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Article

# Innovation and Optimization of Red Culture into the Content of Civic and Political Education in Colleges and Universities Empowered by Data Mining Algorithms

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**Abstract:** In the education of colleges and universities, ideological and political education has become the focus of work, and the integration of red culture in ideological and political education can guide college students to form a correct outlook on life, values and worldview. This paper uses TF-IDF algorithm to analyze the research hotspot, uses Apriori association rule algorithm, principal component analysis method and systematic clustering method to analyze the relevant laws of the red culture integrated into the ideological and political education in colleges and universities, and on the basis of which, it puts forward the content innovation and optimization way of the integration of the red culture into the ideological and political education in colleges and universities. The hot content of this research is curriculum ideology, through the integration of red culture into curriculum ideology, the work of college ideological education can more fully realize its nurturing function and play the role of thought leadership. In the innovation and reform of ideological and political education in colleges and universities, the use of new media on the Internet and the guidance and propaganda of counselors are more important. In addition, the integration of red culture into the ideological and political education in colleges and universities is mainly to excavate the revolutionary culture and the spirit of the times from the ideological and political theory class and course ideology, reform the teaching methods, and incorporate the innovative consciousness, values, patriotism and other ideas embedded in the red culture. This paper focuses on the analysis of the innovation and optimization countermeasures in the integration of red culture into the Civic and Political Education, which has a certain guiding significance for improving the level of Civic and Political work in colleges and universities.

**Keywords:** TF-IDF algorithm; Apriori association analysis; principal component analysis; systematic clustering; red culture; civic education

## 1. Introduction

In the context of the digital era, the rapid development of digital technology provides new opportunities for the protection and application of resources [1]. Colleges and universities should digitally transform red cultural resources to facilitate the application of red cultural resources in the work of ideological and political education while inheriting red culture [2-3]. Establish an exclusive red cultural resource library of the university, use data mining algorithms to excavate and collect digital resources of red culture, store the resources in the library after screening, classifying and organizing



them, and open the access and use of the resource library free of charge to all teachers and students in the university [4-6]. Continuously incorporate into the repository new types of red cultural resources produced in the new era and digital resources created by teachers and students of the university to enhance the scale and diversity of the resources in the repository [7]. Establish cooperative relationships with the government and other universities to realize the interconnection between the resource libraries, build a complete red culture digital resource system, and further promote the rational allocation of resources [8].

For the resources in the library, universities should utilize them effectively to empower the education of Civics and Politics with the efficient use of resources [9-10]. Organize the Civics teachers of the university to develop online high-quality Civics courses on the theme of red culture, integrate red cultural resources such as red stories, red songs, red characters and other red cultural resources by using the courses as a carrier, and upload the courses to online learning platforms such as Learning Power and Mucous Classes, so as to realize the common sharing of course resources [11-13]. Organize student clubs to carry out campus activities based on the digital resources in the library, combine the red culture and club characteristics, and create a strong atmosphere of red culture in the whole school [14].

In this paper, data mining algorithms such as TF-IDF algorithm, Apriori association rule algorithm, principal component analysis method and systematic clustering algorithm are comprehensively applied to innovatively put forward an innovative optimization method for the ideological education in colleges and universities that incorporates red culture. Through the statistical analysis of high-frequency words, correlation analysis and co-occurrence network structure analysis of related research, the hot content of related research and its development trend are explored. Then, association rule mining, principal component extraction and clustering are carried out on the high-frequency words to obtain the potential regularity of the integration of red culture into civic and political education. Finally, the optimization method of Civic and Political Education is designed from the aspects of teaching content innovation, social practice integration, new media platform application and three-dimensional cultivation.

## **2. Research methodology**

### *2.1. Keyword extraction algorithm*

Keywords are the smallest unit that expresses the meaning of the document topic. Usually, keyword extraction algorithms are used to calculate the weight of document words, and then according to the weight size of each word to obtain the document keywords.

TF-IDF algorithm is a keyword extraction algorithm widely used in information retrieval and text mining. The algorithm can measure the criticality of words from the perspective of cross-entropy and is often used to calculate the weight of words. TF-IDF algorithm usually requires the following three steps to extract keywords: text preprocessing, keyword candidate set acquisition and keyword extraction.

#### **2.1.1. Text pre-processing**

(1) Data cleaning. The purpose of data cleaning is to eliminate noise, remove redundant or contradictory data, which can reduce the differences in the original data and ensure the reliability of the subsequent TF-IDF algorithm. It includes deleting irrelevant information, removing empty transactions, and standardizing data specifications.

(2) Segmentation processing. Segmentation processing is an extremely critical part of text preprocessing, and its accuracy will directly affect the final data mining results. At present, the probabilistic statistical model based on the word separation method is more effective and easy to implement.

#### **2.1.2. Keyword candidate set acquisition**

Deactivated words are function words that do not reflect the topic. Their existence increases the data processing time and occupies too much computer memory, so the deactivated words can be removed by traversing the deactivated word list to obtain the keyword candidate set.

#### **2.1.3. TF-IDF keyword extraction**

The main idea of the TF-IDF algorithm [15] is that the weight of a feature word in a document is the frequency of the feature word in the document inversely proportional to the number of documents containing the feature word. The formula for calculating the weight of this algorithm is as follows, the larger the value of the weight, the higher the degree of criticality of the word:

$$\omega = f_1 f_2 = \frac{m}{M} \log_2 \left( \frac{D}{D_w} \right) \quad (1)$$

Where:  $\omega$  is the TF-IDF weight of the word.  $f_1$  is the frequency of occurrence of a feature word in the specified document.  $f_2$  is the inverse text frequency.  $m$  is the number of occurrences of a feature word in the specified document.  $M$  is the total number of words in the specified document.  $D$  is the total number of documents in the corpus.  $D_w$  is the number of documents in which the feature word appears.

## 2.2. Association Rule Algorithm

Association rule algorithms are an analytical method for discovering hidden connections in large amounts of data. The implication expression of association rules is shaped as “ $A \rightarrow B$ ”, where  $A$  is called frequent antecedent,  $B$  is called frequent consequent, and  $A \cap B = \Phi$ .

Apriori algorithm [16] is a more commonly used method for association rule algorithms in practical engineering problems, and its core idea is based on 2 metrics:

(1) Support: it is used to measure the frequency of an association rule. The formula for calculating the size of support is as follows:

$$S = \sigma(A \cup B) / N \quad (2)$$

Where:  $S$  is the support of the association rule,  $\sigma(A \cup B)$  is the number of transactions containing both  $A$  and  $B$ , and  $N$  is the total number of transactions.

(2) Confidence: used to judge the credibility of an association rule, which is essentially the conditional probability of  $B$  in the case that  $A$  has occurred. The formula for calculating the size of the confidence level is as follows:

$$C = \sigma(A \cup B) / \sigma(A) \quad (3)$$

Where:  $C$  is the confidence of the association rule,  $\sigma(A \cup B)$  is the number of transactions containing both  $A$  and  $B$ , and  $\sigma(A)$  is the number of transactions containing  $A$ .

Apriori algorithm controls the exponential growth of candidate itemsets in an all-round way through the pruning technique of support and confidence, which can reduce the computing time and memory consumption, and the logical steps can be summarized as follows:

(1) Generate frequent itemsets layer by layer. A layer-by-layer approach is adopted, starting from the frequent 1-item set and traversing up to the longest frequent item set, and then using the “generate-test” strategy to discover frequent item sets. After each iteration, a new candidate set is generated from the frequent itemsets discovered in the previous iteration. After calculating the support of the candidate set and comparing the support threshold, a new frequent itemset is generated from the candidate set.

(2) Layer-by-layer generation of strong association rules. A layer-by-layer approach is taken to extract all the rules that are above the confidence threshold from the rules whose posterior contains only one item. After the confidence pruning technique, these extracted rules can be used to generate new candidate rules.

In general, the result of the association analysis is a set of association rules arranged in descending order with confidence as the 1st metric and support as the 2nd metric.

## 2.3. Principal Component Analysis

The integration of red culture into the ideological and political education in colleges and universities involves a lot of specialized and basic courses, and the elements of integration are also elaborated from different perspectives. There is often a high degree of correlation and redundancy between these elements, and direct analysis is not only computationally intensive but also easy to lead to information overlap, thus increasing the complexity and uncertainty of model construction. In contrast, principal component analysis [17] uses the idea of dimensionality reduction to map the high-dimensional data space to a low-dimensional subspace by retaining the most important variant information in the data set, while maximizing the retention of the original data features. The main steps are as follows:

(1) Normalize the original data to eliminate the effect of magnitude:

$$X_{ij} = \frac{x_{ij} - \bar{x}_j}{\sigma_j} \quad (4)$$

Where:  $X_{ij}$  is the standardized index.  $\bar{x}_j$ ,  $\sigma_j$  are the mean and standard deviation of the  $j$  th variable respectively.

(2) Create a matrix of correlation coefficients between variables  $R$  :

$$R = \frac{1}{m} X^T X \quad (5)$$

Where:  $X$  is the normalization matrix;  $m$  is the number of samples.

(3) Calculate the eigenvalues and eigenvectors of the correlation coefficient matrix  $R$  :

$$\lambda_1 \geq \lambda_2 \geq \dots \geq \lambda_n \geq 0 \quad (6)$$

$$u_j = (u_{1j}, u_{2j}, \dots, u_{mj})^T \quad (7)$$

Where:  $\lambda_j$  is the eigenvalue of the correlation coefficient matrix  $R$  and  $u_j$  is the eigenvector.

(4) Determine the principal components and list the expressions:

$$\begin{cases} p_j = \lambda_j / \sum_{j=1}^n \lambda_j \\ s_p = \sum_{j=1}^k \lambda_j / \sum_{j=1}^n \lambda_j \end{cases} \quad (8)$$

$$\begin{cases} Y_1 = u_{11}X_{11} + u_{21}X_{12} + \dots + u_{m1}X_{pn} \\ Y_2 = u_{12}X_{21} + u_{22}X_{12} + \dots + u_{m2}X_{pn} \\ \vdots \\ Y_p = u_{1p}X_{p1} + u_{2p}X_{p2} + \dots + u_{mp}X_{pn} \end{cases} \quad (p \leq n) \quad (9)$$

Where:  $p_j$  The contribution rate of principal component  $Y$ .  $s_p$  Cumulative contribution rate of the principal component, when the cumulative contribution rate is >85%, the first  $p$  indicator variables are selected as principal components.

#### 2.4. Systematic clustering algorithm

The basic idea of the systematic clustering algorithm [18] is to first set each sample into a separate class, and use the distance between each two classes as an evaluation index to measure the degree of similarity between them. The larger the distance, the less similar the two classes are, while the smaller the distance, the more similar the two classes are. After the two classes with the highest degree of similarity are merged into a new class, the distance between the new class and other classes is calculated and the class with the highest degree of similarity to the new class is merged, and all classes are merged into one class by continuously iterating this process.

The process of systematic clustering algorithm is as follows:

(1) Data preprocessing

Since there are often differences in the unit of measurement and the degree of change between the  $m$  indicators of the  $n$  samples, which usually lead to very different results in the analysis of the data, in order to eliminate the effects of different scales and the degree of change of the variables and make the data comparable, the data need to be standardized. After the standardized transformation, the data are free from the limitations of the unit of measurement, dimensionless, but if there are still some indicators that do not reside in the range of  $[0,1]$ , the data need to be further normalized, which can greatly improve the accuracy and reasonableness of the results of the system clustering. Data normalization methods usually have the following kinds:

1) Standard deviation standardization:

$$x'_{ij} = \frac{x_{ij} - \bar{x}_j}{s_j} \quad (i = 1, 2, \dots, n, j = 1, 2, \dots, m) \quad (10)$$

Among them:

$$\bar{x}_j = \frac{1}{n} \sum_{i=1}^n x_{ij}, S_j = \left[ \frac{1}{n} \sum_{i=1}^n (x_{ij} - \bar{x}_j)^2 \right]^{\frac{1}{2}}, (j = 1, 2, \dots, m) \quad (11)$$

$x_{ij}$  denoted as raw data for the  $j$  rd indicator of the  $i$  nd sample,  $x'_{ij}$  standardized data for the  $j$  th indicator of the  $i$  th sample.

2) Polar deviation standardization:

$$x''_{ij} = \frac{x'_{ij} - \min_{1 \leq l \leq n} \{x'_{lj}\}}{\max_{1 \leq l \leq n} \{x'_{lj}\} - \min_{1 \leq l \leq n} \{x'_{lj}\}}, (j = 1, 2, \dots, m) \quad (12)$$

Where  $x''_{ij}$  is the normalized data for the  $j$  rd indicator of the  $i$  nd sample. After the polar transformation process, all the indicator data  $x''_{ij} \in [0, 1]$ .

(2) Calculate the distance between samples and samples

In the cluster analysis of the actual problem, usually by measuring the distance between any two sample points to measure the degree of proximity between them, if the definition of  $d_{ij}$  as the distance between sample  $x_i$  and sample  $x_j$ , there are several methods of calculating the distance between samples as follows:

1) Absolute value distance:

$$d_{ij} = \sum_{k=1}^m |x_{ik} - x_{jk}| \quad (13)$$

2) Euclidean distance:

$$d_{ij} = \left[ \sum_{k=1}^m (x_{ik} - x_{jk})^2 \right]^{1/2} \quad (14)$$

3) Minkowski distance:

$$d_{ij} = \left[ \sum_{k=1}^m (x_{ik} - x_{jk})^q \right]^{1/q} \quad (15)$$

4) Chebyshev distance:

$$d_{ij} = \max_{1 \leq k \leq m} |x_{ik} - x_{jk}| \quad (16)$$

5) Marginal distance:

$$d_{ij} = \left[ (x_i - x_j)' S^{-1} (x_i - x_j) \right]^{1/2} \quad (17)$$

Where,  $S$  is the covariance.

6) Lang's distance:

$$d_{ij} = \sum_{k=1}^m \frac{|x_{ik} - x_{jk}|}{x_{ik} + x_{jk}} \quad (18)$$

(3) Calculating class-to-class spacing

The methods of calculating class-to-class spacing include the longest distance method, the shortest distance method, the average intergroup connection method, the average intragroup connection method, the center of mass method, the median method, and the sum of squares of deviations method.

The longest distance method is to take the maximum distance between two samples of different classes as the distance between the two classes.

The shortest distance method is to combine two or more classes with the smallest distance.

The average connection between groups method is to take the average of the distance between two samples of individuals in two classes as the distance between classes. The within-group mean linkage

method is to take the average of the distances between all the individuals in the merged class as the between-class distance after combining the two classes into one class. The center of mass method and median method are used as the distance between the mean and median of the variables in the two classes as the distance between classes, respectively.

The sum of squared deviations method: first,  $n$  sample is set into  $n$  categories, as the sum of squared deviations within a category increases as the number of categories decreases, the two categories with the smallest increase in the sum of squared deviations are merged until all the categories are merged into one.

### 3. Analysis of research hotspots and trends in the integration of red culture into civic and political education

This paper mainly lays the foundation for the innovation and optimization of the content of ideological education in colleges and universities by exploring the laws related to the integration of red culture into ideological education. Before that, the research hotspots and trends of red culture integrated into civic and political education are analyzed.

#### 3.1. Classification of research topics

The 3,564 theme words about the integration of red culture into ideological education were obtained by the TF-IDF algorithm of natural language processing, jieba participle and K-means clustering. Sorted according to the number of occurrences of each theme word, 30 theme words with the highest number of occurrences were selected for statistical analysis, the average TF-IDF value of each theme word was calculated and the research type of each theme word was labeled, and the theme words were labeled as research object O, research content T and research method M. The results of the analysis of the theme words are shown in Table 1. It can be seen that the theme words such as curriculum Civics, colleges and universities, college students, red culture, Civics class, etc., not only have a high number of occurrences, but also have a high average TF-IDF value, which indicates that these theme words are the hotspot directions for scholars to study the integration of red culture into Civics education.

**Table 1.** Keywords analysis results

Serial number	Subject term	Frequency	Type	TF-IDF	Serial number	Subject term	Frequency	Type	TF-IDF
1	College student	16254	O	0.52	16	Theoretical course	784	T	0.61
2	Red	12046	T	0.61	17	Teaching reform	728	T	0.48
3	Education	10489	O	0.45	18	Practice	502	M	0.44
4	Thought	10144	T	0.41	19	Ideological and political theory	464	T	0.59
5	Ideological and political education	9024	T	0.37	20	Ideological and political work	453	T	0.56
6	Politics	7589	T	0.39	21	Internet	450	M	0.45
7	University	5207	O	0.43	22	Blend in	441	T	0.47
8	Red culture	4048	T	0.50	23	Zeitgeist	438	T	0.58
9	Curriculum ideology and politics	1657	T	0.63	24	Revolutionary culture	427	T	0.61
10	Ideological and political course	1325	T	0.72	25	Merge	396	M	0.37
11	Teaching	1248	M	0.44	26	Values	375	T	0.48
12	Culture	1207	T	0.40	27	New era	361	T	0.38
13	Patriotism	1159	T	0.48	28	Socialism	354	T	0.41
14	Innovate	926	T	0.36	29	Instructor	343	O	0.60
15	New media	802	M	0.35	30	Reformation	325	T	0.33

#### 3.2. Analysis of research hotspots

Research hotspot is the focus of the research field for a period of time, and scholars discuss the

topic together. There are many methods to analyze research hotspots, and the more commonly used ones are the scientometric method Citespace software, co-word analysis method, cluster analysis and multi-scale analysis. The traditional cluster analysis, is to use keywords for clustering, and then according to the clustering results to analyze the research hotspot areas, so that the analysis of the research hotspot is represented by the label of the clustering endpoints, the lack of research content and the research object of the correlation analysis.

In this paper, we will analyze the correlation between research content (T) and research object (O), and the heat map is shown in Figure 1. The integration of red culture into Civic and Political Education mainly centers on college students, and the hot content of the research is course Civic and Political. Curriculum Civics is a unique educational concept in Chinese colleges and universities, and it is the way forward for the development of ideological and political education in the new era. Compared with the traditional ideological and political education, the course of ideological and political education is an all-round education for college students, so that the ideological and political education and the professional courses go in the same direction. Through the integration of red culture in the course of ideology and politics, the work of ideological and political education in colleges and universities can more fully realize its function of educating people, play the role of thought leadership, and promote the comprehensive development of ideological and political education.

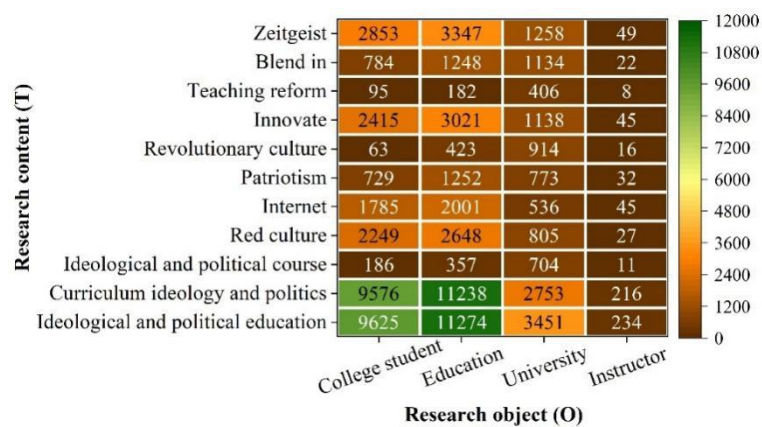


Figure 1. Heat map of research object (O) and research content (T)

### 3.3. Analysis of research themes based on keyword co-occurrence networks

#### 3.3.1. Analysis of keyword co-occurrence network structure

The structural characteristics of the keyword co-occurrence network of the study on the integration of red culture into the ideological education of colleges and universities are shown in Table 2. The number of nodes and edges of the keyword co-occurrence network grows faster, but the overall network density is smaller, which indicates that the connection between the keywords is not close in the overall view, and it is a sparse network. The average clustering coefficients of the network of the keyword co-occurrence network in the three phases are more than 0.85, and the average shortest path length is also shorter, which is only 2.720, which indicates that although the overall network is more sparse, a more compact sub-network has been formed a tighter sub-network. According to the characteristics of complex networks, the higher clustering coefficient and shorter average shortest path length are typical small-world network characteristics, therefore, the keyword co-occurrence network of red culture into the study of ideological education in colleges and universities has a small-world characteristic, and in the empirical study of social network analysis, the small-world characteristics of the network can significantly improve the interaction efficiency and information sharing efficiency between the network nodes, so that the individual participation in the interactive The enthusiasm of individuals participating in the interaction is significantly increased. Therefore, the keyword co-occurrence network forms more closely connected communities based on the semantic association between keywords in the local area, and these communities constitute the theme of the research on the integration of red culture into the ideological and political education in colleges and universities.

Table 2. Research keywords co-appear network structure characteristics

Stage	Number of nodes	Number of edges	Network density	Average clustering coefficient	Average shortest path length
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2008-2013	348	934	0.017	0.884	2.703
2014-2019	1165	3567	0.017	0.871	2.718
2020-2024	948	3129	0.008	0.872	2.738

### 3.3.2. Keyword Co-occurrence Web Community Mining and Thematic Analysis

Finding a clustering subspace based on some association in a complex network is the main purpose of network community mining, and this paper utilizes K-clique penetration algorithm to mine the clustering subspace of keyword co-occurrence network. In this paper, K-clique penetration algorithm is implemented in networkx software to obtain the mining results of keyword co-occurring network communities in various stages of university online public opinion.

Comprehensively analyzing the keywords belonging to each community, it is found that the research themes at each stage are roughly the same, but the keywords corresponding to each theme and their semantics are different, and the research theories and methods involved are different. Keyword co-occurrence network community mining for the study of red culture integration into ideological education in Chinese universities found a total of 4 valid network communities. After analyzing the semantics of the keywords of each community, it was found that 2 communities had greater semantic repetition, and therefore 2 valid communities were retained. After the semantic analysis of the community keywords, the 2 keyword communities are summarized as: ideological and political education in colleges and universities, and counselor work.

#### (1) Ideological and political education in colleges and universities

The first phase of the study focuses on analyzing the impact of red culture on the ideological and political education work in colleges and universities in the information age, and exploring the functional expansion and work innovation of ideological and political education in colleges and universities under this background. In terms of specific implementation, it is mainly for college BBS, building a thematic network ideological and political education platform red cultural resources, sound network ideological and political professional team, and strengthening the team's professional ability to learn and train. With the development of the information society, the role of network ideological and political education in the ideological and political education of college students is becoming more and more obvious, and it will be integrated with the red culture, and the red culture will be included in the process of ideological and political subject education. However, in the process of ideological and political education in colleges and universities, there are common problems such as insufficient attention to red culture education and guidance, insufficient investment and lack of experience. The second phase of the research pays more attention to the practical operation of red culture integration and carries out relevant case analysis and research. For example, the red culture education in colleges and universities and the ideological and political education of college students in the ideals and beliefs education, values education and moral indoctrination are combined with each other to realize the functional coupling effect, resulting in the effect of "1+1>2". At the same time, the teaching of ideological and political education courses in colleges and universities has been explored, and the concept and spirit of red culture have been integrated into the teaching of the courses. The third phase of the study pays more attention to the innovation and reform of ideological and political education in colleges and universities, and the application of mobile Internet by college students is rapidly increasing, which brings new ideas and methods for ideological and political education in colleges and universities, such as: building an emerging network ideological and political education platform, strengthening the ideological leadership, value leadership and political leadership of ideological and political courses for college students, utilizing novel teaching methods, effectively integrating the goal of ideological and political education with the goal of propaganda of the red culture in colleges and universities, and enhancing college students' understanding of the concept and spirit of red culture. Using novel teaching methods, the goal of ideological education and the goal of red culture in colleges and universities are effectively integrated to enhance the recognition and love of college students for red culture.

#### (2) Counselors' Work

At the first stage, the role of counselors in the red culture of colleges and universities in the integration of ideological and political education has been discussed more. The innovative ability of college counselors in the promotion of red culture has an important role in promoting the organic integration of red culture and ideological education. The second stage of the study on how to transform the role of counselors in the integration of red culture into the work of ideological and political education in colleges and universities, college counselors should be transformed from pure ideological and political educators to the network of ideological and red culture guides, and from the experience-based managers to the expert, research-oriented transformation, to become the network information "gatekeeper". What's more important is to establish a professional and vocational

counselor team, strengthen the cultivation of network ability, and improve the counselor's ability to propagate red culture. In the third stage, college counselors emphasize more on the practical ability of integrating red culture into the ideological and political education of colleges and universities, such as the ability to study and judge the information of cultural dissemination, the ability to lead and guide the related issues, and the quality of network crisis public relations.

#### 4. Analysis of the law of the integration of red culture into civic education in colleges and universities

This chapter uses association rule analysis, principal component analysis, and systematic clustering methods to explore the laws related to the integration of red culture into the ideological education of colleges and universities.

##### 4.1. Analysis of association rules

The results of the previous analysis show that the Civic and Political Education integrates the red culture with more contents and involves many specialized and basic courses, and the elements integrated are also elaborated from different perspectives. And the association rule technique is to discover the association between multiple elements from a large amount of data. Therefore, this study applies SPSS Modeler 14.1 statistical software to analyze high-frequency elements with association rules, uses Apriori modeling to further mine the interrelationships between different elements, and sets the conditions of 20% support, 80% confidence, maximum number of antecedent terms of 5, and enhancement degree  $\geq 0.90$  to mine the potential combinations of commonly used elements, and obtains the core combinations of 18 kinds, and association rule mining results are shown in Table 3. The minimum values of support, confidence and enhancement of the obtained 18 core combinations are 27.06%, 81.25% and 0.96 respectively, which meet the set requirements.

The top 10 combinations in terms of association strength are selected through the association rules based on the support ranking: red culture-theoretical class, red culture-innovation, red-teaching, red culture-values, red culture-curriculum ideology, red culture-theoretical class-values, red culture-innovation-theoretical class, red culture-teaching-theoretical class, red culture-patriotism-the spirit of the times-revolutionary culture, red culture- Innovation-Teaching, and its top-ranking high-frequency elements can be cross-checked with each other, indicating the reliability of its statistics. From the above, it can be seen that the integration of red culture into the ideological education of colleges and universities is mainly to excavate the revolutionary culture and the spirit of the times from the ideological theory class and course ideology, reform the teaching method, and incorporate the knowledge of innovation, values, patriotism and so on, which are embedded in the red culture.

**Table 3.** Analysis of association rules of red culture into ideological and political education

Serial Number	Association rule	Support /%	Confidence /%	Lift
1	Red culture→ Theoretical course	74.56	92.89	1.05
2	Red culture→ Innovate	61.54	90.45	1.04
3	Red culture→ Teaching	51.06	88.77	0.99
4	Red culture→ Values	50.55	94.32	1.05
5	Red culture→ Curriculum ideology and politics	48.21	87.51	1.00
6	Red culture→ Teaching reform	32.69	89.37	1.02
7	Red culture→ Zeitgeist	27.46	88.28	0.98
8	Red culture→ Practice	27.66	81.25	1.11
9	Red culture→ Practice, Patriotism	27.26	85.13	0.96
10	Red culture→ Theoretical course, Ideological and political course, Socialism	27.06	93.78	1.28
11	Red culture→ Ideological and political education, Curriculum ideology and politics	27.68	85.88	0.99
12	Red culture→ Patriotism, Zeitgeist	27.21	91.16	1.03
13	Red culture→ Theoretical course, Values	46.54	81.57	1.12
14	Red culture→ Innovate, Theoretical course	44.06	94.16	1.08
15	Red culture→ Teaching, Theoretical course	36.21	93.08	1.07
16	Red culture→ Innovate, Teaching	34.99	93.42	1.07
17	Red culture→ Patriotism, Zeitgeist, Revolutionary culture	35.94	93.78	1.06
18	Red culture→ Teaching, Values	28.68	90.07	1.01

## 4.2. Principal component analysis

The 17 high-frequency elements involved in the association rules were factor analyzed using SPSS Statistics 28.0 statistical software, and the KMO and Bartlett's test of sphericity were completed before the statistics, and the KMO value was 0.86 ( $P < 0.05$ ), and the  $\chi^2$  value of the Bartlett's test of sphericity was 324.0, with a degree of freedom of 138, which is a significant difference ( $P < 0.05$ ), the data had a good linear relationship and could be analyzed by factor analysis. The maximum variance method of rotation was selected to extract and obtain 7 common factors, and the elements were categorized into the common factors with the highest value of their contribution, and the rotated component matrices of the high-frequency elements and the information of the common factors were shown in Table 4 and Table 5, respectively. The results show a total of 7 categories of common factors: F1 for ideological education, curriculum ideology, F2 for theory class, ideology class, socialism, F3 for red culture, values, F4 for the spirit of the times, revolutionary culture, F5 for teaching and learning, innovation, F6 for teaching reform, and F7 for patriotism, practice, which are roughly the same as the results of the association rule analysis, and can be checked against each other in order to validate the data.

**Table 4.** Rotate the element matrix

Serial Number	Name	Element						
		1	2	3	4	5	6	7
1	Red culture	0.061	0.259	0.632	-0.094	-0.018	0.145	-0.083
2	Teaching	0.03	-0.285	0.137	-0.188	0.518	-0.544	-0.054
3	Innovate	-0.09	0.182	0.047	0.038	0.826	0.094	0.078
4	Values	-0.073	-0.026	0.730	0.153	0.066	-0.104	-0.005
5	Ideological and political education	0.761	-0.17	-0.032	-0.099	-0.11	-0.012	0.001
6	Curriculum ideology and politics	0.804	0.166	-0.048	0.099	0.084	-0.121	-0.014
7	Socialism	-0.097	0.786	0.099	-0.043	0.196	0.055	-0.105
8	Patriotism	0.312	0.025	0.197	-0.114	-0.05	0.402	0.467
9	Zeitgeist	-0.166	0.112	0.028	0.726	-0.458	-0.126	0.103
10	Revolutionary culture	-0.009	0.091	0.073	0.785	0.067	-0.023	-0.005
11	Teaching reform	-0.134	-0.061	0.015	0.102	0.13	0.774	0.019
12	Practice	-0.072	-0.023	-0.122	0.079	0.051	-0.016	0.913
13	Theoretical course	0.038	0.583	0.336	0.075	-0.24	-0.343	0.239
14	Ideological and political course	0.173	0.493	-0.469	0.132	-0.059	0.057	-0.037

**Table 5.** Rotate the element matrix

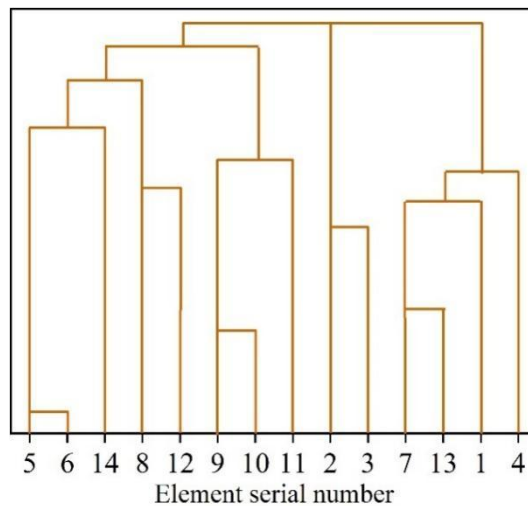
Common factor	Factor analysis combination
F1	Ideological and political education, Curriculum ideology and politics
F2	Theoretical course, Ideological and political course, Socialism
F3	Red culture, Values
F4	Zeitgeist, Revolutionary culture
F5	Teaching, Innovate
F6	Teaching reform
F7	Patriotism, Practice

## 4.3. Cluster analysis

Cluster analysis is one of the basic methods of data mining, as a powerful tool to obtain knowledge in massive data, this study uses SPSS Statistics 28.0 to conduct systematic cluster analysis of the high-frequency elements of red culture into ideological and political education, the statistical method adopts the "centralized plan" and "approximate value matrix" and "Wald" clustering method, the interval adopts the "square Euclidean distance", and the distance between classes is 25, which is divided into four categories. The results of cluster analysis of the integration of red culture into the ideological and political education system are shown in Figure 2. The abscissa represents the serial numbers of different elements, and the corresponding categories are the same as those in Table 4.

Cluster analysis showed that it was categorized into 4 classes. Among them, the clustering category is ideological education, curriculum ideology, ideological courses, patriotism, and practice. The core value of red culture is extremely rich and contains numerous elements of course civics. Integrating red culture into college students' civic education, systematically excavating the connotations, value pursuits, and moral thoughts embedded in red culture allows college students to enhance their patriotism emotion, so that they will have scientific three views, noble character, and love for the motherland, and

incorporate them into their daily life practice. Gathering two categories for the spirit of the times, revolutionary culture, teaching reform. Traditional teaching methods are single and dull, and students can not resonate with the ideological education. Under the new situation, classroom teaching has been adopted online and offline hybrid lectures, online lectures have more video materials and storylines, which enhance the interaction with students. At the same time, in the teaching of Civics and Politics, the spirit of the times and revolutionary culture are integrated, so that students can feel the revolutionary culture in the new era of thinking. Gathering three categories for teaching and innovation, red culture unites the spirit of countless forefathers and martyrs, is the crystallization of the glorious civilization of Chinese culture, colleges and universities are the main place to inherit and carry forward the traditional culture, to rely on the nurturing role of the traditional culture, to provide fertile ground for the dissemination of education and cultural heritage in the new era, while also undertaking the inheritance and innovation of traditional culture. Therefore, the teaching incorporates the essence of red culture, which is integrated into the teaching design of the Civic and Political Science Class, strengthens the value education, enhances the students' sense of mission and responsibility of cultural inheritance, and cultivates their innovative consciousness. The four categories of aggregation are socialism, theory class, red culture, and values. The cultivation of values is an important content of the ideology of college curriculum, and the integration of red values into it is a systematic project. Based on the fit and integration of red culture and socialist core values, colleges and universities should integrate curriculum resources, strengthen the practice of nurturing paths, and explore the degree of integration of the red cultural values education with the ideology of the curriculum. Red culture and values is the key link of the ideological education in colleges and universities, and teachers in colleges and universities should vigorously promote red culture in the ideological theory courses, enhance the correct values of students, and cultivate successors for the construction of socialism.



**Figure 2.** Red culture into ideological and political education system cluster analysis tree

### 5. Innovative and optimized ways of integrating red culture into civic education

Based on the laws obtained and the related literature research, this paper designs the following innovative and optimized ways of integrating red culture into the ideological education.

#### (1) Teaching content innovation

In the ideological and political education of college students, in order to accelerate the promotion of systematic innovation in teaching, all the major colleges and universities have to devote themselves to the innovation of teaching content in the process of carrying out teaching innovation. Teachers play a key role in ideological and political education, a good team of teachers can guide the teaching work in an orderly manner, college students in the process of learning and growth of many problems and their own thinking there is a close correlation between the ideological and political education of the red culture into the ideological and political education can help students to solve their ideological problems, reduce the pressure on teachers in the work of the students. In order to comprehensively change the current teaching status quo, teachers should put the establishment of the teacher team and the innovation of teaching content in the same important position, set up a special ideological and political education team, and regularly provide professional training for teachers in the team, so that these teachers can dynamically grasp the teaching situation of the subject, and fundamentally participate in the innovation of teaching content.

In traditional teaching, the teaching content is more of the theory of celebrities, ancient language and family training and other traditional culture into the classroom, this way of teaching is relatively backward, the students to the classroom teaching content, method of acceptance is not strong, can not guarantee the effectiveness of teaching. Teaching content innovation, teaching content should be closely integrated with students' life learning, teachers in the classroom teaching, in addition to unilateral content output, but also gradually try to take the students as the main body of the teaching, integrated into the educational content about the red culture, organizing Civic and Political Education storytelling, etc., so that students share their own experiences in the classroom, with a variety of practical cases to improve students' ideological and political awareness, not only can This can not only make students' acceptance higher, but also mobilize students' enthusiasm for learning, so that students can effectively combine theoretical learning with practical activities in ideological and political education, and understand and master the connotation of ideological and political education and the spirit of red culture more deeply in practical activities.

(2) Strengthening the effective integration of red classics and social practice activities of college students

In the process of integrating red culture into ideological and political education, the integration of red classics and social practice activities should be strengthened. Because rich and colorful social practice activities can mobilize students' enthusiasm for learning to a large extent, which enables students to understand the basic theories of ideology and politics more deeply in the process of participating in all kinds of practice activities. The high degree of integration of red classics and social practice can enhance the degree of integration of red culture in ideological and political education, and improve the overall teaching results. College students should go out of the classroom, enter the society, and visit the red education bases and red venues on a regular basis, so that they can fully feel the practical charm of the red culture in the process of participating in the red activities, and deeply penetrate into their own learning and work with the spirit and culture embedded in the red culture. In the process of participating in these red activities, they can fully feel the actual charm of red culture and deepen the spiritual culture contained in red culture into their own learning and working process, which will gradually arouse the resonance of people's emotions and thoughts, and realize the transformation of red culture into the inner ideological quality of students. The rich content and diverse forms of the red classics, together with their good infectious power, can completely guarantee their ideological guidance in the minds of students.

(3) Strengthen the effective integration of red classics and new media platforms

After the arrival of the new media era, when teaching ideological and political education courses, the application of new media technology and tools in classroom teaching can completely promote the realization of teaching goals. New media technology presents the characteristics of high efficiency, interactivity, immediacy and diversity, which make it popular among students and teachers in the teaching of contemporary subjects. College students are the most active subjects in the new media, with the help of the network's wide range and strength of dissemination, they can expand the influence of red culture in the process of integrating red culture into ideological and political education. For example, universities and colleges can set up red classic education columns in their campus websites, open official social accounts, and utilize new media to disseminate red classic stories and red classic movies to college students. Teachers can increase the use of network resources when teaching red culture, collect all kinds of information from the open network environment, and improve the overall teaching results through a high degree of combination of network teaching resources and textbook resources.

(4) Implementation of three-dimensional cultivation

When the ideological and political education system of college students is innovative, three-dimensional cultivation is also very important. In the process of students' ideological and political education and cultivation, teachers should pay attention to students' psychological quality and career planning, carry out personalized education and guidance according to the different needs of the students, constantly combine teaching activities with the background of the times, and improve the students' ideological awareness through the promotion of the red spirit. All full-time teachers in the ideological and political education of college students, should always adhere to the goals and requirements of three-dimensional training, because of the complexity and diversity of university education, ideological and political education has a clear division of labor and cooperation, in order to ensure the systematic innovation of teaching, the teacher in the teaching process should penetrate the overall goal of three-dimensional training, so that the different departments within the school can maintain a high degree of cooperation and coordination.

## 6. Conclusion

This paper proposes a content innovation and optimization approach for the integration of red culture into the civic education of colleges and universities, empowered by the TF-IDF algorithm, the Apriori association rule algorithm, the principal component analysis method, and the systematic clustering algorithm.

The high number of occurrences and high average TF-IDF value of the theme words such as curriculum Civics, colleges and universities, college students, red culture, and Civics class indicate that these theme words are the hot direction for scholars to study the integration of red culture into Civics education. Through the correlation analysis of the research content and the research object, it can be seen that the hot content of the research is the course Civics. The integration of red culture into curriculum civic politics can help colleges and universities give full play to the function of educating people and promote the overall development of civic education. In addition, the method of network ideology and counselor work are also important factors affecting the integration of red culture into the ideological education of colleges and universities.

Through the analysis of the law, it can be seen that the red culture is integrated into the civic education of colleges and universities, and the way is mainly from the civic theory class and course civic education to excavate the revolutionary culture and the spirit of the times, and through the reform of the teaching method, the innovation, values, patriotism and other knowledge embedded in the red culture is integrated into the civic education.

On this basis, this paper summarizes the innovative and optimized ways of Civic and Political Education, such as innovating the teaching content, effectively integrating the red classics with social practice and new media platform, and combining the spirit of the times with the characteristics of students for three-dimensional cultivation.

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