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Optimization and Evaluation of Curriculum Effect of Traditional Rule of Law Culture Integrated into Civics Virtual Reality Teaching in Colleges and Universities Based on Differential Evolutionary Algorithm

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ABSTRACT

The organic combination of traditional rule of law culture and Civics education in colleges and universities is a breakthrough to improve the effectiveness of Civics education. Focusing on the Civic and political education that integrates traditional rule of law culture, the article introduces virtual reality technology and differential evolution algorithm to explore the course effect optimization method of Civic and political virtual reality teaching, and obtains the optimal content applied to the corpus through differential evolution algorithm according to the content characteristics of Civic and political education. On this basis, the evaluation index system is constructed to assess the course optimization effect of Civics virtual reality teaching. Example validation shows that the Civics corpus based on differential evolutionary algorithm and the proposed Civics virtual reality teaching method achieve better Civics course optimization effect, with an overall score of 3.833, and have the ability of practical application. Students of different genders and grades show significant differences ($P<0.05$) in the evaluation results of most of the first-level indicators. The application section of virtual reality technology promotes the teaching effect of traditional rule of law culture into the ideological education of colleges and universities.

Keywords: differential evolutionary algorithm, virtual reality, corpus; evaluation index system, civic education

1. Introduction

In the context of comprehensively promoting the rule of law, the cultivation of rule of law talents with “moral and legal cultivation, righteousness and innovation” is the demand and mission of law

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education in colleges and universities [1]. In the new era and new journey, colleges and universities need to pay attention to the cultivation of students' professionalism, professional ethics, and rule of law culture, relying on the synergistic cultivation of law courses and ideology and politics courses, to help students grow up to be composite rule of law talents with strong comprehensive qualities [2-3]. With the morality and law as the lead, colleges and universities need to establish a "big ideological and political" concept, through updating the teaching concept of the course, optimizing the content of the course teaching, perfecting the evaluation of the course teaching and other measures, to carry forward the rule of law culture, enhance the cultural literacy of rule of law talents and cultural self-confidence in practice, to promote the rule of law construction with the cultivation of high-quality rule of law talents [4-5].

The Chinese meaning of VR is virtual reality, in general terms, VR technology empowers the practical teaching of college civic politics class is to simulate the virtual environment through multimedia technology, giving people an immersive feeling, and increasing the audience audio-visual experience [6]. VR technology empowers the practical teaching of college civic politics class is well adapted to the interest and enthusiasm of young students for science and technology, and is able to integrate the dominant and the subjective [7]. Multimedia virtual simulation to simulate the reality of the scene is an important form of practical teaching, through the VR virtual simulation teaching to enhance students' understanding and cognition of the social classroom, is an important way to carry out the unity of the theoretical and practical Civic and Political Classes [8-9]. Therefore, there is an urgent need to enhance the effectiveness of practical teaching of Civic and Political Science courses by improving the ways and methods of integrating VR technology into the teaching of Civic and Political Science courses [10].

The studies conducted around the culture of civics and rule of law are as follows, Zeng, Y et al. discussed the similarities and differences between civic moral education and rule of law education, and concluded that moral and rule of law education is due to be based on the students' personal life experiences in order to encourage students' active participation, and then to develop responsive moral and rule of law perspectives [11]. Wen, H. puts forward a series of teaching practices to promote the completion of the classroom reporting program of the ideology, morality and rule of law course, and relying on the 146 business integration development model, to further promote the transformation of the four links of theoretical knowledge and practice in the "learning, thinking, research and practice" of the ideology, morality and rule of law course [12]. An, J talked about the positive significance of the work for national unity and the establishment of the national ideology and rule of law society, but also conducive to the formation of national community consciousness [13].

Literature focusing on the empowerment of Civics teaching by virtual reality technology includes the following: Liu, Y et al. used virtual reality technology to develop a virtual museum with the theme of Civics education, which in turn promoted the reform and innovation of Civics theoretical course teaching [14]. Zhang, H et al. conceptualized an immersive Civics teaching mode with virtual reality technology as the underlying logic, which can effectively stimulate students' learning motivation [15]. Liu, C et al. studied the introduction of virtual reality technology in the Civics teaching classroom, which enhances the effectiveness of the Civics teaching classroom and has a positive effect on the enhancement of students' cognitive level of national identity [16].

This paper discusses the optimization path of virtual reality technology in the integration of traditional rule of law culture into the teaching of Civics, and proposes the way of combining virtual reality technology and corpus, using the differential evolution method to screen the Civics teaching content that integrates the traditional rule of law culture, and to build a Civics multimodal corpus. Based on this, the proposed Civics virtual reality teaching method is practiced with students of a university as the research object. Drawing on the CIPP model to select the course optimization effect evaluation indexes of Civics virtual reality teaching, the grey correlation analysis method is used to

assess the optimization effect of Civics courses, and the three dimensions of different genders, different grades and different disciplines are analyzed for differentiation, so as to explore the teaching effect of the proposed Civics virtual reality teaching optimization method in depth.

2. Optimization of the curricular effects of virtual reality teaching of Civics

The integration of traditional rule of law culture into the ideological and political education of students in colleges and universities is an important way to cultivate students' rule of law thinking. Based on differential evolutionary algorithm and virtual reality technology, this paper explores the optimization method of integrating traditional rule of law culture into the virtual reality teaching of ideological and political education in colleges and universities.

2.1. Enhanced virtual reality teaching and learning

The use of virtual reality technology to carry out immersive ideological, moral and rule of law education experiences is an innovative teaching method. Through virtual reality technology, students can have a deeper understanding of traditional rule of law culture and can better apply it to real life. Virtual reality technology allows students to personally experience different situations and develop their critical thinking and judgment.The application strategies of VR technology in the teaching of ideology and politics in colleges and universities are as follows.

2.1.1. Increase investment in information technology. Colleges and universities should better combine virtual reality technology with ideological and political education in classroom teaching, create an interactive, three-dimensional and all-round virtual reality technology learning space, and provide material guarantee for the application and popularization of virtual reality technology in the traditional rule of law culture into the ideological and political education of colleges and universities. Based on the school's own characteristics and actual situation, the introduction of existing VR technology-related educational products, to build an educational and teaching platform for the ideological and political courses suitable for the local and our school.

2.1.2. Strengthening the teaching force. It is necessary to “fully allocate” teachers of the Civics course, encourage teachers to participate in more training on the application of VR technology in the Civics course, and guide teachers to study virtual teaching, with the aim of realizing the efficient integration of the curriculum and technology. In the process of resource construction, teachers should be actively called upon to participate and apply for multiple funding when researching topics, so as to accelerate the application of VR technology in college resources. In order to cultivate future-oriented excellent teachers, attract excellent talents from teaching, strengthen the team building of the Civics and Political Science course, emphasize the training of basic teaching skills and practical teaching, and constantly update the content of the course.

2.1.3. Enhanced level of resource development. Introducing and promoting VR technology educational resources, realizing the sharing of resources by region or industry, comprehensively innovating the construction and operation mode, supporting VR enterprises and schools to build bases, developing support platforms for traditional rule of law culture content materials in college and university civic education courses, and building educational resource libraries, such as a corpus of civic education content that incorporates traditional rule of law culture.

2.2. Corpus combined with VR

Corpus technology can provide learners with access to and analysis of a large amount of authentic materials, thus helping them to better understand the traditional culture of the rule of law. Virtual reality technology, on the other hand, can create an immersive learning environment for learners to

practice and experience Civics knowledge in a space without physical boundaries.

2.2.1. Heuristic learning. Integrating the textual data of traditional rule of law culture collected in the corpus with simulated situations can greatly promote learners' active and proactive exploration of traditional rule of law culture in Civic and Political Education. Combining the use of corpus and virtual reality technology, learners are able to learn about different traditional rule of law cultures and improve the literacy of rule of law education. The combination of corpus technology and virtual reality is an interactive learning mode, and when the learning activities become more vivid and interesting, learners are often more willing to invest their time and energy in learning, while the immediate feedback in the interaction can also give learners positive reinforcement.

2.2.2. Corpus construction. Considering the relevance, scale and representativeness of the corpus, the multimodal corpus content is summarized according to the teaching content of Civic and Political Education, which needs to take into account the characteristics of contemporaneity, comprehensiveness and appropriateness. Therefore, in order to obtain the optimal corpus content that meets the requirements, the differential evolution algorithm is used to intelligently screen the content of the Civic Politics teaching corpus that integrates the traditional rule of law culture.

1) Corpus Screening Based on Differential Evolution Algorithm. The population $X^0 = \left[x_1^0, x_2^0, \cdots, x_{N_p}^0 \right]$ is initialized in the space of feasible solutions, where Eq. $|F|$ is the number of feasible solutions generated by each search process and $|S|$ is the number of individuals generated. Similarly, the constraint violation function mean can be used to measure the strength of the different sexual solution inverse constraints in the population as follows:

$$P_{avg} = \sum_{y \in P_o P_c} P_{(y)} / P_o P_c \tag{1}$$

Where, P_o is the number of elements contained in the set, P_e is the number of elements contained in the population, and $P(y)$ is the inverse constraint strength function. In order to reduce the complexity of the algorithm, let the feasible set size is N_1, the infeasible population size is N_2, the maximum size is N_3, O is the number of population sizes, and the complexity of the diversity population can be expressed as:

$$M = N_3 O((N_1 + N_3)^3) + (N_1 + N_3)\log(N_1 + N_3) \tag{2}$$

Then the complexity after one iteration of the difference algorithm can be expressed as:

$$\begin{aligned} M = {} & O(N_1) + O(N_1) + O(N_1) + O(N_2) + O(N_1) \\ & + O(N_1 + N_3) + O((N_1 + N_3)^2) \\ & + O(N_1 + N_3)^3 + O((N_1 + N_3)\log(N_1 + N_3)) \end{aligned} \tag{3}$$

If the search range $N = N_1 + N_2 + N_3$, it effectively reduces the complexity of the processed $M < O(N^3)$.

Where, N_P is the population size, $x_i^0 = \left[x_{i,1}^0, x_{i,2}^0, \cdots, x_{i,D}^0 \right]$ is the individual representation problem solution, and D is the dimension of the optimization object. A new population will be screened after the current population is subjected to the cross mutation operation, and then the selection operation based on the greedy idea is used to process the 2 populations for one-to-one selection, so as to screen and obtain a new generation of populations. The specific process is that the mutation operation is performed on the individual $x_i^{'}$ within each t moment through equation (1) to obtain the corresponding mutated individual v_i^{l+1}, i.e.:

$$v_i^{l+1} = x_{r_1}^l + K(x_{r_2}^l - x_{r_3}^l) \tag{4}$$

where r_1, r_2, r_3 both denote individual characterization coefficients, $r_1, r_2, r_3 \in \{1, 2, \cdots, N_p\}$ are different from each other, $x_{r_1}^t$ is the parent base vector, $(x_{r_2}^t - x_{r_3}^t)$ is the parent difference vector, and K is the scaling factor. Subsequently, the crossover operation of x_i^t and v_i^{t+1} is processed by Eq. (2) to obtain the test individual u_i^{t+1}, which is as follows:

$$u_i^{t+1} = \begin{cases} v_i^{t+1}, & \text{rand}(i) \le \text{CR or } i = rnbr(i) \\ x_{i'}, & \text{other} \end{cases} \tag{5}$$

where $\text{rand}(i)$ is a random number uniformly distributed between [0, 1] and CR is the crossover probability in the range [0, 1] $rnbr(i)$ is a random quantity within $\{1, 2, \cdots, D\}$. Subsequently, the objective function of individuals u_i^{t+1} and x_i^t are compared through equation (3), and the individual with the lower function value is selected as the new population individual. Then:

$$x_i^{t+1} = \begin{cases} u_i^{t+1}, & f(u_i^{t+1}) < f(x_i^t) \\ x_i^t, & \text{other} \end{cases} \tag{6}$$

where $f(u_i^{t+1})$ is the objective function of u_i^{t+1} and $f(x_i^t)$ is the objective function of x_i^t, where $f(u_i^{t+1}) = \int u_i^{t+1} du$, $f(x_i^t) = \int x_i^t dx$.

In order to measure the diversity of the group, the diversity metric criterion ρ is introduced and defined as follows:

$$\rho = \frac{|F|}{|S|} \tag{7}$$

2) Basic framework of the corpus. The general framework of the corpus is shown in Fig. 1, and the whole system is mainly divided into four modules, which are four parts: user management module, framework management module, Civics corpus management module, and corpus statistics retrieval module.

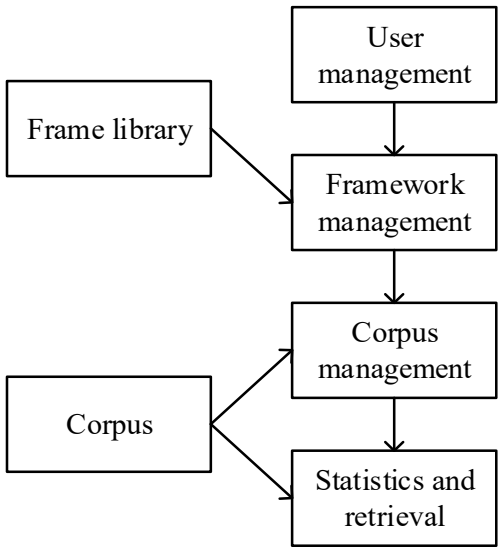

Fig. 1. The basic framework of the system

3. System for evaluating the effectiveness of course optimization

3.1. Sample Selection

This paper takes the students of a university in X city as the experimental objects, based on the course effect optimization method of Civics virtual reality teaching proposed above, combined with

the Civics corpus constructed based on differential evolution algorithm, carries out the virtual reality teaching of the Civics course which integrates the traditional rule of law culture for a period of 3 months. At the end of the course, the teaching effect was evaluated using the constructed course optimization effect evaluation system and grey correlation analysis method.

3.2. System of evaluation indicators

Drawing on the CIPP model, the article constructs the evaluation index system of the optimization effect of the Civics course from the four levels of background, input, process and output. The expert consultation method is used to screen the indicators in the preliminary constructed scale question bank and put forward amendment opinions and suggestions, and finally establish the evaluation index system of the virtual reality teaching of Civic Politics courses integrated with the traditional culture of the rule of law. The evaluation index system of virtual reality teaching of Civics courses is shown in Table 1, which consists of 7 first-level indexes and 14 second-level indexes.

Table 1. The evaluation index system of VR teaching in Ideological and political education

Primary indicator	Secondary indicator
Goals and requirements A1	Education target B1
	Education demand B2
Prior knowledge A2	Basic accomplishment B3
Culture of law A3	The culture of the law is integrated B4
Resource allocation A4	Competency of teachers B5
	VR course construction B6
Teaching activity A5	Autonomous learning B7
	Classroom instruction B8
	Practical teaching B9
Evaluation and feedback A6	Performance evaluation B10
	Instructional feedback B11
Learning effect A7	Knowledge acquisition B12
	Skill breeding B13
	Affective breeding B14

3.3. Gray correlation analysis

In this paper, on the basis of the evaluation index system of the optimization effect of the Civics course, the grey correlation analysis method is used to assess the optimization effect of the course in which the traditional development culture is integrated into the Civics education. Gray correlation analysis, mainly by observing the similarity of the geometric shapes of the change curves of the main factors, to infer their correlation with each other. In gray correlation analysis, the gray scale indicates that the information content of the system or object is not completely reliable, while the correlation indicates that they have some kind of connection with each other. Using gray correlation analysis, it is possible to measure the comparable factors of comparing objects with each other, so as to more accurately determine the degree of correlation between them both. In addition, the gray correlation analysis method is not limited by the total number of samples and laws, and the amount of calculation results is extremely small, so it is very suitable for the use in the practice of optimization effect assessment of Civics courses.

3.3.1. Determining the parameter array. The grey correlation analysis method aims to assess the similarity or proximity between the target subject and the reference subject by creating a system of indicators to better identify the correlation between them. The method defines the data series that characterize the target subject as the reference series, while the data series that characterize the reference subject are defined as the comparison series.

Therefore, the gray correlation analysis method must first establish a reference series that represents the behavioral characteristics of the whole system, also known as the parent series, they are generally $x_0 = \{x_0(k) \mid k = 1, 2 \cdots, m\}$. It can also be a comparison series that affects the actions of the system in order to better analyze the behavioral characteristics of the system, and the comparison series is a sequence of data consisting of various factors that affect the system's activities, which is also called the sub-sequence. Where the subsequence's are generally $x_i = \{x_i(k) \mid k = 1, 2, \cdots, n\} i = 1, 2, \cdots, n$.

3.3.2. Dimensionless quantization. Since the data in the reference and comparison columns in gray correlation analysis have very different importance, they have different scales, which might cause the comparison conclusions to be incorrect or unreliable. To solve this problem, gray correlation analysis usually uses dimensionless processing, i.e., combining all the raw data in the reference and

comparison columns to ensure the reliability of the final conclusions. Dimensionless processing method:

1) Initialization is completed by dividing each data in the matrix by the first number to obtain a new matrix:

$$x_i(k) = \frac{x_i^{'}(k)}{x_1^{'}(k)} \tag{8}$$

2) By dividing the average of all the factors in the matrix by the other factors in the computational matrix, a new matrix can be derived, which is called averaging. Then:

$$x_i(k) = \frac{x_i^{'}(k)}{\frac{1}{m}\sum_{k=1}^{m} x_i^{'}(k)} (i = 0,1,2,\cdots,n; k = 1,2,\cdots,m) \tag{9}$$

3) $\frac{x-\overline{x}}{s}$ Transformation

With the dimensionless processing method, the data series can be represented as the following matrix:

$$\left[X_0, X_1, \cdots, X_i\right] = \begin{bmatrix} x_0(1) & x_1(1) & \cdots & x_i(1) \\ x_0(2) & x_1(2) & \cdots & x_i(2) \\ \vdots & \vdots & \vdots & \vdots \\ x_0(k) & x_1(k) & \cdots & x_i(k) \end{bmatrix} \tag{10}$$

3.3.3. Gray correlation coefficient. In gray correlation analysis, the last step is to calculate the correlation, or degree of relationship, between the reference and comparison series in order to rank the reference series comparison series according to the amount of correlation in order to better analyze their relationship with each other.

The degree of correlation between the reference series x_0 and several other comparison series $x_1, x_2, \cdots, x_n$ is measured by comparing the geometric difference between them. To calculate this degree of correlation, the following formula can be used: ρ, which is a coefficient of differentiation, typically between 0 and 1, and usually 0.5.

$\Delta\min$ is a second level minimum difference of $\min_i \min_i |x_0(k) - x_i(k)|$. $\Delta\max$ is a two level maximum difference of $\max_i \max_i |x_0(k) - x_i(k)|$. By comparing the series X_i with the reference series X_0, we can get the absolute difference between them, i.e. $|x_0(k) - x_i(k)|$.

So the correlation coefficient $\zeta_{0i}(k)$ is calculated as in the following equation:

$$\zeta_{0i}(k) = \frac{\min\limits_i \min\limits_k |x_0(k) - x_i(k)| + \rho \cdot \max\limits_i \max\limits_k |x_0(k) - x_i(k)|}{|x_0(k) - x_i(k)| + \rho \cdot \max\limits_i \max\limits_k |x_0(k) - x_i(k)|} \tag{11}$$

where ρ is the discrimination coefficient, $0 < \rho < 1$. If ρ is smaller, the greater the difference between the correlation coefficients, the greater the ability to discriminate.

3.3.4. Sorting of correlations. The correlation coefficient is a measure of correlation between data columns, which can be used to compare the degree of correlation between different data columns, but it is not conducive to a comprehensive comparison because it has too many values and too much dispersed information. Therefore, in order to better quantify the degree of correlation between the comparable and reference data columns, it is necessary to calculate the average correlation coefficient for each of the comparative data columns.

$$r_{0i} = \frac{1}{m}\sum_{k=1}^{m}\zeta_{0i}(k) \tag{12}$$

where k denotes the number of indicators, 1, 2, ..., m, and i denotes the number of subsequences, 1, 2, ..., n, respectively.

$\{x\}$ represents the linkage between the n subseries, which reflects the "superiority" of the parent series and subseries to each other, rather than just the degree of linkage. The degree of correlation between the factors can be better illustrated by listing the n subseries in order of their degree of correlation. If r_i is greater than r_j, then $\{x_i\}$ is better than $\{x_j\}$ for the same parent series $\{x_0\}$, denoted $\{x_i\} > \{x_j\}$, and r_i denotes the ith subseries to the parent series eigenvalue.

4. Results of the evaluation of the effectiveness of course optimization

On the basis of gray correlation analysis method combined with hierarchical analysis method, a gray correlation comprehensive evaluation model is built to evaluate the course optimization effect level of Civics virtual reality teaching.

4.1. Determination of indicator weights

For the indicator system of the comprehensive evaluation model, research on the influence relationship between indicators is carried out, and the importance of indicators is scored by expert scoring method using Saaty scale, and the obtained judgment matrix is calculated for its characteristic root and whether it passes the consistency test, and the relative weights are finally derived.

The results of the weights of the indicators are shown in Figure 2. The weights of the seven first-level indicators, namely, objectives and needs A1, prior knowledge A2, integration of rule of law culture A3, resource allocation A4, teaching activities A5, evaluation and feedback A6, and learning effects A7, are 0.1079, 0.0350, 0.0912, 0.1813, 0.2503, 0.0998, and 0.2345, with the weights of teaching activities A5 and learning effects A7 being the were the largest. Among the secondary indicators, the weights of the indicators of classroom teaching B8 and VR course construction B6 are both greater than 0.111, which have a greater impact on the course optimization effect of Civics virtual reality teaching.

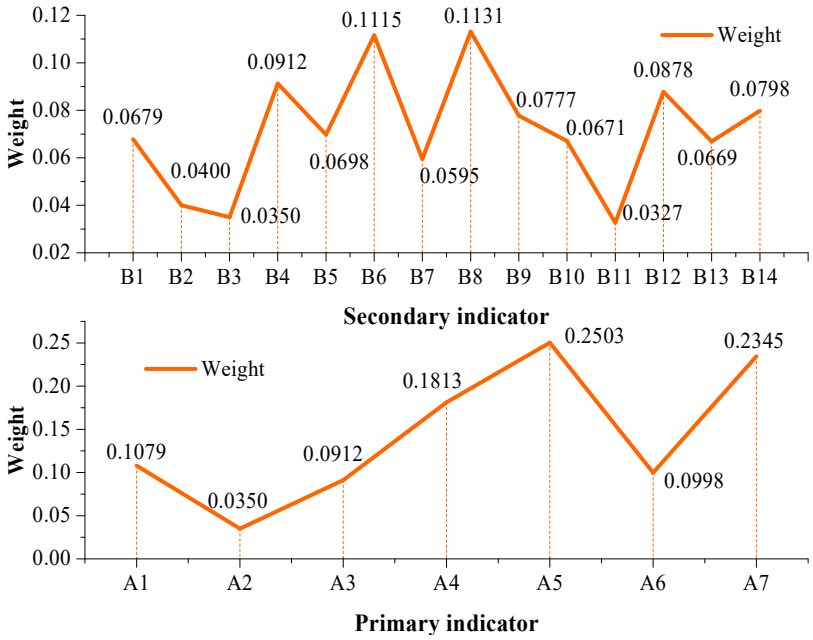

Fig. 2. The weight of each index

4.2. Evaluation score results

The comprehensive evaluation model index of the course optimization effect of ideological and political virtual reality teaching was scored according to the scoring standard. The scoring criteria of evaluation indicators at all levels are divided into 5 grades according to the degree of evaluation grade: "very poor", "poor", "average", "good" and "very good", in order to make the evaluation conclusion more intuitive, 1 point, 2 points, 3 points, 4 points and 5 points are assigned respectively, and the corresponding values in the middle of the evaluation grade are 0.5, 1.5, 2.5, 3.5 and 4.5.

The research was distributed in the form of paper and WeChat questionnaires, a total of 632 questionnaires were recovered, excluding the invalid questionnaires such as irregular answers, taking too short a time to answer, and choosing one answer for the whole questionnaire all together, and obtaining 574 valid questionnaires, with an effective rate of 90.8%, and the recovered samples met the statistical requirements.

The final score summary is shown in Figure 3. The overall evaluation score of the course optimization effect of Civics virtual reality teaching is 3.833 points, and the rating level is good. The evaluation scores of the seven first-level indicators range from 3.459 to 4.025, and the evaluation scores of the second-level indicators are also above 3, which is at a better level. It shows that the teaching application of the Civics corpus based on differential evolutionary algorithm and the virtual reality teaching of Civics incorporating traditional rule of law culture achieve better course optimization.

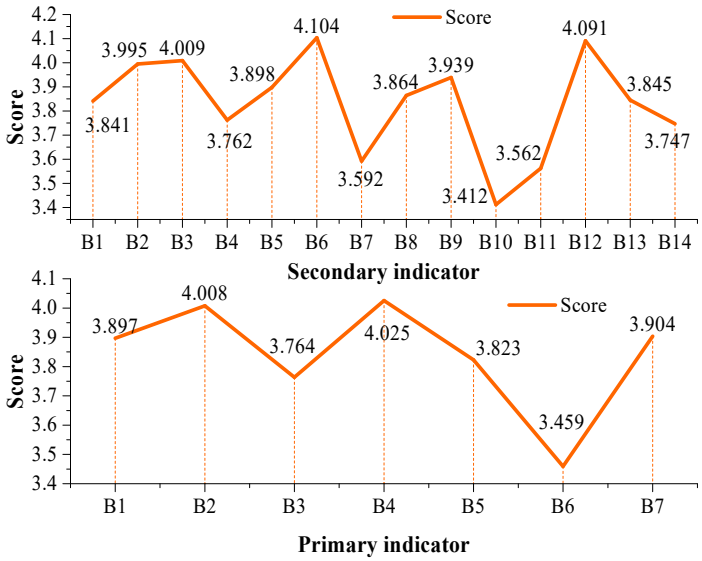

Fig. 3. Final scoring summary

4.3. Analysis of variances

Differential analysis of the research data on the quality of Civics VR teaching aims to find out which elements have a significant impact on the quality of Civics VR teaching. Here, this study uses students' gender, their grade level and subject category as independent variables, and seven aspects of goals and needs A1, prior knowledge A2, integration of rule of law culture A3, resource allocation A4, teaching and practice A5, evaluation feedback A6 and learning effect A7 as dependent variables to conduct the difference analysis.

4.3.1. Gender. The following ANOVA chi-square test is conducted with "students' gender" as the independent variable and 7 level 1 indicators as the dependent variables, and the results of the ANOVA analysis of gender and level 1 indicators are shown in Table 2 below, with * denoting $p<0.05$, ** denoting $p<0.01$. Different "students' gender Different "student gender" on the A1, A2, A3, A4, A5, A6, A7 of the seven primary indicators show significance, p-value is less than 0.01, indicating that the volatility of the sample data of different "student gender" is different, so we can not use ANOVA to analyze the variability of the variables, and we need to use non-parametric test for Therefore, it is not possible to use ANOVA to analyze the differences of variables, and non-parametric test is needed to compare the differences.

Table 2. Variance analysis of gender and primary indicators

	Gender (standard deviation)		F	P
	Female(N=296)	Male(N=278)		
Goals and requirements A1	1.02	0.85	1.2	0.001**
First in knowledge A2	1.12	0.87	0.87	0.001**
Culture of law A3	1.05	0.95	1.17	0.003**
Resource allocation A4	0.99	0.86	1.04	0.007**
Teaching activity A5	1.04	0.84	0.86	0.005**
Evaluation and feedback A6	1.04	0.96	0.98	0.002**
Learning effect A7	1.18	0.97	0.94	0.004**

Non-parametric tests were used to analyze the differences between the "gender of the student" and the seven level 1 indicators, specifically using the Mann-Whitney test. Table 3 shows the non-parametric test analysis of gender and the first-level indicators. Different "student gender"

showed significant differences on A2, A4, A5, A6, A7 (P<0.05), and did not show significant differences on A1, A3 (P>0.05). And in terms of A2, A4, A5, A6, A7, female students recognized the effect of Civics virtual reality teaching more than male students.

Table 3. Non-parametric test analysis of gender and primary indicators

	Gender (median)		Mann-Whitney	P
	Female(N=296)	Male(N=278)		
Goals and requirements A1	3.70	3.70	3.99	0.403
First in knowledge A2	3.25	3.20	4.16	0.007**
Culture of law A3	3.20	3.20	4.1	0.088
Resource allocation A4	3.78	3.71	4.03	0.005**
Teaching activity A5	3.24	3.20	4.09	0.001**
Evaluation and feedback A6	3.23	3.20	3.92	0.002**
Learning effect A7	3.86	3.72	4.04	0.001**

4.3.2. Different grades. The analysis of variance chi-square for different grades is shown in Table 4. All seven indicators showed significance (P<0.05), reflecting that the volatility of the sample data in all grades showed variability and none of them were variance chi-squared, thus allowing for a comparative study of variability using non-parametric tests.

Table 4. Analysis of variance in different grades

	Grade (standard deviation)				F	P
	Freshman	Sophomore	Junior	Senior		
Goals and requirements A1	0.91	0.98	0.86	0.75	8.03	0.005**
First in knowledge A2	0.84	0.9	0.87	0.92	6.83	0.008**
Culture of law A3	0.93	0.79	0.82	0.87	9.81	0.008**
Resource allocation A4	0.80	1.00	0.84	0.73	5.85	0.005**
Teaching activity A5	0.91	1.05	0.96	0.75	4.92	0.002**
Evaluation and feedback A6	1.01	0.73	0.83	0.88	7.85	0.006**
Learning effect A7	0.96	0.92	1.05	0.73	4.61	0.001**

The Kruskal-Wallis test was used for the analysis, and the nonparametric test analysis of grade level and level 1 indicators is shown in Table 5. The sample data of different grades showed extremely significant differences (P<0.01) for A1, A6, and A7, significant differences (P<0.05) for A2, A3, and A4, and no significant differences (P>0.05) for A5.

Table 5. The non-parametric test analysis of grade and primary indicators

	Grade (median)				Kruskal -Wallis	P
	Freshman	Sophomore	Junior	Senior		
Goals and requirements A1	3.86	3.73	3.85	4.06	23.74	0.003**
First in knowledge A2	4.02	3.79	3.78	4.03	14.05	0.014*
Culture of law A3	3.75	4.04	4.02	3.97	13.96	0.021*
Resource allocation A4	3.94	4.01	4.02	3.84	10.93	0.046*
Teaching activity A5	3.9	3.93	3.85	3.93	17.85	0.152
Evaluation and feedback A6	3.95	3.90	3.81	3.85	14.04	0.009**
Learning effect A7	3.92	3.85	3.77	3.79	13.98	0.002**

4.3.3. Different disciplines. The analysis of variance chi-square for different disciplinary categories is shown in Table 6. Discipline categories show significance (P<0.05) for A1, A5 and A7, indicating that the volatility of the sample data of different "discipline categories" is inconsistent and does not have variance chi-square, so it is necessary to use non-parametric tests to compare the differences. A2, A3, A4 and A6 do not show significance (P>0.05), indicating that the volatility of the sample data of different "academic disciplines" is consistent and has the chi-square, so it meets the prerequisite requirements of ANOVA, and can be analyzed by ANOVA for comparison of differences.

Table 6. Analysis of variance of different disciplines

	Disciplines (standard deviation)		F	P
	Humanities and social science(N=273)	Science and engineering(N=301)		
Goals and requirements A1	0.85	0.92	4.93	0.012*
First in knowledge A2	0.91	0.95	2.84	0.142
Culture of law A3	0.91	0.97	3.95	0.308
Resource allocation A4	0.89	0.95	5.86	0.272
Teaching activity A5	0.85	0.93	1.88	0.024*
Evaluation and feedback A6	0.94	0.97	0.92	0.359
Learning effect A7	0.88	0.96	1.91	0.019*

Table 7 shows the nonparametric test analysis and ANOVA for different disciplinary categories. The sample data of different disciplinary categories will not show significant differences (P>0.05) for all seven level 1 indicators, that is, there is no significant difference in the effectiveness of Civics Virtual Reality teaching for students of different disciplinary categories.

Table 7. Non-parametric analysis and variance analysis of different disciplines

	Disciplines (median)		MannWhitney	P
	Humanities and social science(N=273)	Science and engineering(N=301)		
Goals and requirements A1	3.55	3.55	-0.97	0.173
Teaching activity A5	3.20	3.20	0.84	0.151
Learning effect A7	3.20	3.20	0.83	0.144
	Disciplines (mean ± SD)		F	P
	Humanities and social science(N=273)	Science and engineering(N=301)		
First in knowledge A2	3.51±0.82	3.55±0.85	1.92	0.208
Culture of law A3	3.56±0.78	3.58±0.81	1.85	0.153
Resource allocation A4	3.54±0.82	3.55±0.83	0.59	0.247
Evaluation and feedback A6	3.49±0.75	3.52±0.79	0.66	0.196

5. Conclusion

Virtual reality technology provides a new model for the reform of the Civics course in colleges and universities. The study analyzes the course effect optimization method of Civics virtual reality teaching and proposes an intelligent construction scheme of Civics multimodal corpus based on differential evolutionary algorithm. It constructs a Civics course optimization effect assessment system and explores the course optimization effect of traditional rule of law culture integrated into Civics virtual reality teaching.

Based on the cultivation of the rule of law culture of college students under the Civics education in colleges and universities, virtual reality teaching and the combination of corpus can be used for creative intermingling to achieve the goal of cultivating modern talents with both rule of law and Civics literacy by increasing the investment in informatization, strengthening the construction of the teaching team and the level of resource construction.

The study confirms the evaluation index system of Civics virtual reality teaching effect and its weights of 7 first-level indicators and 14 second-level indicators, and the teaching activity (0.2503) and learning effect (0.2345) in the first-level indicators make the greatest contribution to the optimization effect of the course. The overall evaluation score after the implementation of the optimization method of the Civics course is 3.833, which is a good level, reflecting the actual utility of the Civics corpus based on differential evolutionary algorithm and the proposed Civics virtual reality teaching method. There are significant differences in the results of most of the first-level indicators by students' different genders and grades ($P<0.05$), and there are no significant differences in different disciplines ($P>0.05$).

In summary, through the integration of virtual reality technology and college civic education, the attractiveness and infectious force of college civic education classes are improved, which is conducive to the integration of traditional rule of law culture. In the future, virtual reality technology and college civic education will present a broader development prospect.

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