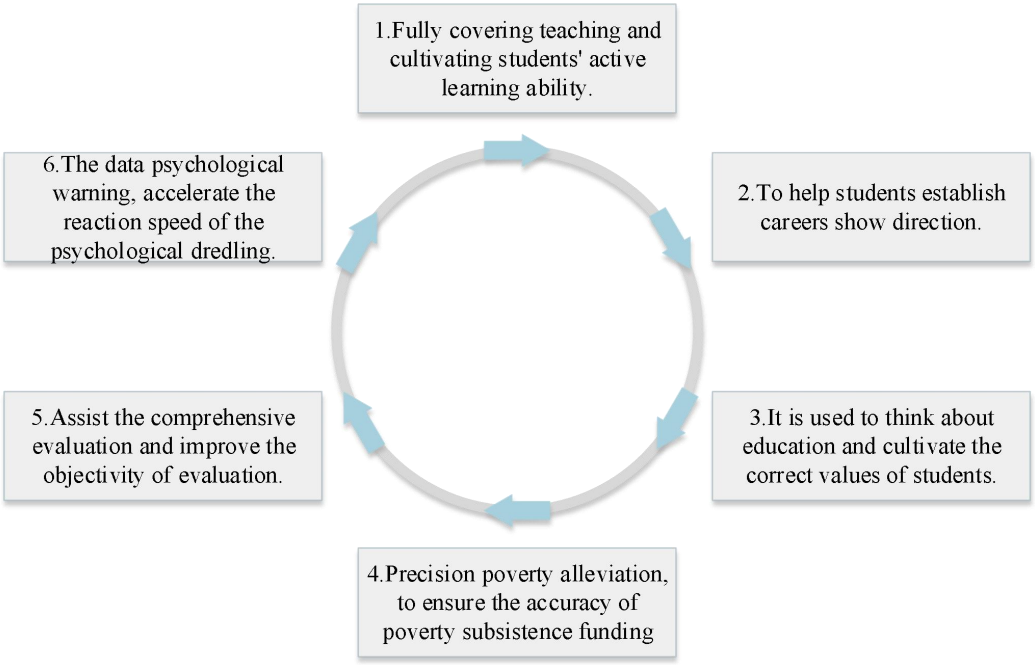

Figure 1. The application of data analysis technology in the management of college students.

2.1. Comprehensive Coverage of Teaching and Learning

The teaching platform of colleges and universities can truly and completely record the classroom teaching videos or students' learning data in the teaching platform, use big data technology to comprehensively collect these data, integrate the teaching platform and classroom teaching data, and provide resource support and technical support for students' independent learning. Through the collection of multi-source data, we can assess the learning situation of students, dig deep into the learning needs of students, summarize and summarize the deficiencies in teaching, in order to adjust and optimize practical teaching and improve the effect of teaching. Or the collected big data can be used to analyze students' learning strengths and weaknesses, accurately assess students' learning status, give students guidance on learning methods and contents, enhance their self-confidence in learning, and meet the needs of students' individual development.

2.2. Assistance in Career Planning

In the work of career planning for college student management, big data technology is used to collect career planning reference factors, such as personal factors, which mainly include students' personality, interests, self-values, abilities and strengths, etc. Through big data collection and analysis, it helps students to deeply know and understand themselves. At the same time, according to the majors and employment directions of college students, the environmental and social factors of career planning are collected to clarify the demand for enterprise positions and the development potential of the positions, so as to provide a basis for the subsequent employment guidance and ensure the students' rational choice of career.

2.3. Application of Civic Education

Big data technology is used to collect students' behavioral data at school and network behavioral data to create a dynamic ideological model in order to accurately and in real time grasp the changes in students' ideological values and provide guidance and direction for ideological and political education. For example, the model is used to collect students' grooming, learning behavior, consumption behavior, and online behavior at school, and after data processing, the ideological dynamics of individual or groups of students are obtained, and then the ideological and political education plan is formulated. Through the campus network, collect the information released by students on online platforms or mobile APPs, the articles and videos they browse, as well as the comments and messages, etc., to obtain network public opinion in a timely manner, in order to provide positive guidance and protect the safety of the network public opinion field in colleges and universities. Using big data technology to establish a model of

students' ideological dynamics, it portrays each student's thoughts, dynamically grasps students' ideological and psychological changes, provides students with targeted education, and controls and guides public opinion on emergencies and focal issues, so as to improve the timeliness and relevance of ideological education and foster students' correct ideological values while innovating student management.

2.4. Precise Poverty Alleviation and Assistance

In the screening process of poor students, in order to ensure the accuracy and reasonableness of the selection, the evaluation index system of the degree of poverty of students is established based on big data technology, and the data of poor students are collected in the intelligent terminals and information systems of colleges and universities, so as to evaluate the degree of poverty of the students in a data-oriented way, screen out the real poor students, and realize the accurate poverty alleviation and assistance.

2.5. Complementary Integrated Assessment

In the assessment of students, big data technology is utilized to comprehensively collect assessment data and comprehensively assess students, breaking the limitations of the original single assessment and improving the scientific nature of the assessment. The first is to set up a student file to record the growth process of students in the school in a multi-dimensional and comprehensive way. The second is to collect contextual data from the student management platform or classroom teaching, sports activities, club activities, etc., and record students' learning performance, labor performance, helping performance, school behavior and other data information in the file bag as the basis for assessment. Thirdly, it is specialized in using big data to establish a digital model for assessment, regularly inputting students' data for assessment, sending the assessment results to students, and giving guidance suggestions to promote better development of students.

2.6. Psychological Warning of Data

The use of big data technology to establish a student psychological early warning management platform to collect students' psychological data, such as classroom performance, absenteeism, online platform remarks, online shopping and other data, and use big data analysis algorithms to assess the level of students' psychological health and the psychological problems that exist. The psychological early warning management platform automatically sends out reminders and gives psychological problems, and the student administrators grasp the students' psychological abnormalities in a timely manner through the early warning, immediately make accurate psychological guidance responses, and carry out targeted psychological interventions, so as to realize the over-warning and timely control of the students' psychological problems, and to avoid the depth of the development of the students' psychological problems.

3. Student Profiling Based on K-Prototypes Clustering

According to the application of data analysis technology in the management of students in colleges and universities, this paper launches a research from the application of data analysis technology in the enhancement of the effect of civic education, using K-prototypes clustering algorithm to analyze the students' behavioral data in school and establish the students' portraits, which provides a reference to carry out accurate civic education in order to enhance the effect of civic education.

3.1. Indicator System for Student Profiling

The rational design of the indicator framework is the key to the modeling of student portraits. In this paper, the six dimensions of morality, intelligence, physical fitness, aesthetics, labor and future-oriented are used as the design framework for the first-level indicators. The indicator framework of student portrait is shown in Table 1, which contains 6 first-level indicators, 20 second-level indicators and 50 third-level indicators.

Table 1. Student portrait index framework.

Primary indicator	Secondary indicator	Tertiary index
Virtue	Responsibility A1	Quality of social responsibility B1
		National identity quality B2
		International understanding quality B3
	Good conduct A2	Politically positive and outstanding B4
		Advanced personal title B5
		Integrity test B6
		No other bad integrity records B7
	Participate in collective activities A3	Actively participate in group activities B8
		Actively participate in collective activities B9
		No late and early retreat B10
		No truant B11
	Public welfare activities and volunteer activities A4	Volunteer for blood donation B12
		Volunteer activities and public welfare activities B13
	Life park behavior A5	No violation of the rules of the dormitory B14
		No late return B15
		The average dormitory health score is more than 19 points in this school year B16
	Living park labor A6	The education practice activities of the living park labor B17
Wisdom	Learn to learn A7	Good at learning quality B18
		The quality of reflection B19
		Quality of information consciousness B20
	Scientific spirit A8	Quality of rational thinking B21
		Critical quality B22
		Explore quality B23
	Average GPA A9	Average GPA B24
	Scientific innovation ability A10	Participate in scientific research projects B25
		Participate in professional competitions or entries B26
		The project competition won the prize B27
Sports	Healthy life A11	Cherish the quality of life B28
		The quality of the whole person B29
		Self-management quality B30
	Daily exercise A12	Actively participate in sports B31
	Environmental adaptation A13	Get along well with your classmates B32
		Attend mental health lectures, courses, activities B33
	Participate in various activities A14	Sports meeting B34
		Cultural sports competition B35
		The competition above the city level B36
	Sports competition awards A15	School style competition awards B37
		The competition awarded above the city level B38
Beauty	Cultural background A16	Quality of cultural accumulation B39
		Quality of humanistic feelings B40
		The quality of aesthetic interest B41
	Practical innovation A17	Quality of labor consciousness B42
		Problem solving quality B43
		Quality of application technology B44
	Social practice A18	Student cadre B45
		Summer social practice B46

	Vocational skill A19	Part-time job B47
		Examination examination B48
For the future	Cross-cultural communication A20	Foreign language level B49
		Participate in cross-cultural communication activities B50

3.2. Cluster Analysis Methods

3.2.1. K-Prototypes Algorithm

Let the dataset $X=\{X_1,X_2,X_3,\cdots,X_n\}$, there are a total of n data, and each data in the dataset has m attributes, that is, $X_i=\{x_{i1},x_{i2},x_{i3},\cdots,x_{ip},x_{i(p+1)},\cdots,x_{im}\}$, the numeric data comes first and there are a total of p attributes, and the subtype data comes after a total of $m-p$ attributes. Let the initial prototype set be $V=\{V_1,V_2,V_3,\cdots,V_k\}$, the set obtained in the intermediate process be $C=\{C_1,C_2,C_3,\cdots,C_k\}$, and the distance formula is shown in Equation (1).

The distance from the sample X_i to the prototype V_j is:

$$d(X_i,V_j)=\sum_{j=1}^{p}\left|X_{ij}-V_{ij}\right|^2+\eta\sum_{j=p+1}^{m}\delta(X_{ij},V_{ij})^2 \tag{1}$$

$$\delta(X_{ij},V_{ij})=\begin{cases}0, & X_{ij}=V_{ij}\\ 1, & X_{ij}\neq V_{ij}\end{cases} \tag{2}$$

where η is the categorical attribute weight.

Solve the criterion function in cluster analysis as:

$$F(X,V)=\sum_{i=1}^{n}\sum_{j=1}^{k}u_{ij}d(X_i,V_j) \tag{3}$$

where $\sum_{i=1}^{k}u_{ij}=1$ and $u_{ij}\in[0,1]$, i.e., u_{ij} is 1 when the sample X_i is partitioned into C_j and 0 when it is not in C_j.

The K-prototypes algorithm is based on partitioning the sample set X into k mutually disjoint classes and minimizes the value of the objective function.

3.2.2. Enhanced K-Prototypes

To address the limitations of the above K-prototypes algorithm, this paper proposes an enhanced K-prototypes hybrid data clustering algorithm (EKPCA). This paper also defines a new distance formula and selects more initial prototypes to cover the overall information of the data, followed by iterative elimination of redundant prototypes. The new distance formula is as follows.

The distance from sample X_i to prototype V_i is:

$$d(X_i,V_i)=\sum_{j=1}^{p}\left|X_{ij}-V_{ij}\right|^2+\sum_{j=p+1}^{m}\beta\cdot\delta(X_{ij},V_{ij}) \tag{4}$$

$$\beta=\exp\left\{\left(\sum_{j=p+1}^{m}\theta(X_{ij},V_{ij})\right)/(p-m)\right\} \tag{5}$$

$$\theta(X_{ij},V_{ij})=\begin{cases}1, & X_{ij}=V_{ij}\\ 0, & X_{ij}\neq V_{ij}\end{cases} \tag{6}$$

The exponential function e^x increases its slope with the increase of x, so this paper uses the exponential function property to define the distance calculation formula, which enlarges the variability between the data, so that it helps to categorize the points at the edge of the cluster.

The following is an example to verify that equations (4)~(6) satisfy the three properties of distance.

Suppose $X_1 = \{1, a, b, c, d\}$, $X_2 = \{3, d, c, b, a\}$, and $V = \{2, a, c, d, b\}$. After calculations it can be obtained:

$$d(V, X_1) = 1 + 3e^{-0.25}, d(V, X_2) = 1 + 3e^{-0.25}, d(X_1, X_2) = 4 \tag{7}$$

(1) Non-negativity: from the above results:

$$d(V, X_1) > 0, d(V, X_2) > 0, d(X_1, X_2) > 0 \tag{8}$$

Therefore, non-negativity is satisfied.

(2) Symmetry: from the above result:

$$d(V, X_1) = d(X_1, V) \tag{9}$$

$$d(V, X_2) = d(X_2, V) \tag{10}$$

$$d(X_1, X_2) = d(X_2, X_1) \tag{11}$$

Therefore, symmetry is satisfied.

(3) Trigonometric inequality: from the above result:

$$d(V, X_1) + d(V, X_2) > d(X_1, X_2) \tag{12}$$

$$d(V, X_1) + d(X_1, X_2) > d(V, X_2) \tag{13}$$

$$d(V, X_2) + d(X_1, X_2) > d(V, X_1) \tag{14}$$

That is, the triangular inequality is satisfied.

Equation (4) ~ (6) using the nature of the exponential function, when the subtype sample data between two two similarity is small, β take a larger value, similarity is larger, take a smaller value. The exponential function is nonlinear change, so that it can meet the categorized data when the difference between the categorized data is larger increase the subtype data distance weight, two samples categorized data part of the difference is small when the subtype data distance weight is reduced, so as to make the difference between the individual data more significant.

EKPCA algorithm in the selection of the initial point, select the number of greater than the target prototype k, select μk prototype, μ is a positive integer, and then calculate the μk existing data in the cluster to the center of the remaining $\mu k - 1$ cluster center of the distance, merging distance of the smallest distance of the cluster of the data, merged clusters to calculate the distance from the center of the rest of the clusters, taking the average distance between the data within the clusters. Next, the distance from the existing data in the $\mu k - 1$ clusters to the centers of the remaining $\mu k - 2$ clusters is calculated, and the data in the cluster with the smallest distance is merged, and the merged clusters are merged according to this process until there are k clusters left.

3.3. Cluster Analysis of Students

3.3.1. Analysis of Clustering Results

This paper takes 60 students of a major in a university as the research object to carry out a case study, and collects various types of data such as students' basic information, behavioral information, and evaluation information by means of students' comprehensive assessment forms and questionnaires, and analyzes them by using the EKPCA clustering algorithm. Considering the actual situation of the research in this paper, only the profile coefficients are calculated when the number of clusters is 3 and more than 3. The contour coefficients are summarized as shown in Figure 2. When the value of K is 6, the contour coefficient is 1.01, which is the closest to 1, and the clustering effect is the best, and six clusters of A, B, C, D, E, F are obtained, and the percentage of clustering categories is shown in Fig. 3. 6 clusters of A, B, C, D, E, F account for 5%, 36.7%, 10%, 23.3%, 8.3% and 16.7%, respectively.

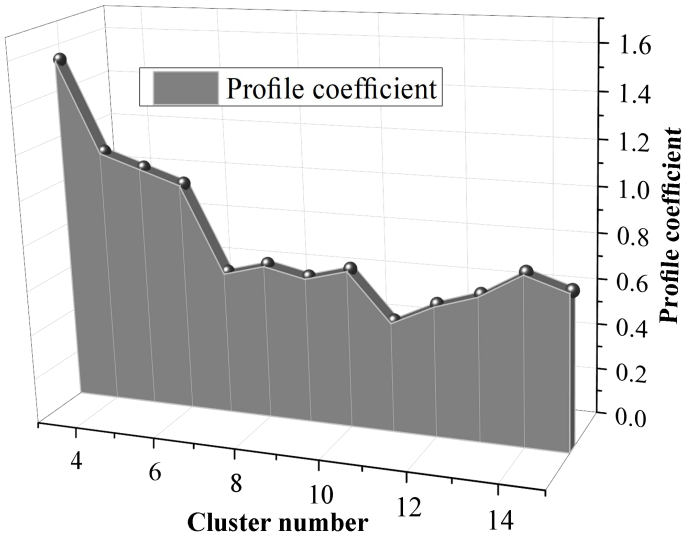

Figure 2. Profile coefficient summary

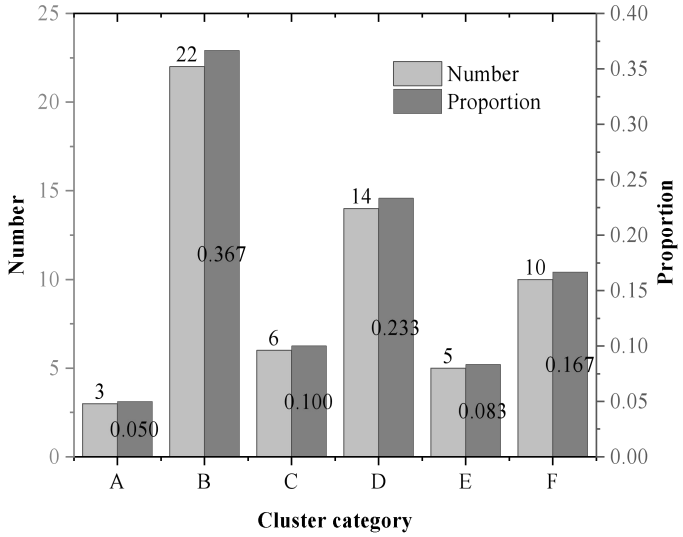

Figure 3. Cluster category basic information summary

3.3.2. Analysis of Student Profiles

In order to observe the portrait characteristics of the 6 categories of students under the 6 dimensions of morality, intelligence, physical fitness, aesthetics, labor, and future-oriented, the average value of each indicator of the 6 categories of students was compared. The average values of each category under each indicator are shown in Figures 4 to 10, which are the results of the indicators for the 6 categories of students, A, B, C, D, E, F, and the results of the indicators for the overall students.

Observation and analysis of the values of each indicator under the six dimensions of the six categories of students found that the students of category A do not have a sufficient understanding of responsibility, B1~B3 indicator value of about 1.48, poor performance in public welfare activities, B12~B13 indicator value tends to be close to 0, but can actively participate in collective activities, life park labor education and practical activities. Insufficient understanding of learning to learn, the spirit of science, low scientific research and innovation ability, the value of the indicators is 0~1.51. Insufficient understanding of the humanistic heritage. Insufficient understanding of humanistic heritage. Poor effect of practical innovation, social practice, vocational skills ability and other labor education. This means that students of category A belong to the “weak consciousness type”, and attention should be paid to cultivating the consciousness of scientific research, labor, collective, learning and communication.

Students in category B do not perform well in participating in collective activities and practical

activities of labor education in life parks, with indicator values below 2. Learning mindset is very good, but needs to work on scientific research and innovation. The number of lectures, courses and activities on mental health is low, with an indicator value of 2.33. Social practice and vocational skills are insufficient, with an indicator value of less than 0.60 from B45 to B48. Intercultural communication skills need to be focused on improving. This indicates that students in category B belong to the "guided progress type", with good self-learning mindset, but need to pay attention to their intercultural communication, scientific research and innovation ability, and social skills, as well as guiding them to pay attention to mental health and other activities, and strengthening their sense of collective consciousness.

Students in Category C have excellent performance in all aspects, and it is especially noted that students in Category C actively serve as student leaders. This indicates that students in category C belong to the "exemplary leader type", and teachers can guide students in category C to play the role of peers and explore their talents in various aspects, so as to guide them to grow up and achieve success in a targeted manner.

Students in category D have better performance in all aspects and have participated in volunteer activities and public welfare activities many times, but they have participated in fewer labor education and practical activities in the living park and need to be strengthened, with the index values of 1.64 and 0.20 respectively, which means that students in category D belong to the "silent hard-working" type of students, and they need to be taught how to teach and guided by their teachers. This means that students in category D are "silent hardworking" students who need teachers to teach them methods and guide them.

Category E students are good at behavioral performance in the campus, research and innovation, internships and part-time jobs, participation in cross-cultural exchange activities, and good at social practice, with index values between 0.72 and 2.00. The index value is between 0.72 and 2.00, which indicates that E students are good at innovation, practice and communication, and belong to the "innovation and practice type" students. Students in category E should be guided to seize the opportunity to realize their potential and encouraged to make progress.

Students in category F have bad behaviors such as late arrivals and early departures (1.89), absenteeism (1.60), poor GPA (2.84), poor scientific research and innovation ability (both with a value of 0), low awareness of healthy living (1.02-1.11), low participation in sports competitions (0-0.48), and need to strengthen their performance in labor practice and cross-cultural communication. This indicates that students in category F belong to the "poorly disciplined type", and without a correct attitude towards basic discipline and health consciousness, they cannot make progress in academic performance and labor practice, so they should focus on building up their sense of discipline and correcting their attitude towards life.

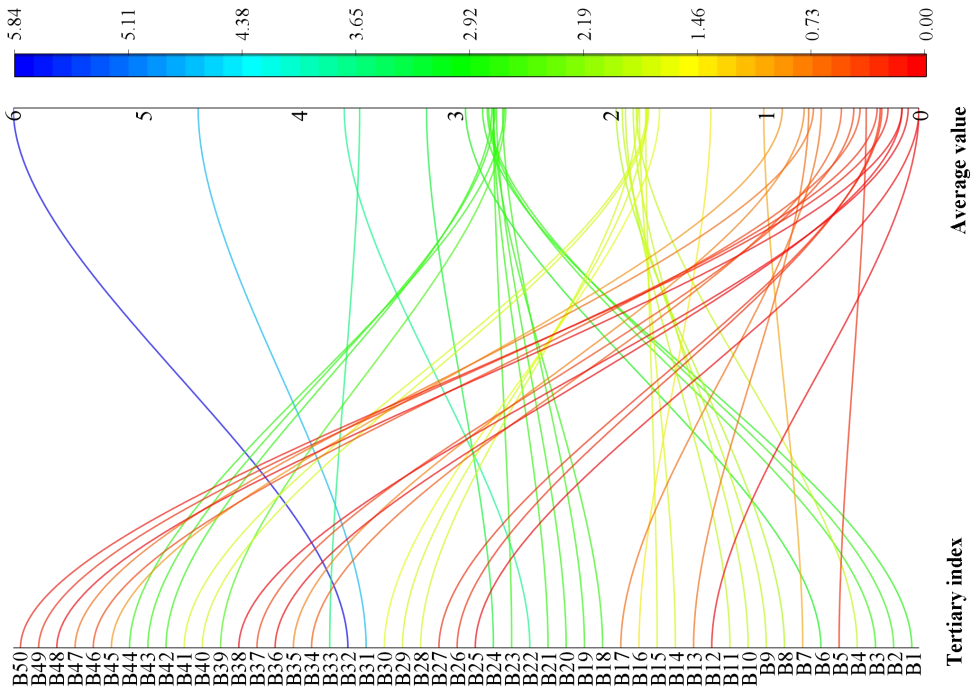

Figure 4. The average result of each index (Total).

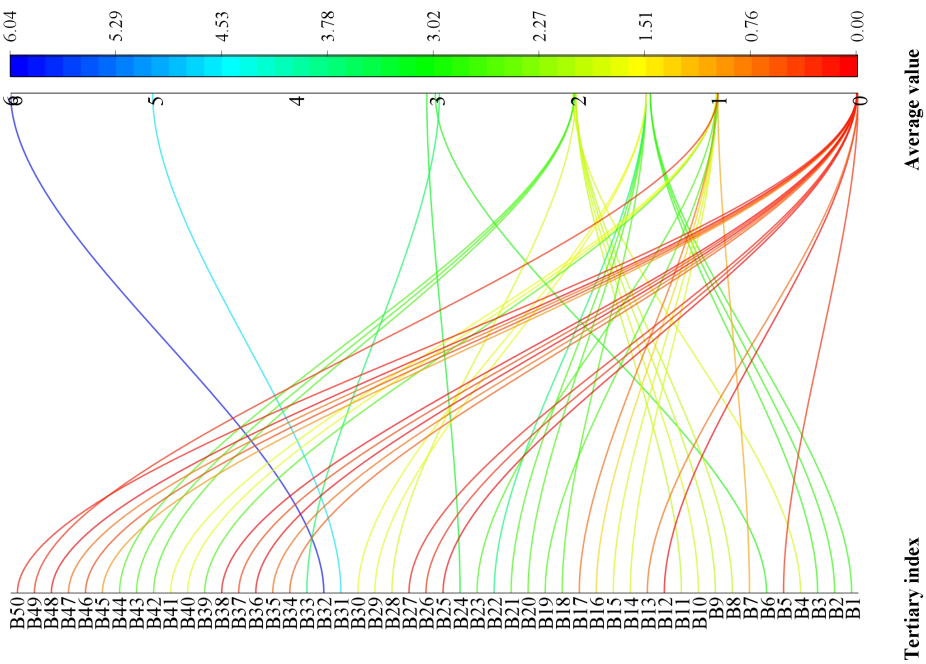

Figure 5. The average result of each index (Cluster A).

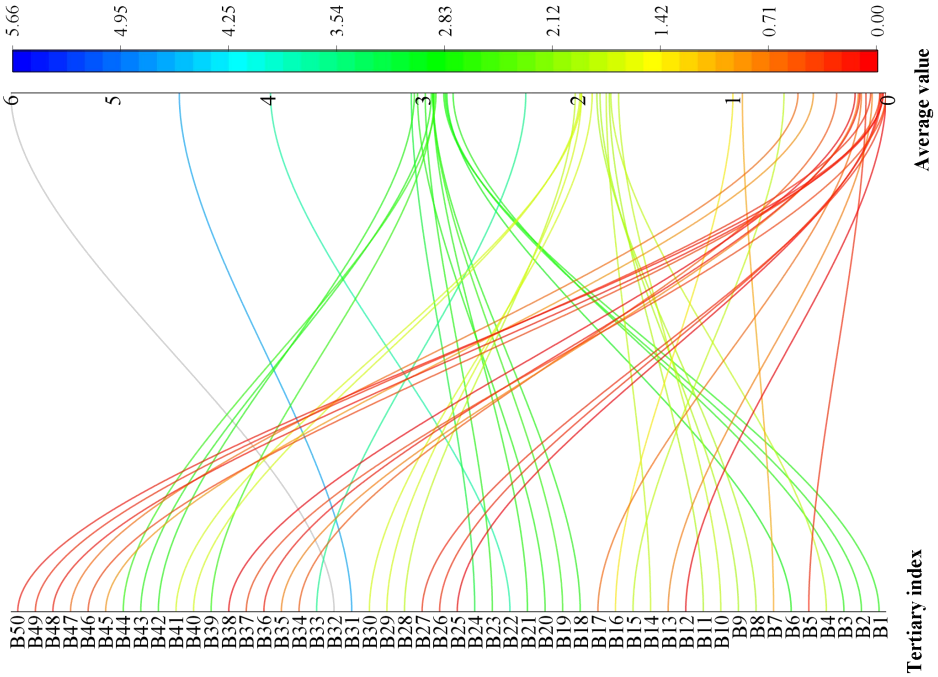

Figure 6. The average result of each index (Cluster B).

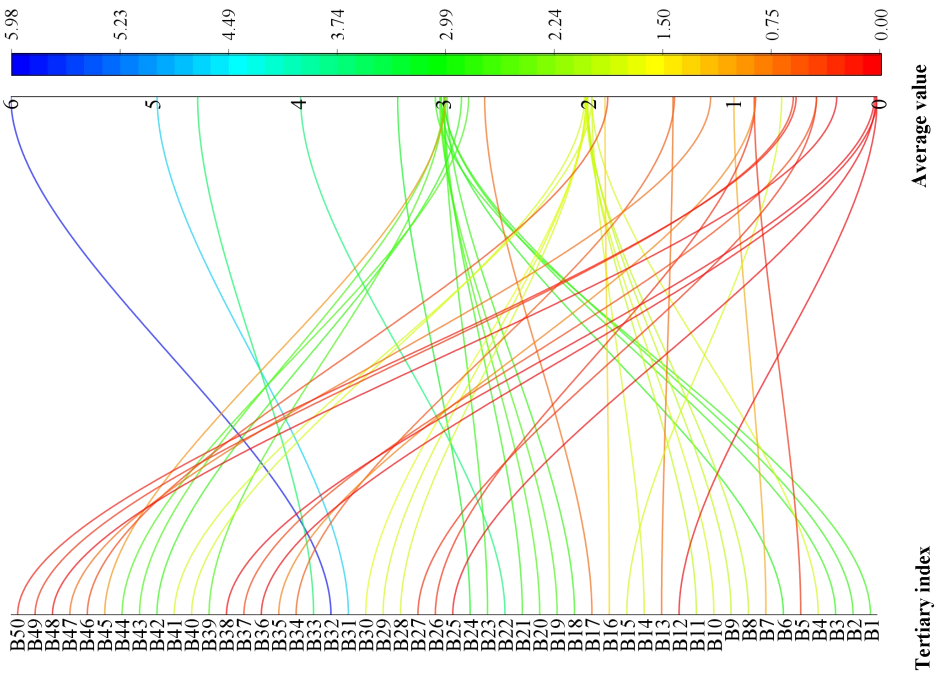

Figure 7. The average result of each index(Cluster C).

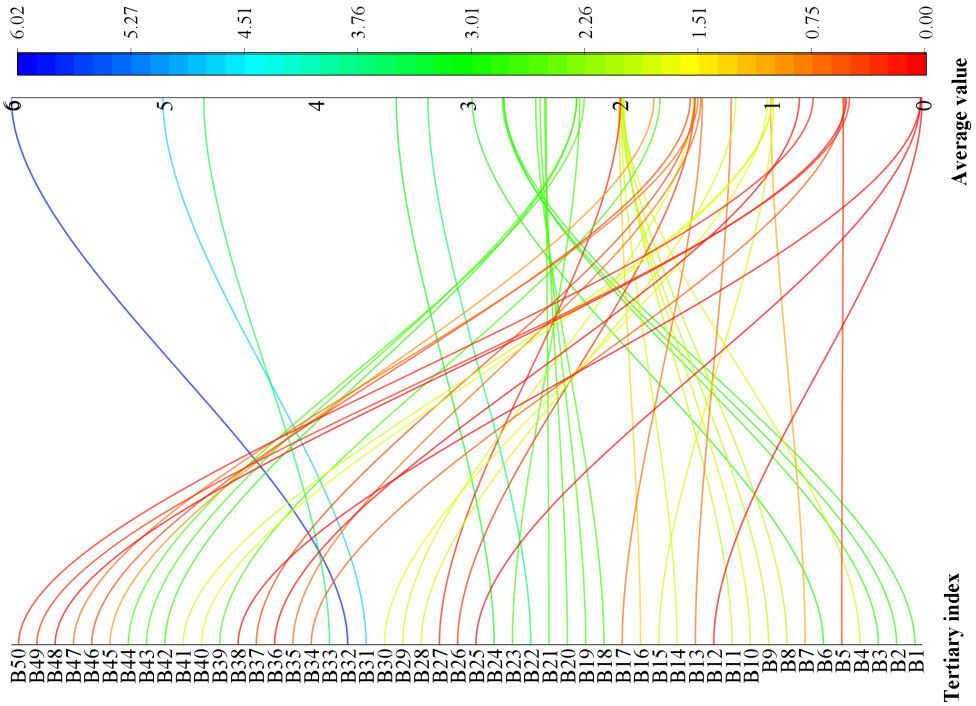

Figure 8. The average result of each index (Cluster D).

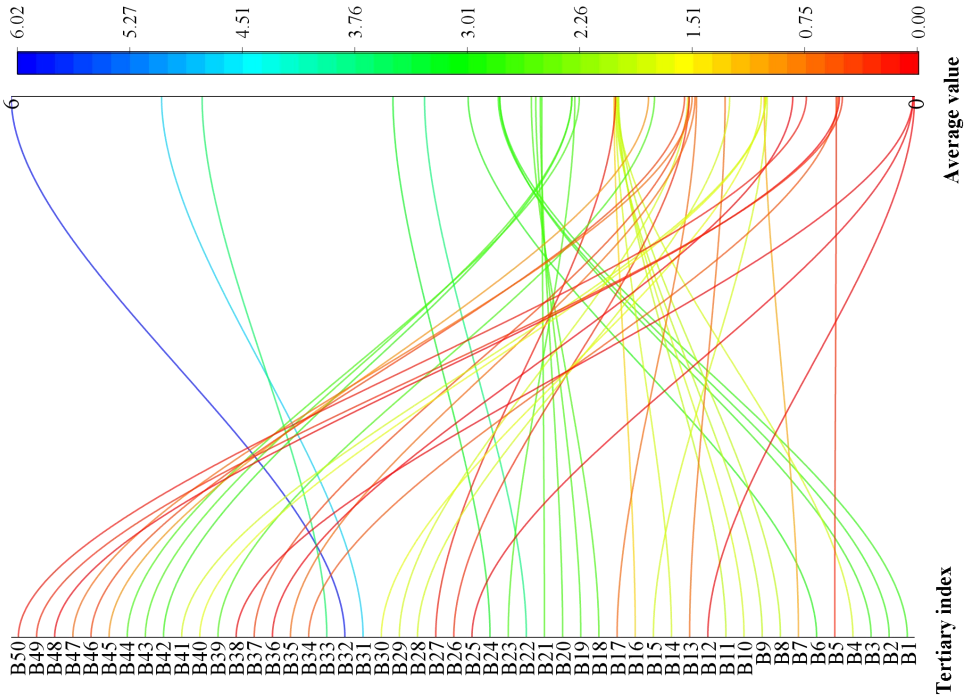

Figure 9. The average result of each index (Cluster E).

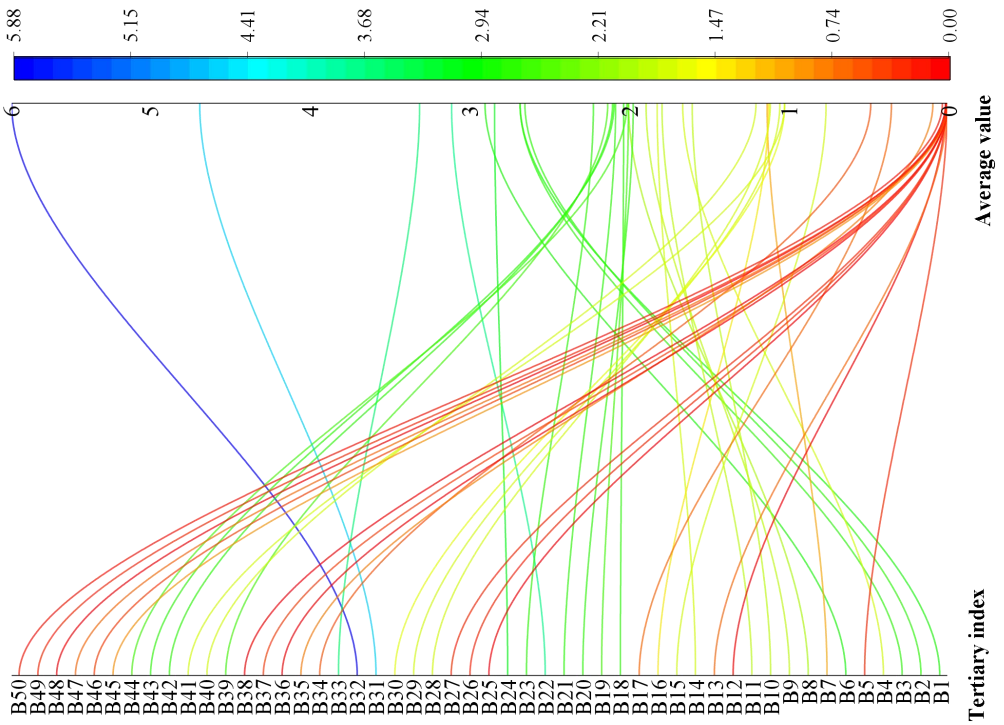

Figure 10. The average result of each index (Cluster F).

4. Analysis of the Optimization and Enhancement of the Effectiveness of Civic Education

4.1. Measures to Optimize Civic Education

On the basis of the analysis of student portraits using the clustering algorithm, for the six categories of students from A to F, this paper proposes the optimization of the teaching mode of civic education by

classified teaching and tailored to the needs of the students. It mainly includes the following three levels of measures:

4.1.1. Designing Diverse Lesson Plans

When teachers prepare lesson plans for Civics and Political Science classes, they formulate different teaching objectives, highlight compatible teaching priorities, and design reasonable teaching contents according to the characteristics of different classifications of students as described in the previous section, and take into full consideration of their own learning interests, theoretical foundations, and receptive abilities, so as to make it easier for students to understand and accept the knowledge.

4.1.2. Realization of Practical Instruction in the Classroom of Classification

In the practical classroom teaching of Civics and Political Science, schools can stratify students according to the learning ability, interest level and theoretical foundation of the six categories of students or differentiate them according to the specialties of arts and sciences, and form a large class of students with small differences in the categories, so that the teachers can be more targeted in choosing the contents of the lectures and methods of imparting the lectures.

4.1.3. Implementation of Differentiated Assessment Methods

At present, the assessment of the Civic and Political Science course has a large proportion of the usual grades, therefore, the teacher can not change the situation of the final unified examination, should be as much as possible to realize the differentiated assessment in the assessment of the usual grades, so that it can more comprehensively reflect the learning status of different categories of students. For example, for the content of ideal beliefs in the Civic and Political Science class, for the E class students with strong expression ability, they can carry out scenarios and speeches about ideal beliefs. For B students who have strong theoretical foundation, they can have thematic knowledge competitions. Various assessment methods can motivate students' participation to a greater extent, enhance students' learning enthusiasm, and reflect the teaching effect more comprehensively.

4.1.4. Thematic Teaching for Special Groups

In the previous student clustering analysis, there will be some special groups of students F class, the learning ability and healthy life thinking consciousness of this type of students is not strong, easy to negative, isolation, low self-esteem and other psychological problems, once the extreme reaction, will cause more serious consequences. Therefore, in the ideological counseling of students, teachers of ideology must pay special attention to the needs of this special group, can carry out single psychological counseling, but also close to the problem of students gathered together to take a theme-based teaching, clear focus.

4.2. Design of Teaching Experiments

In order to assess the effectiveness of the Civics education optimization measures proposed in the previous section, a teaching experiment was conducted on the 60 students selected above, and the Civics education effect assessment model was constructed by combining the cluster analysis algorithm. Before the implementation of the optimization measures of Civic and Political Education, the Civic and Political Education Effectiveness Assessment Model was used to conduct an assessment once, and then the Civic and Political Education Optimization Measures based on Student Portrait were applied to the Civic and Political Education teaching of the sample students, and then the assessment model was used to conduct the measurements again, comparing the results of the assessment of the effectiveness of the Civic and Political Education in the two times, so as to get the enhancement effect of the Civic and Political Education.

4.3. Evaluation Model of the Effectiveness of Civic and Political Education

4.3.1. Standardization of Indicator Data

The index system for evaluating the effectiveness of civic and political education includes five first-level indicators: psychological quality, legal quality, moral quality, political quality and ideological quality. Each secondary indicator is as follows:

Psychological quality: mental outlook C1, mental health C2, quality of consciousness and love psychology C3, emotional character self-knowledge C4.

Legal quality: legal and disciplinary behavior C5, legal and disciplinary concept C6, legal knowledge

C7.

Moral quality: family morality C8, social morality C9, collectivism C10.

Political quality: political practice ability C11, political behavior C12, Marxist theory quality C13.

Ideological quality: learning attitude C14, patriotism and national spirit C15, outlook on life and values C16, ideals and beliefs C17.

The process of indicator quantification is as follows: let the indicator data of the first level be set as the timeliness of the ideological education I, and there are a total of i indicator data of this level, i.e., I, from which i indicators are generated n second-level indicator data respectively. Denoted as:

$$I_i = \left\{ I_{i,1}, I_{i,2}, I_{i,3}, \cdots, I_{i,n} \right\} \tag{15}$$

The correlation test analysis of the indicator data resulted in the correlation coefficient between the indicator data expressed as:

$$r = \frac{\operatorname{cov}(i,n)}{\left| \sqrt{i+n-1} \right|} \tag{16}$$

In equation (16), $\operatorname{cov}(i,n)$ represents the covariance between the two indicator data. If r is greater than the significance level $\left(r > p\right)$, a bias variance test is performed to test the net correlation between the two data, taking into account the presence of other confounding factors in the indicator. The coefficient of bias variance is expressed as:

$$D_{i,n} = \frac{r_i - r_n r_i}{\sqrt{\left(1 - r_i^2\right)\left(1 - r_n^2\right)}} \tag{17}$$

The plus or minus sign of the coefficient reflects the change in direction between the indicator value and the target value, indicating whether the trend is consistent. The absolute nature of the correlation coefficient, on the other hand, reflects the strength of the correlation. Indicator data that meet the two standardized tests are used in the clustering algorithm for preprocessing.

4.3.2. Indicator Clustering and Fusion Processing

The fuzzy C-mean clustering method algorithm is used to standardize the data of the indicators for evaluating the effectiveness of ideological and political education according to the dynamic clustering analysis, and the specific expression:

$$u_i = K_{i,n}(I_{i,n}) + c^2 \tag{18}$$

In Eq. (18), $K_{i,n}$ is the number of evaluation index clustering kernel, and c is the initial cohesion point of evaluation index. According to the group center of gravity analysis method to derive the fuzzy dynamic equation of the evaluation target of the effectiveness of ideological education, the specific expression is:

$$J = \frac{k}{2} \sum_{i=1,n=4} K_{i,n}(I) u_i^2 \tag{19}$$

In Eq. (19), k is the clustering center value. The objective function is determined by calculating the distance between the evaluation data and the clustering center:

$$L = \frac{J}{2} \sum_{i=1,n=4} K_{i,n}(I) u_i^2 - \eta \tag{20}$$

In Eq. (20), η is the fuzzy comprehensive evaluation value of the effect of ideological education. After clustering and integrating the obtained data information, the evaluation data fusion clustering expression is obtained as:

$$T = \frac{J}{2} \sum_{i=1,n=4} K_{i,n}(I) u_i^2 - \sum_{i=1} \eta \phi_i \tag{21}$$

In Eq. (21), φ_i is the fuzzy comprehensive judgment value of the i th optimal program. According to the evaluation data fusion method, the output fusion data information is expressed as:

$$E = \frac{J}{2} \sum T - \sum_{i=1} \eta \phi_i \tag{22}$$

So far, the clustering and integration of indicator data have been completed, on the basis of which the construction of the Civic Education Effectiveness Assessment Model is carried out, so as to realize the optimization of the Civic Education Effectiveness Assessment Model and improve the accuracy and efficiency of the assessment.

4.3.3. Assessment Modeling

In order to realize the assessment of the effectiveness of the civic education, the automatic assessment model of the timeliness of the civic education is constructed based on the clustering analysis results obtained from the fuzzy comprehensive judgment value of the optimal program. The estimation formula for the evaluation of the effectiveness of civic and political education is transformed into a least squares solution as in equation (23):

$$R = \sum TE - \sum_{i=1} \eta\phi_i + f(t) \tag{23}$$

Denote by $f(t)$ the time point of the assessment big data distribution. Calculate the comprehensive fuzzy magnitude of the assessment of the effectiveness of civic education using formula (24):

$$U = \sum_{n=1} R \cdot w - \sum_{i=1} \eta\phi_i + T \tag{24}$$

where w is the value of dynamic fuzzy weights for the evaluation of the effectiveness of ideological education. The similarity of the distribution of evaluation indicators is solved by using the fuzzy closeness filling method, the specific expression is shown in equation (25):

$$Y = \sum_{n=1} R \cdot w + U\sqrt{\lambda} \tag{25}$$

In equation (25), λ is the degree of affiliation of each evaluation level. The factor score coefficients of all subsequences are sought for each sample in the evaluation index data set by means of the public factor analysis method:

$$x = \sum_{i=1} UY_i^2 - \frac{T\sqrt{\lambda}}{2} \cdot \partial \tag{26}$$

In Eq. (26), ∂ is the a priori distribution probability of the assessment, and the fusion of the mean value of the distribution probability of the indicators of the assessment of the effectiveness of the ideological and political education is realized through the linear feature fusion method to obtain the specific expression as Eq. (27):

$$v = \frac{T\sqrt{x}}{2} \cdot \partial + \sqrt{m}\sum b_i \cdot t \tag{27}$$

In Eq. (27), ∂ is the decision threshold for the assessment of the effect of ideological education, b_i is the adaptive initial step of the i th assessment index, t is the assessment moment, and m is the correlation coefficient of the characteristic distribution. According to the public factor analysis method, the optimal assessment model is derived as:

$$M = \frac{T\sqrt{\lambda}}{2} \cdot \partial + \sqrt{m}\sum_{i=1} b_i \cdot t + \frac{x_i}{Y} \tag{28}$$

In summary, based on the Civic Education Effectiveness Assessment data, the Civic Education Effectiveness Assessment data fusion clustering was realized by aggregating the Civic Education Effectiveness Assessment values, and the optimal model was derived by calculating the factor score coefficients of the sub-sequences through the Common Factor Analysis method, which completes the construction of the Civic Education Effectiveness Assessment data model and realizes the Civic Education Effectiveness Assessment.

4.4. Civic Education Enhances Effectiveness

In this study, 17 secondary indicators were prepared into a questionnaire, which was distributed offline and data were collected. The data collection mainly involves teachers and students of a major in universities, and the evaluation subjects of the effectiveness of Civic and Political Education are divided into schools, teachers, teaching supervisors and students. The reliability and validity of the questionnaire were tested using SPSS software, and the standardized reliability coefficient was 0.862, which is relatively high.The coefficient result of KMO test was 0.857, which indicates that the validity of the

questionnaire is good.

This study adopts the Civic Education Effectiveness Assessment Model for evaluation, data collection through the questionnaire, using a five-grade scoring format, each option has a scoring guideline corresponding to it, and the Civic Education Effectiveness Evaluation Grade is five grades: good, better, average, poor, and poor, with corresponding scores of 100, 75, 50, 25, and 0. Evaluation results of full 100 points, 60 points and above are qualified, and scores in the range of between 0 and 30 points is poor, between 31 and 60 points is poor, between 61 and 75 points is average, between 76 and 90 points is good, between 91 and 100 points is good. Finally, the Civic Education Effectiveness Assessment Model was used to calculate the scores of each index and the overall score.

Before and after the implementation of the optimization measures of Civic and Political Education, the comparison of the results of Civic and Political Education Effectiveness Assessment is shown in Figure 11. Before and after the optimization of the civic education based on students' portraits, all the indicators are improved to different degrees, and the overall score of the civic education effect is improved from 72.69 to 80.24, which is 10.39%, and the evaluation grade is improved from average to better, which verifies that the optimization of the civic education based on the students' portraits can effectively improve its teaching effect. The scores of 12 out of 17 indicators after optimization are above 75, which means that a better effect of Civic and Political Education is achieved. Among them, Marxist theoretical quality C13, spiritual outlook C1 and concept of law and discipline C6 have the highest scores, all of which are above 90.

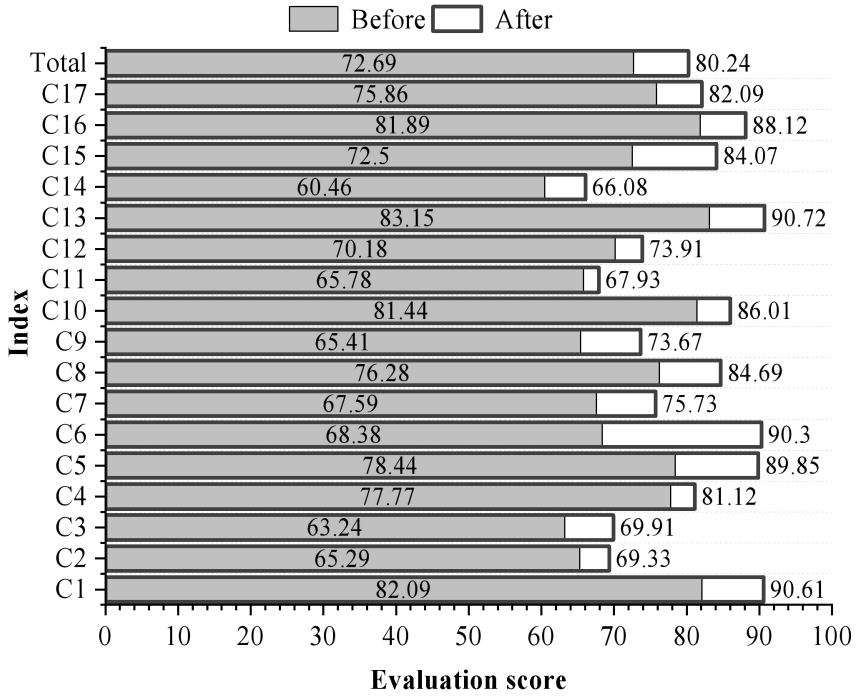

Figure 11. The comparison results of the evaluation of ideological and political education.

5. Conclusion

Based on the application of data analysis technology in student management in colleges and universities, the study focuses on the application of ideological education. The enhanced K-prototypes clustering algorithm is used to construct student portraits, and optimization measures for ideological education are proposed to test the role of the application of data analytics technology on the enhancement of the effect of ideological education through the comparison of the evaluation of the effect of ideological education before and after the implementation of the measures. Through the clustering of index data, the sample students were divided into six categories: "weak consciousness", "leading progress", "exemplary leader", "silent effort", "innovative practice" and "poor discipline", accounting for 5%, 36.7%, 10%, 23.3%, 8.3% and 16.7%, respectively, of which the proportion of "guiding progressive" students was the largest. After adopting the optimization measures of civic education based on student portraits, the assessment score of civic education was improved by 10.39%, the evaluation grade of civic education effect was improved from average to better, and the scores of more than 70% of the indexes were

improved to more than 75 after optimization, which showed a better enhancement effect of civic education. Therefore, the student portraits obtained by using the enhanced K-prototypes clustering algorithm can guide the optimization strategy of Civic and Political Education and promote the improvement of Civic and Political Education effect. In addition to its application to Civic and Political Education, data analysis technology can also be applied to student management work such as comprehensive coverage of teaching, help in career planning, accurate poverty alleviation and assistance, assistance in comprehensive assessment, and data psychological early warning, which promotes the intelligent and efficient development of student management work.

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