Evolutionary Algorithm in the Evaluation Index System of Students' Comprehensive Moral Education Ability

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Abstract: In order to understand the application of evolutionary algorithms in the comprehensive evaluation of student moral education, an application research based on evolutionary algorithms in the comprehensive evaluation of student moral education has been proposed. Firstly, we conducted an in-depth analysis of various factors that need to be considered in the comprehensive evaluation system for college students, including moral quality, intellectual level, physical health, aesthetic taste, labor skills, etc. These factors are crucial in evaluating a student's overall quality. Next, we specifically considered the unique situation of students at China University of Geosciences and conducted a comprehensive evaluation of their qualities from different dimensions. These dimensions include moral and ethical qualities. This multidimensional evaluation can provide a more comprehensive understanding of students' qualities and potential. Finally, in order to determine the weights of various evaluation indicators more objectively, we adopted evolutionary algorithms to determine the dimensions of each quality and the weights of each indicator, in order to better reflect the overall quality of students. This not only improves the objectivity of evaluation index weights, but also provides strong support for developing more reasonable evaluation standards.

Keywords: Evolutionary algorithm; Comprehensive evaluation of moral education; Evaluating indicator

1 Introduction

With the continuous development and improvement of the education system, the comprehensive evaluation of students' moral education has gradually become an important tool for evaluating the quality of education and students' quality. Traditional evaluation methods usually focus on subject grades and standardized exams, however, students' comprehensive qualities include multiple aspects such as morality, intelligence, physical fitness, aesthetics, and labor. Therefore, how to evaluate students' moral education quality more comprehensively and objectively has become an urgent problem to be solved. Especially in higher education institutions such as China University of Geosciences, students come from different backgrounds and have diverse interests and talents, which increases the complexity of comprehensive evaluation of moral education. Schools need a more effective method to better understand students' overall qualities and provide them with more appropriate education and guidance. This study aims to explore the application of evolutionary algorithms in the comprehensive evaluation of students' moral education, in order to improve the objectivity and scientificity of the evaluation. Evolutionary

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algorithms are a powerful optimization tool that can simulate the process of biological evolution to find the best solution. We believe that introducing evolutionary algorithms into the comprehensive evaluation of student moral education can better balance the importance of various quality dimensions, determine the weight of evaluation indicators more accurately, and provide more reasonable evaluation standards [1-2].

In today's era of educational reform, colleges and universities are focused on developing student morals, focusing not only on teaching, but also on all aspects of developing the quality of students. It is necessary to develop a model for evaluating students' moral behavior in order to cultivate good education and develop moral education. The traditional process of evaluating student ethics is highly retrospective, and it is difficult to maintain integrity and research by relying on false evaluations. It does not meet the needs of a good education. Therefore, it is necessary to update technology, update the model of correct moral assessment of students, and train them in information technology. By using big data technology and information technology, we can create a good system to evaluate the moral behavior of college students, develop standards, and improve the quality of moral education of college students. moral education of college students. As shown in Figure 1:

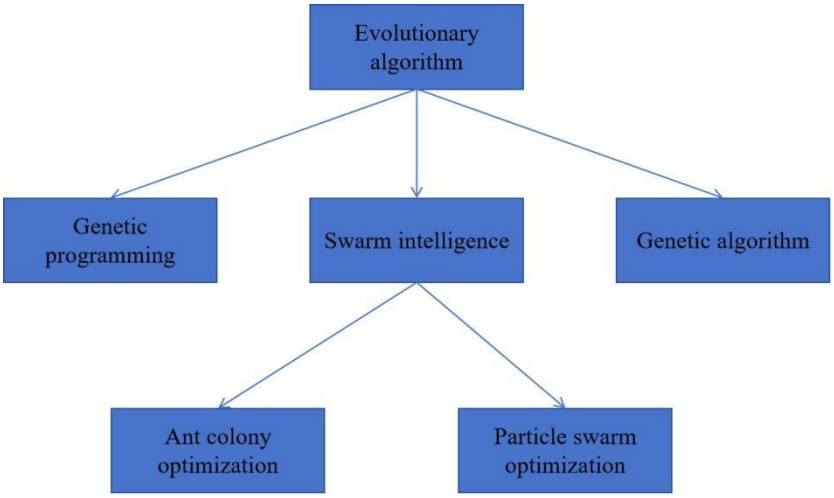

Figure 1. Evolutionary algorithm

2 Determine the evaluation index

After researching many examples, according to the characteristics of China Geo University and the development trend of computer science and technology, we divide the evaluation of good skills as follows. Ethical research: political philosophy, ethics, solidarity, disciplinary philosophy, public health, social work practice [3].

Professional quality: including the results of various courses this school year.

Physical quality: including cultural and sports activities, sports achievements and physical quality.

Psychological quality: including adaptability, withstand pressure capability, coordination and so on.

Developmental quality: including cooperative spirit, practical ability, innovative consciousness and ability, management ability, skills and specialties.

In essence, the above five qualities expand and extend the five aspects of students' morality, intelligence, physique, beauty and labor. It perfects the shortcomings in the traditional evaluation system, is closer to the times and social development, and can comprehensively evaluate a student.

Based on the above facts, we put forward a reasonable index system (see Table 1) in order to establish a relatively perfect evaluation system of college students' moral comprehensive quality, to evaluate students fairly and guide them to develop in a healthier direction.

Table 1 Index system for evaluating the comprehensive quality of college students' moral education

Primary index	Secondary index
Moral education quality	Political concept
	Public virtue
	Collective spirit
	Labour for public good
Professional quality	Average academic year grade
Psychological diathesis	Adaptive capacity
	Withstand pressure capability
	Coordinate ability
	Team spirit
Developmental quality	Ability to organize and coordinate
	Ability of practice
	Supervisory capability
	Skill specialty

3 Optimization model for determining weights

In order to evaluate students fairly, it is necessary to objectively evaluate the importance of each index, that is, the weight of each index in the index system. Taking the determination of the weight of the first-level index as an example, the method of determining the weight of the second-level index of each first-level index is similar. Remember the weight of moral education quality x_1, professional quality x_2, physical quality x_3, psychological quality x_4 and developmental quality x_5. Now the problem is to find a group of non-negative weights x_1, x_2, X_3, x_4, x_5, satisfying $x_1+x_2+x_3+x_4+x_5 = 1$. We made a questionnaire survey: P teachers and Q students were asked to make a preliminary judgment on the weight. Let the weight judgment vector of the p teacher be $(x_{P,1}, x_{P,2}, x_{P,3}, x_{P,4}, x_{P,5})$.Let the q-th student's weight judgment vector be $(x_{q,1}, x_{q,2}, x_{q,3}, x_{q,4}, x_{q,5})$, q = P+1, 2, …, P+Q. Their judgments are subjective, and it is difficult for any one person's judgment to directly serve as the final result. Our hope is to make full use of the judgments of these teachers and students, and try to overcome their subjectivity. The way is to require each indicator. Question 1: Find x_k that holds Equation (1):

$$\min fk(x,k) = t\sum_{1}^{p} x, p, k + s\sum_{p+1}^{p+q} x, q, k, k = 1,2,\cdots k \tag{1}$$

Here, t and s are the authoritative coefficients of teachers and students respectively. An example is given to illustrate the reason for this. Suppose that the moral education quality x_1 has five questionnaire weights of 0.1, 0.1, 0.1, 0.6, and t = 0.5 and s = 0.5, then the solution of the above minimization problem is $x_1 = 0.1$. It should be noted that an intuitive way is to average $x_1 = 0.2$. If the questionnaire weight of 0.6 is an irresponsible weight, then the above optimization problem actually eliminates the interference of this irresponsible weight. Generally, the optimal solution of minimizing problem 1 will shift from the average weight of the questionnaire to the direction of the maximum weight density of the questionnaire as a whole. The weight of one indicator can be obtained for each solution of minimizing problem 1, and the weight of each indicator $x_1, x_2,\ldots,x_K$ can be obtained by solving it for K times[4-5].

Question 2 Find a set of non-negative weights $x_1, x_2,\ldots,x_K$ as shown in Formula (2).

$$\min f(x^{-1}\cdots, x^k) = \sum_{k=1}^{k} t\sum_{p=1}^{p} x, p, k + s\sum_{q=p+1}^{p+q} x, q, k - x^k \tag{2}$$

We know that the weight of each index should satisfy $x_1+x_2+\ldots+x_K = 1$. However, generally speaking, the solutions of problem 2 $x_1, x_2, \ldots,x_K$ do not satisfy $x_1+x_2+\ldots+x_K = 1$. Adding this constraint condition, the following constrained optimization problem is obtained:

Question 3 Find a set of non-negative weights $x_1, x_2, \ldots,x_K$ as shown in Formula (3).

$$\min f(x_1, x_2, \cdots x_k) = \sum_{k=1}^{k} (t\sum_{p=1}^{p} (x, p, k = xk) \tag{3}$$

Here, the decision-making space is: $0 \le a \le x_k \le b_k \le 1, k = 1,2,\ldots,K$,K is the number of indicators, P is the number of teachers participating in the weight judgment, Q is the number of students participating in the weight judgment, s is the teacher's authority coefficient, t is the student's authority coefficient, $x_{p,k}$ is the weight given by the p-th teacher to the k-th indicator,$x_{q,k}$ are the weights given by the q-th student to the k-th index, a_k is the upper limit of the weight of the k-th index, and b_k is the lower limit of the weight of the k-th index.

Problem 3 is a nonlinear constrained optimization problem, which is difficult to be solved by classical optimization methods. Evolutionary algorithm is a kind of calculation model to simulate the evolution process of nature, which is especially suitable for solving complex optimization problems. Therefore, this paper considers using evolutionary algorithm to solve this problem. The problem of determining the weights of the secondary indicators corresponding to the primary indicators can be solved by the same method as the above-mentioned primary indicators[6-7].

4 Evolutionary algorithm to determine the index weight

To sum up, the problem of determining index weights is transformed into a nonlinear equality constrained optimization problem. Because the ability of evolutionary algorithm to deal with equality constraints is weaker than that of inequality constraints, we will transform problem 3

into inequality constrained optimization problem.

From $x_1 + x_2 + \ldots + x_K = 1$, there is formula (4)

$$x^k = 1 - (x^1 + x^2 + \cdots x^{k-1}) \quad (4)$$

Equation (5) of inequality constrained optimization problem is transformed into equation (4) of unconstrained optimization problem:

$$\min f(x1, \cdots xk-1) + g(x1, xk-1)$$

The decision space is still: $0 \leq a_k \leq x_k \leq b_k \leq 1$, k = 1,2,…,K-1.

Evolutionary algorithm: The framework is as follows:

Step 1 Randomly generates a population P_0 of size N, and the evolutionary algebraic counter t = 0.

Step 2 Performs repeated genetic operations on P_t, resulting in N offspring individuals Q_t.

Step 3$R_t = P_t \cup Q_t$,

Step 4 Eliminated N individuals with poor fitness in R_t, and produced the next generation population P_{t+1} = t+1.

Step 5 If the system needs to continue to evolve, go to step 2, otherwise, go to Step 6.

Step 6 Outputs the best individual in P_t as a result[8].

The numerical experiment is shown in Table 2:

1) Algorithm parameter setting

Population size: 100, evolutionary algebra: 300.

2) Experimental sample data

Questionnaire survey and individual estimation were conducted in Computer College of China Geo University, and sample data were obtained.

3) Experimental results

Table 2 Average and variance of all first-level indicators

	Average value	Variance
Moral education quality	0.245	0.012
Professional quality	0.523	0.0118
Physical quality	0.0526	0.009
Psychological diathesis	0.0589	0.0006
Developmental quality	0.0989	0.0001

As shown in Table 2 In order to verify the performance of the algorithm, the average and variance of each index are obtained after the sample data is run 50 times according to this algorithm, and the calculation results of the evolutionary algorithm are very stable. According to the questionnaire data, the weights obtained by the evolutionary algorithm are objective.

The index weight calculated by evolutionary algorithm can well reflect fairness, and the comprehensive quality of moral education of computer college students can be well reflected in

the evaluation of students' total quality. Teachers and students are very satisfied with the calculation results. If they are students from other departments, we can also use this method to objectively determine the index system and weight[9-10].

5 Conclusion

This paper realizes an evaluation system of college students' moral comprehensive quality. Finally, the following conclusions are drawn:

(1) According to the characteristics of China Geo University and the development direction of computer science and technology, the evaluation index of talent quality is put forward;

(2) According to the characteristics of the index system, an optimization model which can objectively determine the weight value is established after demonstration;

(3) Because the model is a constrained nonlinear optimization problem, which is difficult to be solved by classical methods, this paper adopts evolutionary algorithm to solve it. The experimental results show that evolutionary algorithm can get objective and stable weights.

(4) The method in this paper can be extended to the establishment of index system in other fields.

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