Virtual Reality (VR) Technology in Civics Practice Teaching Evaluating the Effect of Immersive Experience

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***Abstract*—In order to improve the low precision of the current immersive experience effect assessment method, a virtual reality Civics practice teaching immersive experience effect assessment method with enterprise development optimisation algorithm and mixed kernel extreme learning machine is proposed. Firstly, we analyse the current status of research on virtual reality Civic and political practice teaching, design the idea of assessing the application of VR technology in Civic and political practice teaching, extract the relevant assessment features, and construct the effect assessment system; secondly, we use the enterprise development optimization algorithm to optimize the parameters of the mixed kernel extreme learning machine, and construct the immersive experience effect assessment model; finally, we use the data of Civic and political practice teaching based on VR technology to verify and analyse the proposed model. The results show that the proposed model effectively improves the assessment accuracy of the immersive experience effect assessment method and achieves a higher precision of the Civic and political practice teaching effect assessment.**

Keywords*—*Virtual reality technology; civics practice teaching; immersive experience effect assessment; enterprise development optimisation algorithm

I. Introduction

With the ongoing advancement of contemporary educational technology, the state has placed increasing significance on reforms aimed at advancing the informatization of teacher education [1]. The primary means of providing college students with a thorough, high-quality education is through ideological and political theory classes in colleges and universities, where the focal point of students' ideological and political education is the practical instruction of these courses [2]. In the context of the contemporary era, enhancing the implementation of patriotism education within the practical instruction of ideological and political theory courses in higher education institutions presents both a theoretical challenge and an operational issue in the practical teaching process [3]. Then, the scarcity of Civics instructors and the increasing student population in numerous Chinese colleges and universities, coupled with a limited number of practice bases collaborating with educational institutions, inadequate funding for practical training, and various objective factors, have resulted in unsatisfactory outcomes for the practical instruction of Civics and Politics courses in recent years. This is further exacerbated by insufficient preparation, premature timing, and an inability to ensure safety protocols [4]. Consequently, to furnish students with a real-time, interactive, and immersive learning experience that aligns with their interests and curiosity, it is essential to transcend conventional temporal and spatial constraints in education. This necessitates the design of innovative pedagogical models and assessment methods, reflecting the current developmental trend in the practical instruction of Civics and Politics courses at the collegiate level [5].

A new technology with significant application potential, virtual reality has evolved significantly in recent years. [6]. The integration of virtual reality technology with Civics education transcends the temporal and spatial constraints of conventional teaching, while also facilitating a tailored instructional approach based on specific resources [7]. Currently, the research on Civics practice teaching based on virtual reality technology is mainly divided into VR practice teaching design, VR practice teaching experience effect assessment, etc. The design research for VR practice teaching is primarily grounded in the current state of Civics practice instruction, assessing the requirements of Civics practice teaching, and questioning the Civics practice teaching curriculum utilizing VR technology [8]. The VR practice teaching experience effect assessment is based on the experience effect of Civics practice teaching curriculum based on VR technology, extracting the value of the assessment system. Course experience effect, extracting the evaluation system value, combining the evaluation algorithm, and constructing the VR Civics practice teaching experience effect assessment model [9]. Through reviewing a large amount of literature and combining with reality, at present, the following problems mainly exist in the practice teaching of Civics based on VR technology [10]: 1) Civics classes are more theoretical, and there are fewer studies on practice teaching using VR technology; 2) there are fewer studies on the assessment of the experiential effect of the VR Civics practice teaching experience; and 3) the precision of the assessment of the experiential effect of the Civics practice teaching experience based on the data-driven algorithms is small.

Focusing on the problem of evaluating the effect of the Civics practice teaching experience based on VR technology, the theme of this paper is written in the following framework: this paper analyses the status quo of Civics practice teaching, designs the Civics practice teaching experience method based on VR technology, and puts forward the method of evaluating

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the application of VR technology in the Civics practice teaching; focusing on the problem of evaluating the application of VR Civics practice teaching, combining ED algorithms with the HKELM model, and constructing an immersive experience effect evaluation no model of VR Civics practice teaching based on ED- HKELM learning algorithm. HKELM learning algorithm, to build a VR Civic and Political Practice Teaching Immersive Experience Effect Evaluation based on ED-HKELM learning algorithm, through the experimental analysis, the algorithmic model proposed in this paper effectively solves the problem of Civic and Political Practice Teaching Experience Effect Evaluation based on VR technology, and improves the evaluation accuracy and effect.

II. Status Analysis and Methodological Design

A. Current Status of Related Research

Using a variety of high-tech techniques, including computer graphics, computer simulation, artificial intelligence, sensing, display, network parallel processing, and others, virtual reality technology creates a realistic visual, aural, tactile, olfactory, gustatory, and other perceptions of the computer system [11], specifically as shown in Fig. 1.

Fig. 1. Virtual reality technology.

Virtual reality technology includes the basic features of immersion, interactivity and imagination [12], as shown in Fig. 2； 1) Immersion. Immersive virtual reality systems use a variety of input and output devices to simulate the real world from the visual, auditory and even tactile, olfactory and other aspects to create a virtual scenario; 2) Interactivity. The virtual situation created by virtual reality technology is not a static three-dimensional world, but a multi-dimensional world that can be interacted with the user; 3) Imaginative. When the user is completely immersed in the "real" virtual environment, and with the virtual environment of the object to produce a variety of interactive activities, so as to obtain perceptual and rational understanding.

Virtual venues are the simulation and creation of real venues by human beings using virtual reality technology, which can allow users to immerse themselves in digital exhibition halls [13], specifically as shown in Fig. 3. In this paper, a series of red VR venues are developed according to the needs of the Civics class, and a method of evaluating the effect of immersive experience of VR Civics practice teaching is designed, as shown in Fig. 4.

A review of related literature reveals that virtual reality technology has attracted much attention in the field of education [14]. Many research teams have applied virtual reality technology to classroom teaching, which includes various aspects such as medical anatomy teaching, nursing teaching, chemistry experiment, electromechanical maintenance, etc., as shown in Fig. 5. Cowden and Martinez [15] used virtual reality technology to virtualise the human body; Li and Chen [16] established an immersive system learning situation with the help of virtual reality technology in order to stimulate learners' interest and learning motivation in science learning; and Jing et al. [17] established a remote virtual education laboratory, which accomplished the perfect combination of virtual reality technology and remote education.

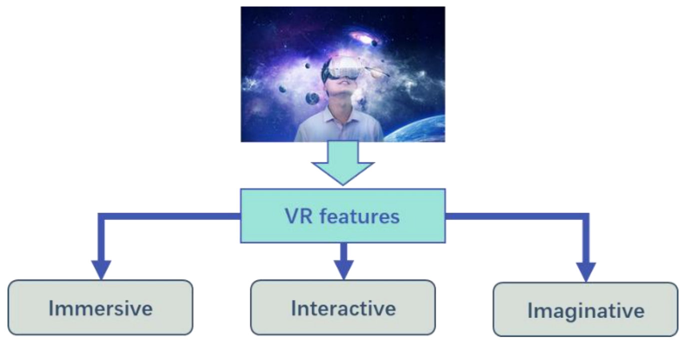


Fig. 2. Characteristics of VR technology.

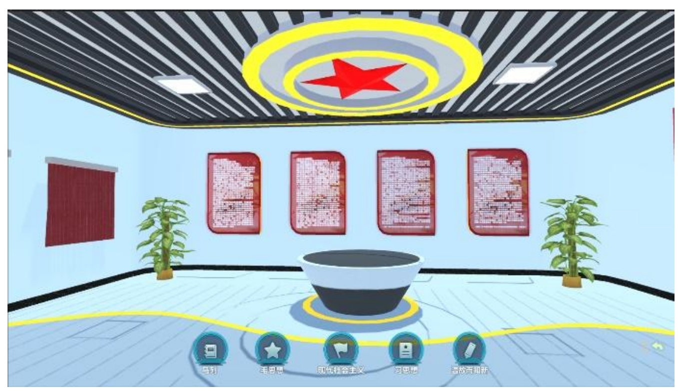


Fig. 3. Virtual venue.

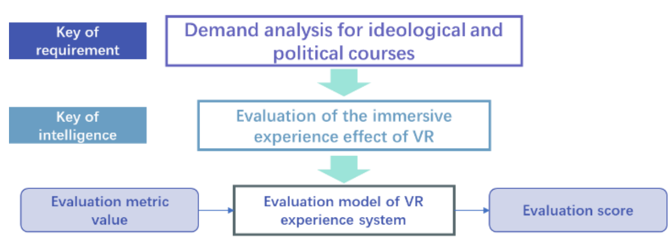


Fig. 4. Evaluation of the effect of VR-based teaching experience in red virtual venues.

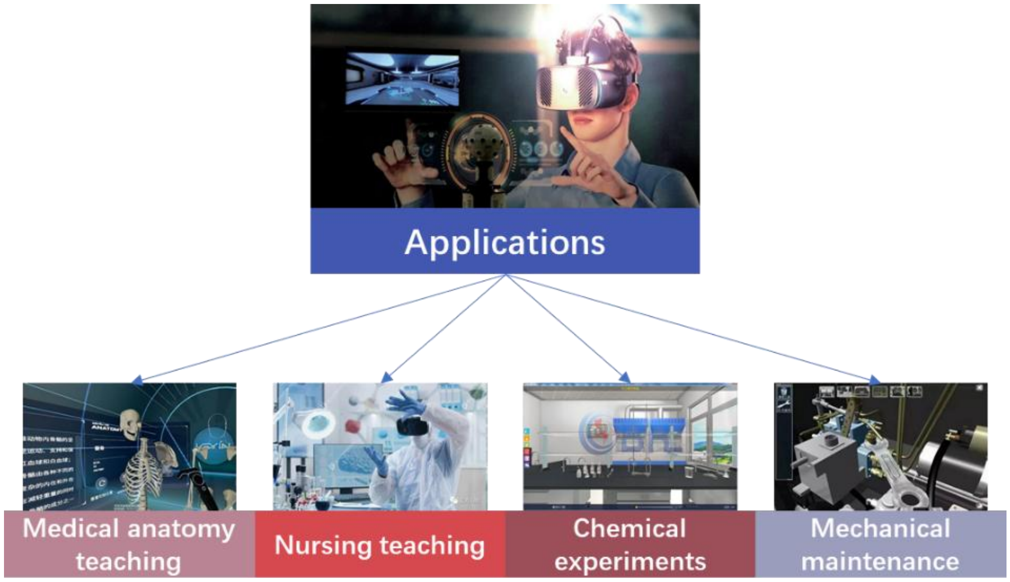


Fig. 5. VR technology in the field of education.

B. Design of Civics Practice Teaching Experience

1) Principles of VR Civics Teaching Design: Aesthetics, harmony, value, and effectiveness are the four key tenets of VR Civics education design [18], as shown in Fig. 6.

a) Principle of attractiveness: Attracting students with the charms of technology and value;

b) Principle of harmony: Teachers and students in the virtual field are the real community;

c) Principle of value: The virtual education field possesses the moral atmosphere of goodness;

d) Principle of effectiveness: The virtual education field is conducive to improving the teaching quality of the Civics class.

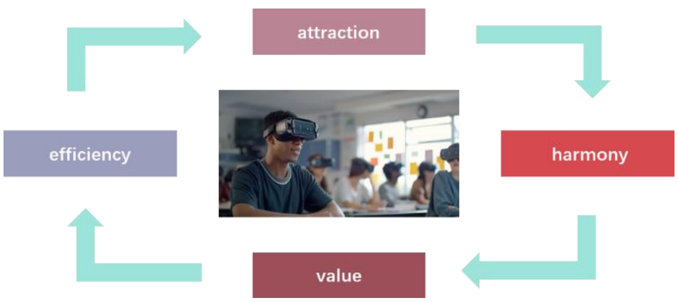


Fig. 6. Principles of VR Civics teaching design.

2) Core elements and application mechanisms: The core elements of the application of the immersive experience method in the Civics classroom include clear goals, immediate feedback, appropriate challenges and effective incentives. In Fig. 7, To build an efficient Civics immersive experience classroom we must probe deeply into the motivation mechanism, participation mechanism, incentive mechanism and feedback mechanism behind it, explore the inner power of these mechanisms, and establish the application mechanism of immersive experience suitable for Civics classroom [19].

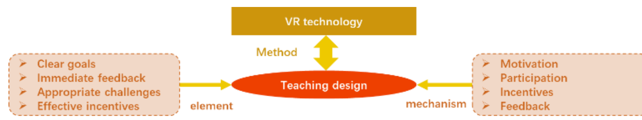


Fig. 7. VR Civics teaching design elements and mechanisms.

3) Design process: The "dominant-subject" teaching design model serves as the foundation for the VR Civic and Political Practice Teaching Model, which eschews the drawbacks of the conventional teaching mode and fully encourages student initiative in the learning process as well as the teacher's guiding role in instructional activities. The flow chart for the VR Civic and Political Practice Teaching Model is shown in Fig. 8.

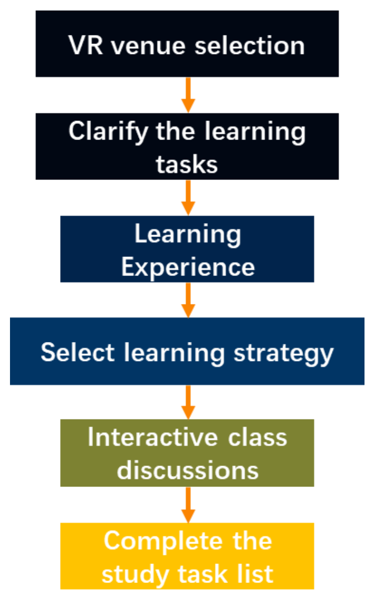


Fig. 8. VR civics teaching design process.

C. Evaluation Ideas for the Application of VR Technology in Civics Practice Teaching

This paper establishes an assessment system to analyze the impact of immersive VR technology on Civic and Political Practice Teaching, focusing on four dimensions: alignment of VR environments, design of learning content, analysis of teacher and student roles, and learning experiences within VR settings, as illustrated in Fig. 9. The system indicators facilitate the extraction of index data, which, when integrated with a data-driven algorithm, generates an assessment model for the implementation of VR technology in civic and political practice education, as seen in Fig. 10.

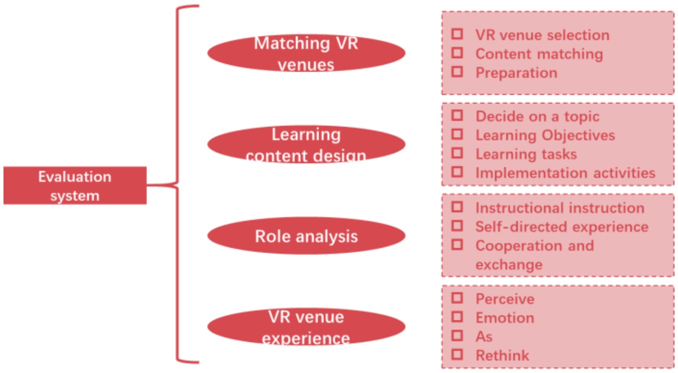


Fig. 9. Evaluation system of VR technology citing experience effect.

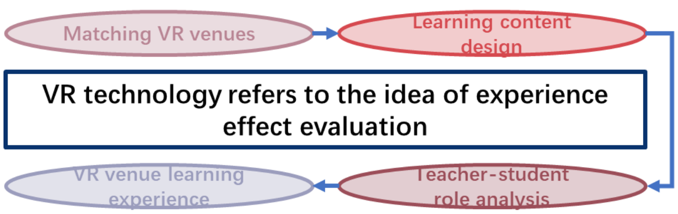


Fig. 10. VR technology referencing experience effect.

III. A Model for Evaluating the Effectiveness of Immersive Experiences

A. HKELM Algorithm

The current application assessment based on data analysis mainly relies on machine learning methods [21], while the application assessment data of the Civics practice teaching in this paper is complex, numerous and part of the data reliability is low, which makes the assessment and analysis more difficult. This paper studies the improvement of the assessment algorithm from two perspectives: the optimal selection of machine learning algorithm parameters and its own classification performance. First, from the perspective of its own classification performance, this paper selects the Kernel Extreme Learning Machine (KELM) [22], which has a fast learning speed and strong generalisation ability, to optimally construct the VR Civic and Political Practice Teaching and Learning Application Assessment Model.

KELM is a single hidden layer feed-forward neural network (structure shown in Fig. 11) [23], through the introduction of the kernel function to improve the original iteration number of slow shortcomings, reduce the amount of operations and improve efficiency, with a very good nonlinear regression and classification effect, the output model is expressed as follows:

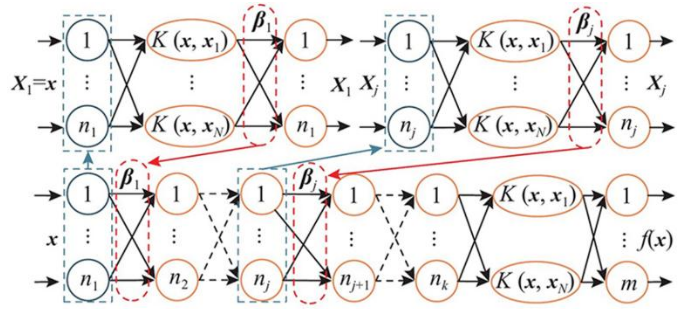


Fig. 11. KELM structure.

$$f(x) = h(x)\beta = H\beta \tag{1}$$

Where x is the sample data; $f(x)$ is the model output; $h(x)$ represents the input of the implicit layer; H is the feature mapping matrix, which is derived from the kernel function mapping the sample data; and β is the vector that outputs the implicit layer data to the output layer.

$$\beta = H^T\left(HH^T + I/C\right)^{-1} T \tag{2}$$

Where, C is the regularisation parameter; I is the unit matrix; and is the training set target vector. the matrix model of KELM is as follows:

$$\Omega = HH^T \tag{3}$$

$$\Omega_{i,j} = h(x_i)h(x_j) = K(x_i, x_j) \tag{4}$$

The kernel matrix Ω is used to replace the HH^T matrix of KELM and $K(x_i, x_j)$ is the kernel function matrix. The kernel function maps the input data to the high dimensional implicit layer space to obtain the output model as follows:

$$f(x) = \begin{bmatrix} K(x, x_1) \\ \vdots \\ K(x, x_N) \end{bmatrix}^T \left(\frac{I_0}{C} + \Omega\right)^{-1} T = \begin{bmatrix} K(x, x_1) \\ \vdots \\ K(x, x_N) \end{bmatrix}^T \beta \tag{5}$$

The determination of the kernel function determines the prediction results, and a single kernel function search has limitations. poly kernel function is a global kernel function, RBF kernel function is a local kernel function, the two kernel functions using a linear combination of the composition of the new hybrid kernel function, so that the KELM has the global and local aspects of the excellent classification performance, the Poly and RBF functional equations are expressed as follows:

$$K_{Poly}(x_i, x_j) = (x, x_i + c_1)^d \tag{6}$$

$$K_{RBF}\left(x_i, x_j\right) = \exp\left(-\left\|x_i - x_j\right\|^2 / \sigma^2\right) \tag{7}$$

Where σ , c_1 , d are the kernel parameters of the Poly kernel function kernel RBF kernel function, and the mixed kernel function is obtained by linear combination of the two:

$$K_H\left(x_i, x_j\right) = s_1 K_{Poly}\left(x_i, x_j\right) + s_2 K_{RBF}\left(x_i, x_j\right) \tag{8}$$

$$s_1 + s_2 = 1 \tag{9}$$

Substituting the mixed kernel function into the output function yields the HKELM model (shown in Fig. 12) [24], the mixed kernel function enhances the classification speed and accuracy of the model, where the parameters C , σ , c_1 , d , s_1 by have a great impact on the HKELM, and the parameters are optimised by the Enterprise Development Optimisation Algorithm for optimisation and to enhance the performance of the evaluation.

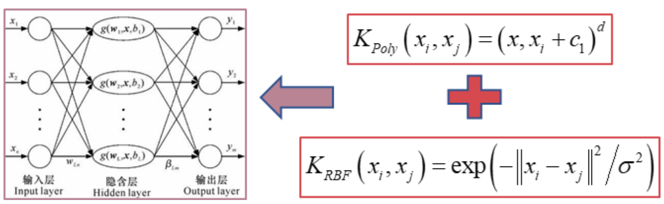


Fig. 12. HKELM modelling strategy.

B. Optimisation Algorithms for Enterprise Development

Enterprise development optimization (ED) [25] is a meta-heuristic optimisation algorithm subject to the enterprise development process. The process includes tasks, structures, technologies and human interactions. An activity switching technique is employed to ascertain each stage by revising the search solution. Every organization must strive for continuous development, which depends on experimentation and resources. After over 20 years of examining industry organizations, it is evident that intricate organizational systems depend on four categories of variables for interaction: task, structure, technology, and people, as depicted in the enlightening schematic in Fig. 13.

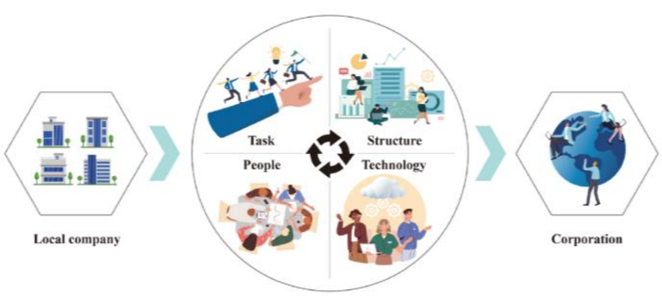


Fig. 13. Optimisation strategy for ED algorithm.

1) Population initialisation: As with all meta-heuristic optimisers, the ED optimiser randomly generates initial totals with uniform distributions for optimisation:

$$x_i = rand \times \left(u_b - l_b\right) + l_b \tag{10}$$

where u_b and l_b denote the upper and lower bounds of the problem, respectively.

2) Mandate: In business process management, tasks can take different forms or exist as daily transactions. In order to simulate task activities, the worst activities are replaced:

$$x_{worst}\left(t\right) = l_b + rand\left(0,1\right) \times \left(u_b - l_b\right) \tag{11}$$

where x_{worst} denotes the worst single solution in the search space.

3) Structure: Considering the organisational structure (Fig. 14) as a workflow, the new organisational structure is considered to be affected by other workflow structures in the organisation and the current optimal workflow, and is therefore updated by the following equation:

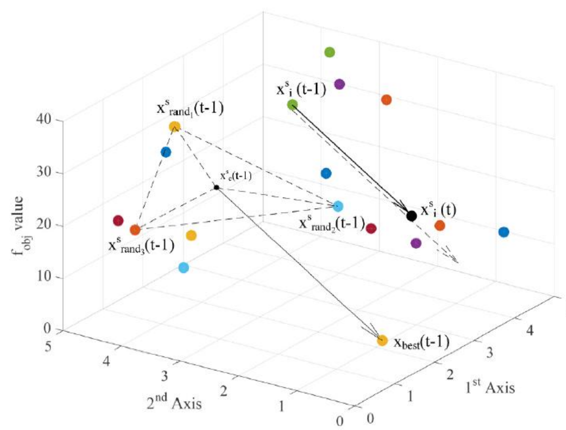


Fig. 14. ED algorithm structure strategy.

$$x_i^s\left(t\right) = x_i^s\left(t-1\right) + rand\left(-1,1\right) \times \left(x_{best}\left(t-1\right) - x_c^s\left(t-1\right)\right) \tag{12}$$

$$x_c^s\left(t-1\right) = \frac{x_{rand_1}^s\left(t-1\right) + x_{rand_2}^s\left(t-1\right) + \cdots + x_{rand_m}^s\left(t-1\right)}{m} \tag{13}$$

Where, $x_i^s\left(t\right)$ denotes the new structure; $x_{best}\left(t-1\right)$ denotes the current optimal solution; $x_c^s\left(t-1\right)$ denotes other workflow-centred structures affecting the new structure; $x_{rand_1}^s\left(t-1\right)$, $x_{rand_2}^s\left(t-1\right)$, … , $x_{rand_m}^s\left(t-1\right)$ are randomly selected individuals from the solutions in the aggregate; m denotes the number of workflows affecting the new structure; and it has been determined through experiments that m=3 can produce optimal results in a shorter computation time.

4) Technology: Numerous academics have emphasized the pivotal role of technology in shaping organizational change.

Organizations often reinvent themselves not directly due to outstanding ideas, but rather in reaction to technical advancements that facilitate the actualization of those ideas. From a strategic openness standpoint, organizations must enhance their exploration and development initiatives to obtain and utilize the knowledge requisite for innovation activities, as seen in Fig. 15. The following equation models the balance of this step of exploration and exploitation:

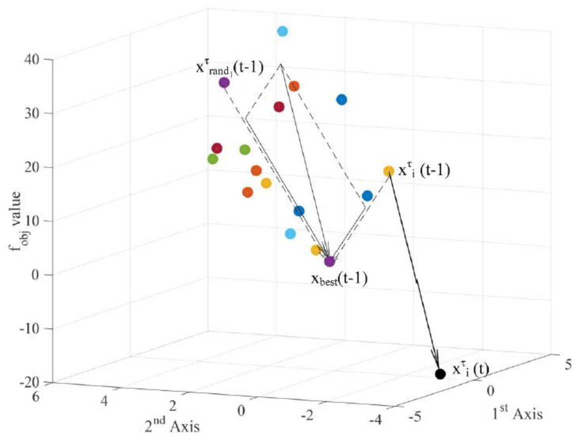


Fig. 15. Technical strategy of ED algorithm.

$$x_i^{\tau}(t) = x_i^{\tau}(t-1) + rand^{\alpha}(0,1) \times \left(x_{best}(t-1) - x_i^{\tau}(t-1)\right) + rand^{\beta}(0,1) \times \left(x_{best}(t-1) - x_{rand_1}^{\tau}(t-1)\right) \tag{14}$$

Where $x_{best}(t-1) - x_{rand_1}^{\tau}(t-1)$ denotes the exploration phase and $x_{best}(t-1) - x_i^{\tau}(t-1)$ denotes the development phase.

5) Personnel: Organizations must cultivate a participatory work culture that enhances individual creativity and collaboration through respect for others and stakeholders. This work culture affects employee commitment and engagement in sustainability. Compassion is essential for the efficacy of any production system or supply chain. Assuming attributes constitute a dimension, the subsequent equation illustrates the modeling of random selection of characteristics and the modification of individuals' actions (refer to Fig. 16). The mathematical model is shown in the following equation:

$$x_{i,d}^{p}(t) = x_{i,d}^{p}(t-1) + rand(-1,1) \times \left(x_{best,d}(t-1) - x_{c,d}^{p}(t-1)\right) \tag{15}$$

$$x_{c,d}^{p}(t-1) = \frac{x_{rand_1,d}^{p}(t-1) + x_{rand_2,d}^{s}(t-1) + \cdots + x_{rand_m,d}^{s}(t-1)}{m} \tag{16}$$

where d is a random feature of the person.

$$d = \left\lceil rand(0,1) \times n_d \right\rceil \tag{17}$$

Where n_d is the number of dimensions of the solution.

6) Conversion mechanism: The suggested ED algorithm assumes that the organization concentrates on one step at a time. Consequently, solely one of the four components (namely, task, structure, technology, and person) transpires at time *t* and is regulated by the activity transition mechanism, as seen in Table I and Fig. 17. The mechanism of the acting structure, technological phase, and human phase is presented as a function c(*t*), as seen in the subsequent equation:

$$c(t) = \left\lceil 3 \times \left(1 - \frac{rand(0,1) \times t}{Max_{iter}}\right) \right\rceil \tag{18}$$

Where t is the current iteration number and Max_{iter} is the maximum iteration number.

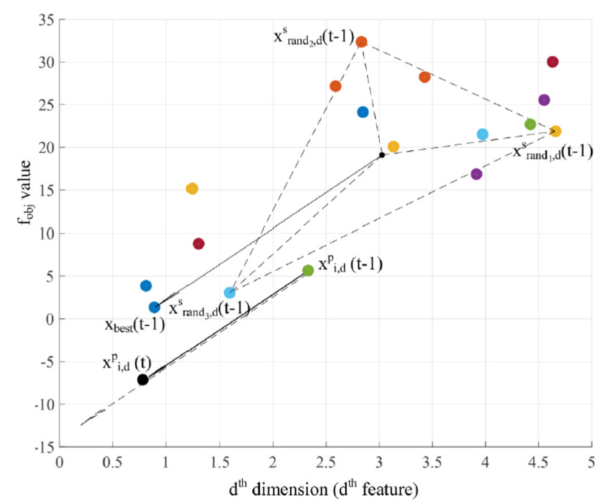


Fig. 16. ED algorithm staffing strategy.

TABLE I. CONVERSION MECHANISM PSEUDO-CODE

Algorithm 1: Conversion Mechanism Pseudo-Code
Calculate c;
If rand<p1 then p1=0.1;
Execute the task;
Else
Switch c;
Case c=1
Enforce the STRUCTURE policy;
Case c=2
Execute a TECHNOLOGY strategy;
Case c=3
Enforce the PEOPLE strategy;
End switch
End if

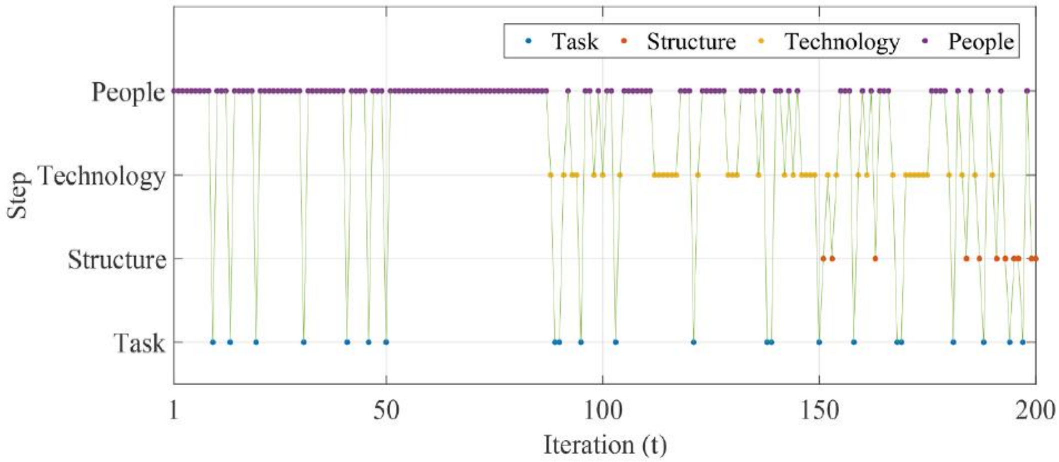


Fig. 17. ED algorithm conversion mechanism.

7) ED pseudo-code: According to the optimisation strategy of ED algorithm, the pseudo code is shown in Table II.

TABLE II. ED ALGORITHM PSEUDO-CODE

Algorithm 2: ED Optimisation Algorithm	
1	Set the search space, population size, and maximum number of iterations;
2	Initialising populations;
3	Calculate the fitness value and find the optimal solution;
4	Repeat
5	For i = 1:npop do
6	Calculate the value of c;
7	If rand<p1 then p1=0.1;
8	Execute the task;
9	Else
10	Switch c;
11	Case c=1
12	Enforce the STRUCTURE policy;
13	Case c=2
14	Execute a TECHNOLOGY strategy;
15	Case c=3
16	Enforce the PEOPLE strategy;
17	End switch
18	End if
19	End for
20	Until the iterative stopping strategy is satisfied
21	Output optimal solution

C. ED-HKELM Model Construction Process

1) ED-HKELM model construction: In order to improve the accuracy of the immersive [22] Civic and Political Practice Teaching Experience Effectiveness Assessment Model based on the HKELM algorithm, this paper adopts the ED optimisation algorithm to optimise the parameters of the HKELM algorithm C , σ , c_1 , d , s_1 , and constructs the ED-HKELM immersive Civic and Political Practice Teaching Experience Effectiveness Assessment Model, and the specific optimisation structure is shown in Fig. 18.

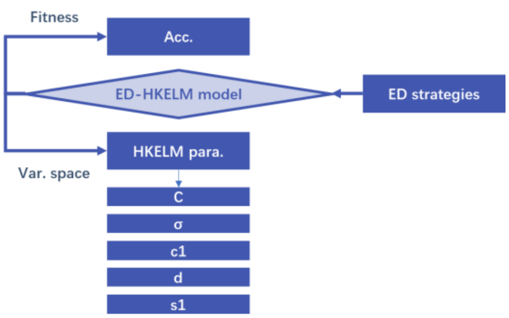


Fig. 18. ED-HKELM model structure

The optimisation decision variables of the ED optimisation HKELM model construction process are the parameters of the HKELM model C , σ , c_1 , d , s_1 , and the specific coding is shown in Fig. 19; We take the accuracy rate as the ED optimisation fitness function; The optimisation strategy of the HKELM model includes the task, structure, technology and personnel strategy of the ED algorithm.

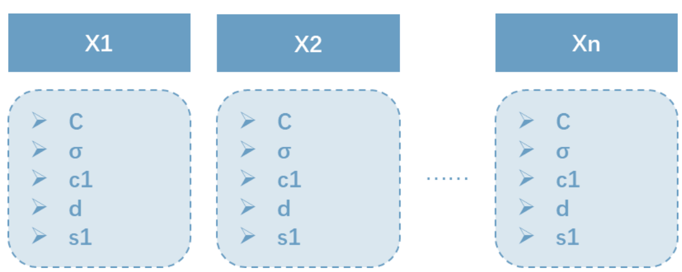


Fig. 19. Parameter coding structure of the ED-optimised HKELM model

2) ED-HKELM model application: In this paper, the design of the ED-HKELM model-based immersive civic politics practice teaching experience effect assessment method is mainly divided into the following processes:

a) Use the designed VR technology-based civic politics practice teaching system to extract the immersive experience effect assessment index value, and construct the assessment system;

b) Initialise the ED optimisation algorithm and the HKELM model parameters, and construct the ED optimisation population using real number coding, namely the HKELM model parameter population;

c) During the optimisation iteration, update the position of HKELM model parameter population according to the ED optimisation strategy;

d) Calculate the fitness value, determine whether the maximum number of iterations is reached, and output the optimal solution, i.e. the optimal HKELM model parameters.

IV. Results and Discussion

A. Data Acquisition and Parameterisation

Experiment in a hardware environment equipped with windows 10 operating system, Intel i5 processor, NVIDIA GTX1050Ti 4G graphics card, 16G memory. The computer programming used, using the Python 3.7 based PyCharm compiler, the implementation of immersive Civic and Political Practice Teaching Experience Effectiveness Evaluation model modelling, training, analysis and other functions is mainly based on the program libraries of TensorFlow 2.1 and Keras 2.3, as well as Pandas, Numpy, Scikit-Learn, Matplotlib and other data processing libraries.

The ED-HKELM model is trained, optimised, and tested using the evaluation data of Civics practice teaching based on VR technology. Randomly selected 70% sample size as the training set, 15% as the testing set, and 15% as the validation set.The parameter settings of the comparison algorithm are shown in Table III.

TABLE III. Comparative Model Parameter Settings

algorithmic model	*parametric*	*set up*
KELM	C	100
	σ	0.01
HKELM	C	100
	σ	0.01
	c1	5
	d	10
	s1	0.3
ED-KELM	Npop	100
	Maxiter	1000
ED-HKELM	Npop	100
	Maxiter	1000

B. Comparison and Analysis of Assessments

1) Performance analysis of ED algorithm optimisation: Fig. 20 gives the performance results of the ED algorithm in F1, F6, F8, F12 and F13 test function optimisation. From Fig. 20, it can be seen that the ED optimisation algorithm can converge to a certain accuracy during the optimisation of F1, F6, F8, F12, and F13 test functions, which satisfies the convergence requirements. Figure 20 further analyses the optimization performance of the Enterprise Development Optimization Algorithm (ED Algorithm) in different test functions, and verifies the synergy and advantages of its global search capability and local development capability from multiple dimensions.

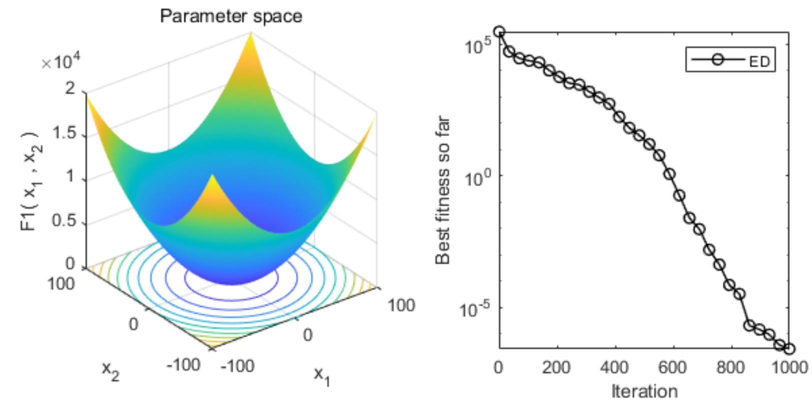
In the F1, F6, F8, F12 and F13 test functions, the convergence curves of the ED algorithm exhibit rapid decrease and stabilisation, which indicates that the algorithm is able to rapidly locate the high potential regions of the solution space in the early iteration stage, thus reducing the exploration time. Meanwhile, in the later iterations, the ED algorithm continues to refine the search through its dynamic activity switching mechanism (including the four optimisation strategies of task, structure, technology and personnel) to fully explore the local extremes of the solution space. This global and local collaborative optimisation strategy makes the ED algorithm exhibit excellent robustness in test functions of different complexity.

Specific analyses show that in the F1 and F6 functions, the fitness value decreases rapidly in the initial stage, reflecting the efficient search capability of the ED algorithm for single-peak functions. While in multi-peak functions (e.g., F8 and F12), the ED algorithm shows stronger resistance to local optima, and continues to explore the global optimal solution through its techniques and structural optimisation strategies. In addition, the stable performance of the ED algorithm on the complex multi-dimensional function of F13 further proves the applicability of its dynamic activity switching mechanism, which is able to optimise efficiently in high-dimensional search space.

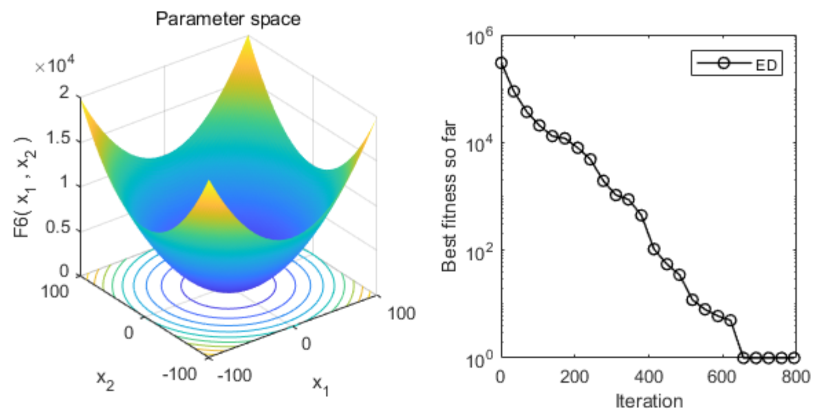
This wide applicability makes the ED algorithm not only suitable for classical optimisation problems, but also able to play an important role in the optimisation of experience assessment models for complex educational scenarios, such as virtual reality Civics practice teaching. Its good convergence performance and parameter tuning ability provide strong support for accurate and efficient immersive experience assessment based on the ED-HKELM model. In the future, its scalability and practicality can be verified by more test functions and real scenarios, which will lay a more solid foundation for the promotion and application of the intelligent optimisation algorithm.

2) Design effect analysis: The effect of the practical teaching of Civics based on VR technology designed in this paper is shown in Fig. 21.

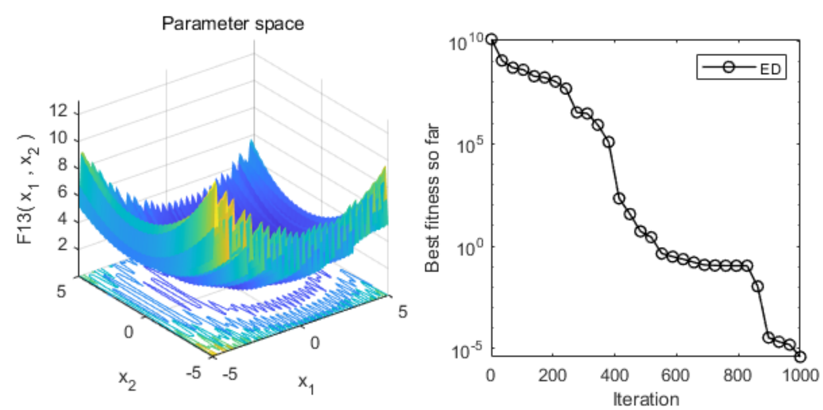
Fig. 21 (a) gives the software facilities of the VR teaching environment, and this paper focuses on the virtual exhibition hall of the Memorial Hall of the Victims of the Invasion of the Japanese Army in the Nanjing Massacre as a practical teaching case. The VR venue to the year when the Japanese army invasion of China when the evil committed by the performance of the best, virtual reality technology immersion can be fully stimulate the eyes of the students, learning motivation and efficiency will be greatly improved; Fig. 21 (b) gives the VR teaching site schematic diagram, the students put on the VR helmet, into the "Nanjing Massacre Memorial Museum Virtual Venue".



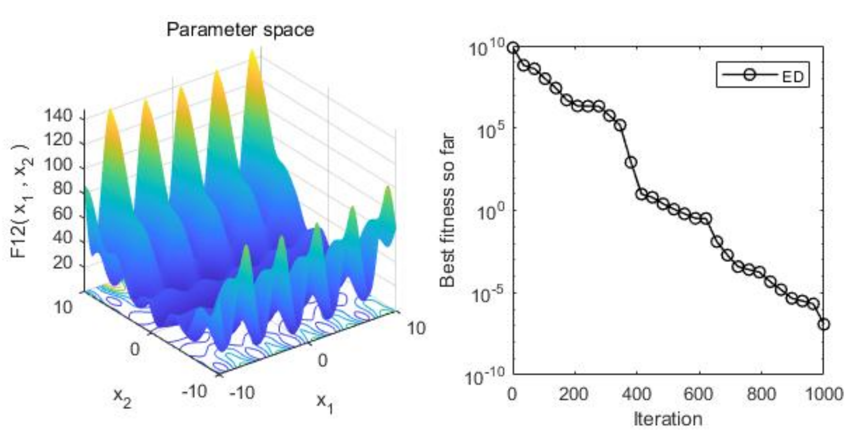
(a) F1



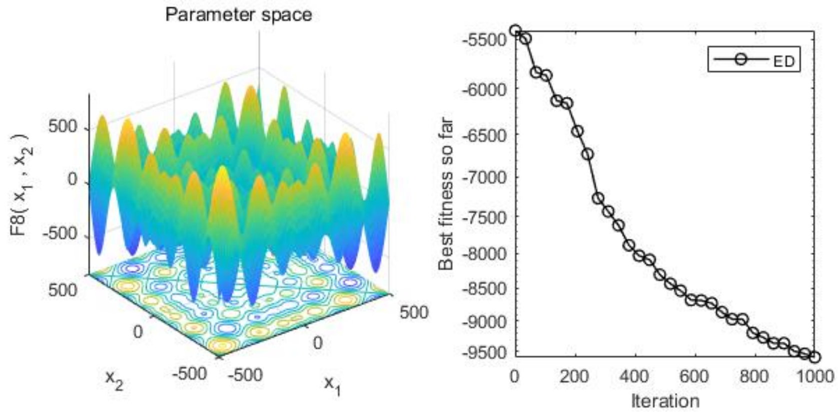
(b) F6



(c) F13



(d) F12



(e) F8

Fig. 20. Performance analysis of ED algorithm optimisation.

Fig. 21 demonstrates the design effect of Civics practice teaching based on VR technology, including the virtual pavilion interface (Fig. 21(a)) and the schematic diagram of the VR teaching site (Fig. 21(b)), which aims to assess the effect of the immersive experience of VR technology in Civics practice teaching.

Fig. 21(a) takes the Memorial Hall for the Victims of the Invasion of the Japanese Army in the Nanjing Massacre as a case study, and digitally reproduces the historical scenes and cultural connotations of the real venue through VR technology. The design of the virtual pavilion focuses on visual, auditory and other multi-sensory experiences, providing a highly immersive learning environment. For example, through three-dimensional modelling, image rendering and sound fusion, students can "walk into" the memorial hall and intuitively feel the authenticity and shock of historical events. This highly immersive virtual venue not only makes up for the limitations of space and time in traditional teaching, but also triggers students' emotional resonance and learning interest through dynamic scenes.

(a) Virtual pavilion interface.

(b) Effectiveness of classes.

Fig. 21. Design effect.

Fig. 21 (b) shows the actual use of VR in teaching, where students wear VR headsets to enter the virtual arena to start learning, and the use of VR equipment enhances the interactivity and engagement of learning, allowing students to "explore" the relevant historical scenes and interact with the virtual objects in the virtual environment. This type of experiential teaching combines technology-driven and educational needs, and can stimulate students' learning initiative while enhancing their memory and understanding of historical events.

The design effect in Fig. 21 illustrates that the practical teaching of Civics and Politics based on VR technology significantly improves the learning effect and experience feeling of students by providing an immersive, interactive and highly realistic learning environment. This teaching mode not only enhances classroom efficiency, but also provides a reproducible technical solution for practical teaching, which has a wide range of application prospects.

3) Evaluation performance analysis: In order to verify the efficiency of the ED-HKELM model, KELM, HKELM, ED-KELM and ED-HKELM are used in this paper for comparative analyses, and the specific results are shown in Fig. 22 and Table IV.

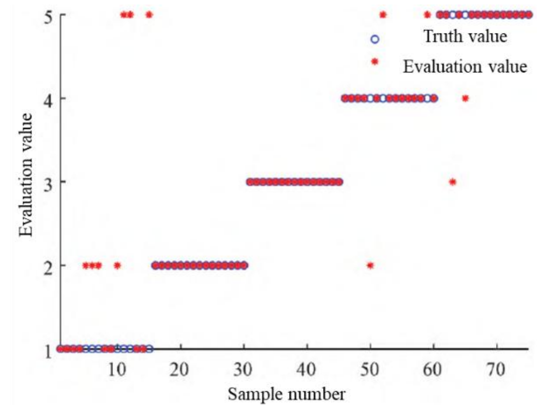
Fig. 22 demonstrates the comparison between the assessment results of the immersive experience effect of VR Civic and Political Practice Teaching and the real value based on different assessment models, aiming to verify the superiority of the proposed ED-HKELM model in terms of assessment accuracy. The figure includes four sub-figures corresponding to the assessment results of the KELM, HKELM, ED-KELM and ED-HKELM models.

There is a significant deviation between the assessment results in Fig. 22 (a) of the KELM model and the real value, especially in the interval of large data fluctuations, which shows a large error. This indicates that although the KELM model has some advantages in assessment speed, its adaptability to complex and nonlinear data is weak, and it is difficult to accurately reflect the real effect of VR immersive teaching.

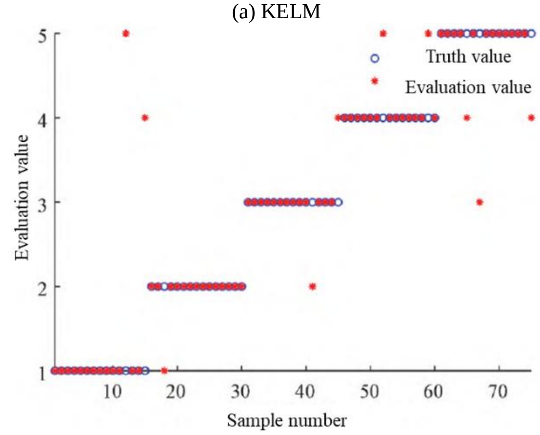
The HKELM model (Fig. 22 (b)) has improved its classification performance compared to KELM by introducing the mixing kernel function, and the match between the evaluation results and the true values is significantly improved. However, some deviations still exist in some intervals, indicating that the optimisation of the model is not yet optimal.

ED-KELM model (Fig. 22 (c)), by optimising the KELM parameters through the ED algorithm, the ED-KELM model further improves the assessment accuracy with a significantly better fit to the true values. In regions with drastic data changes, the model shows better robustness and higher adaptability.

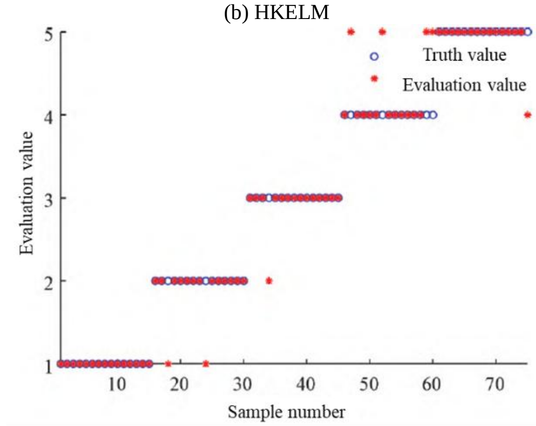
The ED-HKELM model (Fig. 22 (d)) performs the best among all models, and its evaluation results almost completely overlap with the true values, demonstrating extremely high accuracy. This is attributed to the comprehensive optimisation of the HKELM parameters by the ED algorithm, which enables the model to achieve a balance between global search and local exploitation capabilities, thus significantly improving the evaluation accuracy.



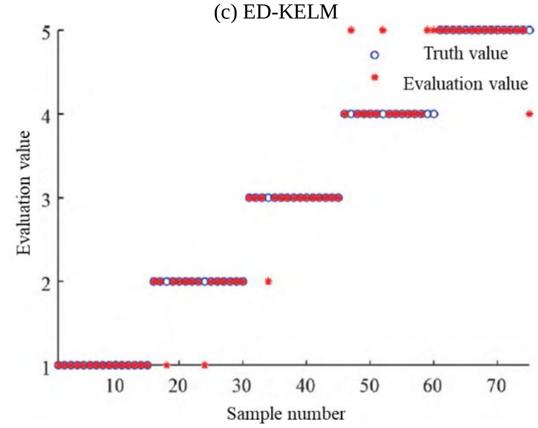
(a) KELM



(b) HKELM



(c) ED-KELM



(d) ED-HKELM

Fig. 22. Comparative results of the evaluation of different models.

The analysis in Fig. 22 shows that the ED-KELM model has significant superiority in the assessment of immersive experience effect of VR Civics practice teaching, and its high accuracy and strong adaptability provide a reliable tool for the scientific assessment of immersive teaching effect. In contrast, the traditional KELM and HKELM models have certain limitations, while the ED-KELM model has been improved but is still not optimal. Future research can further combine real-time data updating with dynamic optimisation strategies to enhance the applicability and intelligence of the models.

Table IV compares the performance of four evaluation models, KELM, HKELM, ED-KELM and ED-HKELM, in evaluating the effect of immersive experience in VR Civics practice teaching. The KELM model has an accuracy, recall, and precision rate of 84.0%, 84.0%, and 86.7%, respectively, which shows a basic evaluation capability, but is less effective in complex feature processing. The HKELM model improves the accuracy and recall to 86.7% and the precision rate to 87.1% by introducing the mixed kernel function, which enhances the adaptability but falls short of the optimum. The ED-KELM model further optimises the parameters by combining with the Enterprise Development (ED) optimisation algorithm, and the metrics are significantly improved to 89.3%, 89.3% and 90.1%, which is an excellent performance in the classification performance. The ED-HKELM model, on the other hand, achieves 94.7%, 94.7% and 94.8% in accuracy, recall and precision, respectively, demonstrating optimal performance. This is attributed to the comprehensive optimisation of HKELM parameters by the ED algorithm, which significantly improves the classification accuracy and adaptability.

TABLE IV. COMPARISON OF EVALUATION PERFORMANCE OF DIFFERENT MODELS

Assessment methodology	***accuracy***	***recall rate***	***accuracy***
KELM	84.0 per cent	84.0 per cent	86.7 per cent
HKELM	86.7 per cent	86.7 per cent	87.1%
ED-KELM	89.3 per cent	89.3 per cent	90.1%
ED-HKELM	94.7 per cent	94.7 per cent	94.8 per cent

The results of the ED algorithm to optimise the HKELM parameters are: $C = 95$, $\sigma = 0.013$, $c_1 = 2.55$, $d = 7.30$, $s_1 = 0.36$.

V. CONCLUSION

This paper addresses the challenge of evaluating the immersive experience of Civic and Political Practice Teaching utilizing VR technology by integrating machine learning and intelligent optimization algorithms, proposing an assessment method based on the ED-HKELM model. By examining the present state of research on Civic and Political Practice Teaching utilizing VR technology, formulating a Civic and Political Practice Teaching framework grounded in VR technology, identifying the assessment issues related to the immersive experience effect of Civic and Political Practice Teaching, acquiring the index data for the immersive experience effect assessment, refining the parameters of the HKELM model through the ED algorithm, developing an immersive experience effect assessment model, and employing the Civic and Political Practice Teaching data based on VR technology to validate and analyze the proposed methodology. The proposed method is evaluated and analyzed using data from Civic and Political practice instruction utilizing VR technology. The results show that the immersive experience effect assessment model in this paper has high assessment accuracy.

Although this paper effectively improves the accuracy of the assessment of the immersive experience effect of VR Civics practice teaching, there is still room for further optimisation. Future research can focus on dynamic optimisation and real-time assessment technology, combined with dynamic data flow processing to achieve instant feedback, to improve the interactivity of teaching and assessment adaptability; extended to multi-scene and multi-task assessment, to verify the model's versatility and robustness in different teaching needs; integrated into the students' individual characteristics analysis, combined with intelligent recommendation algorithms, the development of personalised assessment system, to provide students with targeted learning advice; Optimise the computational complexity of the algorithm to improve the applicability of the model in low-cost devices and multi-platform environments. These directions will further promote the scientific and intelligent application of VR technology in teaching and learning assessment, and help improve the overall quality of education.

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