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Music Teaching Innovation in Primary and Secondary Schools based on Genetic Algorithm and Artificial Neural Network

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Abstract: At present, the academia has explored the innovation research of music teaching (MT) in PASS. Researchers have applied the combination of genetic algorithm (GA) and neural network (NN) to English teaching innovation, which has greatly improved the efficiency of English teaching. For this reason, this paper briefly analyzes GA and NN technology, and combines them to analyze the feasibility. Through the combination of GA and artificial NN, it is applied to the innovation research of MT in primary and secondary schools (PASS). With spectrum reading teaching as the main research object, it is proposed to carry out spectrum reading teaching with various technical means in combination with the algorithm. Finally, it is investigated and analyzed through experiments; it verifies the effectiveness of the innovative methods of MT in PASS proposed in this paper.

1. Introduction

GA and NN algorithm are intelligent algorithms developed by computer technology in recent years. At the same time, learning notation in MT practice is a boring learning content. Therefore, in order to improve the efficiency of music notation, it is necessary to reasonably allocate class hours. However, it can be found in the survey that many teachers often assign unreasonable practical teaching methods. It often appears that teachers prefer a model of practical teaching methods. Although this can arouse the learning interest of primary and secondary school students to a certain extent, students have long been bored when using a single practical learning method, Finally, the result of practical teaching is not ideal because of the weariness of learning. In this paper, GA and

artificial NN are applied to MT innovation in PASS for research and analysis.

GA is a research hotspot in recent years. It is an effective method to solve complex problems such as combinatorial optimization, and has extremely important application value in many fields. Many scholars at home and abroad have studied and analyzed the innovative research on MT in PASS based on the combination of GA and artificial NN [1]. Genetic selection, crossover and mutation are the three basic operations of GA. They have an important impact on the effectiveness of the algorithm when solving specific problems. The combination of GA and artificial NN and its application in the research of MT in PASS to explore its effect is the current research hotspot [2].

Spectrum reading teaching is very boring for students. Compared with singing and performance, it is very boring and knowledgeable. Obviously, compared with aesthetic experience, it is difficult to arouse students' interest in learning. Students are easily bored in learning, which is not conducive to MT in PASS. This paper makes a comprehensive analysis of the MT in PASS. The GA is combined with the artificial NN, and its brief analysis is carried out. It is applied to the innovation research of MT in PASS; In combination with the different applications of notation in MT in PASS, the trade-offs between its advantages and disadvantages, the ease of students' mastering and other realistic situations, we will explore the methods of notation teaching, use flexible teaching methods to run notation teaching through the teaching process of singing, solfeggio, music appreciation, instrumental MT and local ethnic MT in PASS, and explore its notation teaching methods and practical methods, as well as the practical effects of these methods, Look for optimization strategies, so as to improve the ability of reading music and participating in music practice by adopting appropriate notation [3-4].

2. Research on MT Innovation in PASS

2.1. Feasibility of Combination of GA and NN

GA has global search ability and strong robustness, and is suitable for solving complex problems. Artificial NN is a nonlinear adaptive system with learning and memory functions. GA and artificial NN have some inherent defects; researchers have done a lot of optimization and improvement work. The NN has adaptive learning and memory functions, but its convergence speed is slow and it is easy to fall into local optimum; However, GA has fast convergence speed, global search ability, but no learning ability, and is prone to premature phenomenon [5-6]. These two algorithms will always have some shortcomings when used alone. From the advantages and disadvantages of the two algorithms, we can see that they are complementary. If the two algorithms can be combined to achieve complementary advantages, it will be of great research significance [7-8].

2.2. Concept of Genetic NN Algorithm

The main body of genetic NN algorithm used in this paper is composed of improved GA and improved genetic NN algorithm. According to rough set theory, the improved GA performs attribute reduction and dimension reduction on the large-scale network original data, making the large-scale knowledge system miniaturized and getting a simplified data set [9-10]. Then the improved genetic NN algorithm is used to complete the classification and detection of the simplified data set. The organizational structure of the genetic NN algorithm is shown in Figure 1.

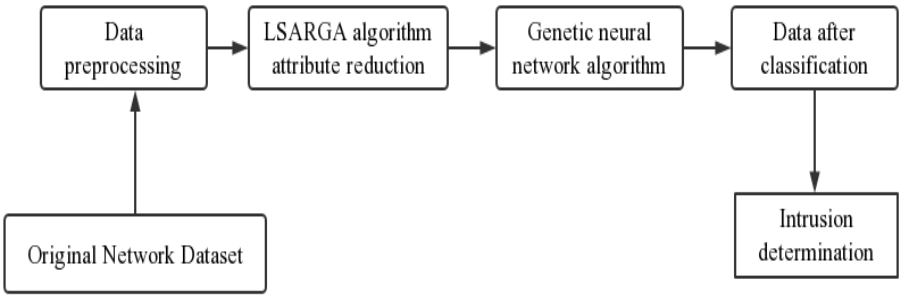

Figure 1. Organizational structure of genetic NN algorithm

The raw data is a string of character formats. First of all, the preprocessing is to convert the original data in the training set into the form of a decision table, indicating the condition attributes and decision attributes. Because some attributes are in character format, the information in these character formats should be converted to digital format. Secondly, many attribute values in the condition attribute are continuous, so these continuous attributes should be changed into discrete values [11-12]. Finally, the preprocessing also needs to initialize the relevant parameters of the GA, such as population size, genetic operators, iteration times and cycle end conditions.

2.3. Innovation in MT in PASS

2.3.1. Games

The primary and secondary school students are young, and it is difficult to learn some abstract knowledge. Reading music is an abstract knowledge, which they have not met in their daily life. They feel at a loss in the face of strange musical symbols. In addition, they are dull and boring, and cannot arouse their interest in learning. Their confidence in learning has been frustrated repeatedly, and the degree of difficulty in learning can be imagined. Games are the most interesting for primary and middle school students. Spectrum teaching can be combined with games to teach in the process of games, so that students can acquire knowledge in the process of games, which can simplify difficulties, fully stimulate students' potential, mobilize their innovative thinking ability, and smoothly complete teaching tasks. The teaching effect is relatively obvious [13-14].

For example, in the learning of quarter note and eighth note, teachers can let students walk and run, and teachers can dub synchronously, so that students can feel the difference between walking and running. It takes a long time to walk and a short time to "run", so that they can obviously feel the difference between quarter note and eighth note. Students can read while walking, feel the difference of syllables, and master the pronunciation of the two notes [15].

2.3.2. Formula

One of the most typical characteristics of pithy formula is catchy and easy to remember. The teacher can turn the theoretical knowledge into some pithy formula, so that students can remember it in a simple way, and mobilize students' interest in learning at the same time. The forms of the pithy formula can be flexible and diverse, and do not rigidly adhere to the tradition. After the pithy formula is formed, students can recite and memorize freely. Students can make gestures while reciting, or draw syllables while reciting, encouraging students to create their own, which is more conducive to students' memory and mastery [16].

3. Analysis of GA and Artificial NN Algorithm

3.1. Basic Concept of GA

Based on the theory of biological evolution, GA searches the solution space of the problem in the way of "survival of the fittest, superiority over inferiority" by simulating genetic variation in natural evolution. It is an optimization algorithm for solving combinatorial optimization problems. Chromosomes are carriers of genetic material in biology; In GAs, chromosomes are usually represented by gene strings. Fitness is a quantitative value used to measure the advantages and disadvantages of a single chromosome. Without losing generality, the larger the fitness value of a chromosome, the better it is, that is, the closer the solution represented by the chromosome is to the optimal solution of the problem. The fitness function is used to decode the chromosome gene string and obtain its fitness.

Genetic operator is an indispensable part of GA, which is closely related to fitness and affects the performance of the algorithm. Genetic operators are generally classified into the following three categories:

3.1.1. Selection Operator

The selection operator is used to select excellent individuals for the next generation of population. P represents the population, n represents the size of the population, then P={X1, X2,... Xn}, in addition, f (Xi) (Xi ∈ p) represents the fitness value of individual Xi to the environment, Ps (Xi) represents the probability of individual Xi being selected, then Ps (Xi) can be expressed by formula (1):

$$P_s(X_i)=\frac{f(X_i)}{\sum_{i=1}^{n} f(X_i)}, i=1,2,...,n \tag{1}$$

Formula (1) can be used to calculate the probability distribution of each chromosome in the parent generation. When selecting, randomly generate a number between [0,1] α, If $\sum_{k=1}^{i=1} p_s(X_k) < \alpha \le \sum_{k=1}^{i} p_s(X_k)(i=1,2,...,n)$, then chromosome Xi is selected, repeat the selection operation to get m chromosomes, forming a mating pool for the next step of crossover and mutation operations. Then the expected value of each chromosome in the parent generation that can enter the next generation for reproduction is P (Xi) =m * Ps (Xi) (i=1, 2,..., n).

3.1.2. Crossing Operator

The crossover operator is used to exchange and recombine the genes of two parent individuals with probability Pc [0,1] to generate new individuals. The parent individuals are generated by the selection operator.

3.1.3. Mutation Operator

In biological genetics, mutation refers to a phenomenon that the gene of chromosome mutates. In GA, the mutation operator is used to simulate this phenomenon. It uses the mutation probability Pm to mutate a gene in the chromosome string. The specific process can be expressed by the formula (2):

$$O(p_m, a_1), x_i^{'} = \begin{cases} 1-x, a_i < p_m \\ x_i, no \end{cases} i = 1,2,...,n \quad (2)$$

In formula (2), ai ∈ [0,1] is a random number, Pm is the probability of gene mutation, xi is the gene in the chromosome, and n is the length of the string. Formula (2) is to reverse a gene in the chromosome.

Using GA to solve the problem has a general process. First, we need to code chromosomes and initialize the population according to the specific problem, then determine the fitness function of chromosomes according to the optimized objective function, and then use genetic operators to perform iterative operations to achieve the evolution of the population, even if the search is in the direction of the optimal solution. The basic process of GA will be described in detail below.

3.2. Basic Process of GA

GA is a random search algorithm, which is an iterative calculation process. It conducts random search in the solution space of the problem, and realizes the reconstruction and evolution of individuals in the population through genetic operation, so as to ensure that the search moves towards the optimal solution of the problem. The main steps of GA are as follows:

Determine the input parameter set X (i.e. the solution of the problem), and select a coding mechanism to code it; Initialize the population and relevant parameters, such as population size, cross probability Pc, variation probability Pm, etc; The fitness function f (X) is designed according to the objective function of the problem to calculate the fitness of individuals; Calculate the individual fitness and evaluate the current population. If the stop criterion is met, go to step 6; Otherwise, go to step 5; Determine genetic strategies such as selection, crossover and variation, carry out genetic operations on the current population to generate the next generation population, and go to step 4; Algorithm terminated.

3.3. NN

Neurons are the basic units of NNs. In biology, biological neurons are the basic units of human brain for information processing. Biological neurons are composed of cell bodies, dendrites, axons and synapses. In the artificial NN, each neuron has multiple inputs, but only one output. Its model structure is shown in Figure 2.

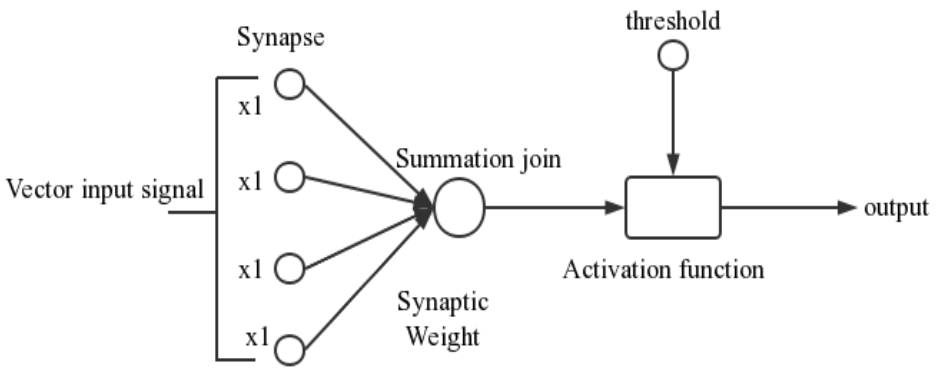

Figure 2. Nonlinear model of artificial neuron

As shown in Figure 2, the neuron model is a nonlinear model, which is mainly composed of four parts: synapse, summation link, activation function and threshold. The input of each neuron is multiple connection channels, and each connection channel corresponds to a corresponding synaptic weight. In the figure, the continuous value of the vector signal x ∈ Rn+1 represents a set of input signals of the synapse, and the xj input signal represents the jth synapse, where the x component is xj, j=1,2,..., n, that is, x=[x1, x2,..., xn] T. Synaptic weights are expressed in wqj, xj, j=1,2,..., n, which correspond to synapses one by one. The function of summation connection is to find the inner product uq of the input vector and the weight vector, which can be expressed by formula (3), where wq=[wq1, wq2,..., wqn] T ∈ Rn+1.

$$u_q = \sum_{j=1}^{n} w_{qj} x_j = w_q^T x = x^T w_q \tag{3}$$

The inner product uq obtained from the summation connection is transferred to the activation function as the input of the activation function. The function of the activation function is to control the activation of the input to the output through the function conversion of the input and output, and to convert the input of the possible infinite field into a finite specific output.

4. Analysis of MT Innovation in PASS based on GA and Artificial NN

4.1. Carry out Spectrum Reading Teaching by Various Technical Means

4.1.1. Sing Songs First, and Then Read Music

It is very boring for students to practice intonation and study music knowledge repeatedly and review constantly. In essence, music belongs to the art of hearing. It should establish the basic concept and form a preliminary impression under the sense of hearing. So we can teach by singing new songs and reading music scores. Teachers can use multimedia or sing by themselves to let students have a preliminary hearing of music, and then learn music scores. Through the initial auditory experience, the students have developed a strong interest. In the repeated singing process, they have a preliminary impression of the treble and a certain degree of understanding of the difficulties in music score, which can improve the students' ability to learn music score.

4.1.2. Read the Rhythm First, Then Read the Music

Rhythm is the skeleton of music and plays an irreplaceable role in music. Pitch and rhythm together constitute the whole process of music. If you can sing the right pitch but can't master the rhythm, the song will still be out of tune. Only by mastering the correct rhythm and the law of strength and weakness can we acquire music knowledge and ability. How to conduct rhythm training in classroom teaching. This can be done from the following points:

(1) Integrate rhythm training into the game. The physical and mental characteristics of the junior students in PASS determine that they are active and like to play, so they can design some content of learning rhythm during play, and combine the occurrence characteristics of objects to simulate the music rhythm. For example, the whole class is divided into several groups, each group represents a kind of animal, and then simulate the animal's cry, practice in groups, and then practice together to form a multi voice effect. Students can appreciate the characteristics of each music element and grasp its key points in the overall cooperation.

(2) Use body movements for rhythm training. The most basic actions can be set as the basis of rhythm training. For example, when drumming at a certain beat, other students form a circle and run

when they hear the drum in a clockwise direction. When the drum stops, people stop. Through this training, students can feel the difference between walking and running, and practice the two simpler rhythms. After the game is played, the teacher can organize the students to play drums and set the rhythm for the game. In the game of walking and running, the students have mastered the basic rhythm types, their imagination has been further developed, and their innovative thinking ability has been improved. Teachers can encourage students to create more actions according to music to increase the fun of the game.

(3) Rhythm recitation. Reciting can exercise students' language expression ability, and speak some simple nouns according to a certain rhythm. Students can feel the change of rhythm and grasp the rhythm speed in the process of reciting. Teachers can guide students to broaden the source of materials, such as choosing some idioms or proverbs, and children's songs and fairy tales. All of these can be used as materials to train students, with slight changes in rhythm, so that students can experience them separately.

4.1.3. Assistance of Instrumental MT

In the process of learning music notation, it is necessary to consolidate the knowledge points learned through the combination of theory and practice, and also to cultivate the interest in the way of practice. Another way to learn music is to use musical instruments. Musical instrument teaching is one of the classroom teaching contents, and also an effective way to learn music. In the process of reading music while playing, we have a deeper understanding of music knowledge, and our ability to learn music has been further improved.

4.2. Class Hour Allocation of Practice Methods

When teachers allocate class hours, they need to allocate various practical methods reasonably. According to the learning characteristics and interests of students, teachers can use various practical teaching methods alternately to maintain students' enthusiasm for music learning. School interest groups can also be set up to carry out various forms of knowledge competitions to improve students' enthusiasm for learning.

4.3. Implementation Effect Analysis

In order to understand the implementation effect of the final practice mode, the survey is also conducted from the two aspects of students' spectrum reading ability and their interest after time learning. The specific survey results are shown in Figure 3 and Figure 4.

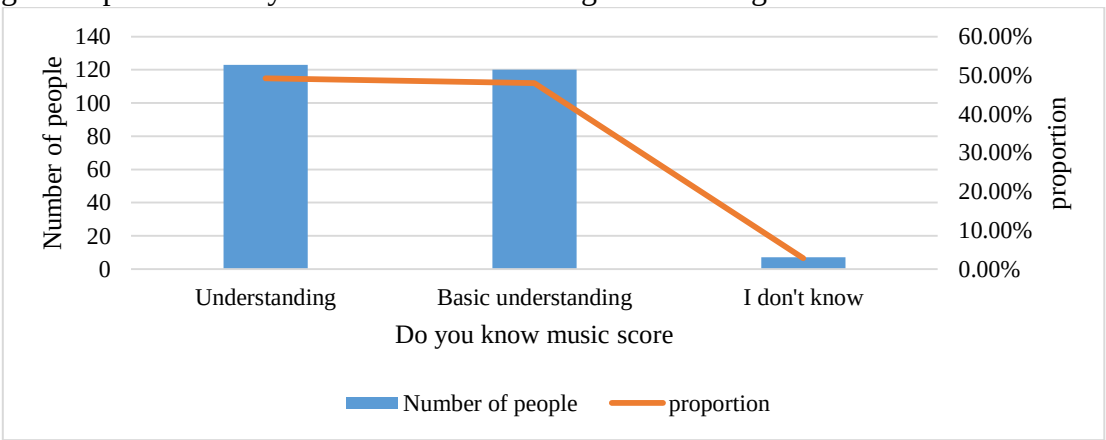

Figure 3. Do you know the score

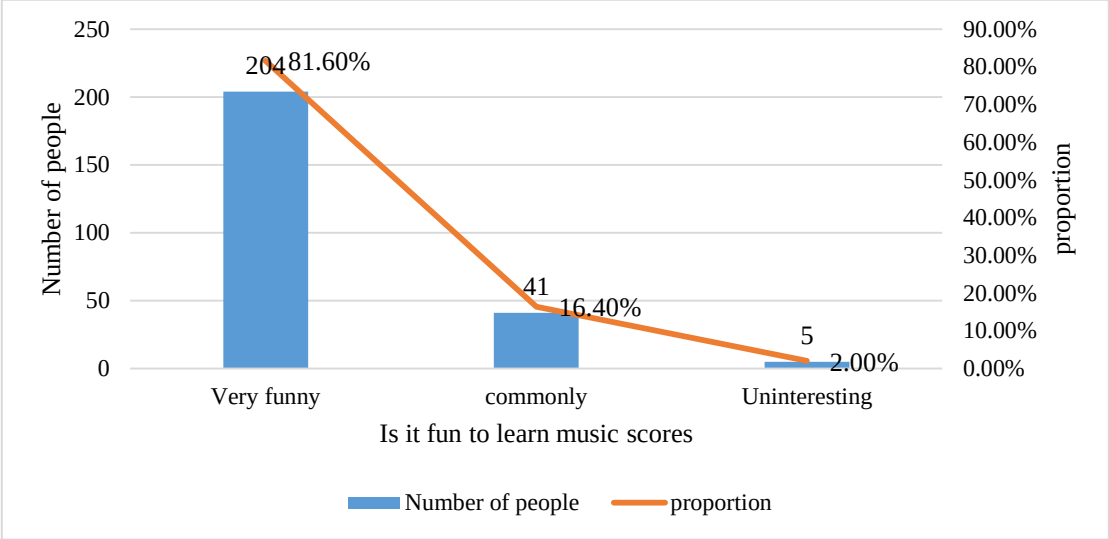

Figure 4. Is it fun to learn music scores

The interest results after learning are shown in Table 1.

Table 1. The interest results after learning

Is it fun to learn music scores	Number of people	proportion
Very funny	204	81.6%
Commonly	41	16.4%
uninteresting	5	2%

From the above survey results, we can see that the practical results of the spectrum teaching method used by teachers have been greatly improved. The number of people who know music scores has risen from 55 to 123, and the proportion has also risen from 22% to 49.2%. The proportion of students who chose basic knowledge also decreased from 60.8% to 48%, a decrease of 12.8 percentage points. The survey results on whether it is interesting to learn music scores also show that they are relatively satisfied. 81.6% of the students choose "very interesting" from time to time, 16.4% think it is "average", and only 2% think it is boring to learn music scores. According to the investigation of these two questions, it can be seen that the optimized teaching method of spectrum reading has obvious advantages, which can improve students' ability of spectrum reading and arouse their interest in learning.

5. Conclusion

Based on the combination of GA and artificial NN, this paper analyzes the innovation of MT in PASS, which is of great significance for improving the efficiency of music learning in PASS. However, there are also shortcomings. The current use of notation in China mainly depends on the interest and thinking of music teachers in the process of practice. At the same time, due to the influence of many factors such as music genre, Chinese and foreign music works, and forms of expression, the research on its teaching system is not systematic. Many studies have been controversial so far, and there is no conclusive conclusion. The practical research is insufficient, especially in the current practice teaching, the improvement of spectrum reading ability is ignored, and then the practicality and practicality in the practical operation are ignored. Therefore, it is necessary to explore and select the practical teaching method of spectrum reading that is suitable for China's national conditions to deepen the reform of basic education, and to standardize it through

compiling textbooks.

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Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Conflict of Interest

The author states that this article has no conflict of interest.

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