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BP neural network model-based disabled students sports disturbance and strategy research

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ABSTRACT

Disabled students physical health is wish of numerous disabled students' parents, due to disabled students will suffer discrimination in society, so their normal physical exercises are hard to ensure to go smoothly. To physical educators, they are difficult to judge by eyes whether on earth disabled students have hearing problems or speaking problems. In order to convenient for physical educators working smoothly, the paper specially establishes judgment model. At first, on the basis of referencing lots of documents, the paper utilizes principal component analysis method to divide eight sports events that disabled students may prefer into two items, one is running event, and the other is comprehensive event. And then adopt hierarchical investigation form to extract deaf-mute students and speech-impaired students' evaluation status on the two sports events, and regard the investigation result as feature values. Random sample six disabled students as judged objects, utilize *BP* neural network model algorithm, use *Matlab* software to program the calculation process. It gets result; result by investigation is consistent to practical status, so that it verifies the model's feasibility.

KEYWORDS

Deaf-mute students; Speech-impaired; Principle component analysis; *BP* neural network model.

INTRODUCTION

In recent years, as China becomes stronger, national government pays more and more attentions to vulnerable groups, especially in disabled people. Disabled students sports issues are event the hotspot of social concerns. Lots of elementary schools, secondary schools and universities have corresponding assisting policies on disabled students. However, disabled students sports issues have not yet been properly solved.

In 2007, Yang Chen in the article "Kaifeng city special school different types of disabled students sports demand and intervention policies", took Kaifeng city as an example, verified Chinese present disabled students physical education status, which mainly reflected as teachers specialization degrees were low, school sports syllabus and sports facilities were backward, and put forward corresponding improvement measures for the status. In 2013, Mei Sa in the article "American disabled people sports organization research— based on the perspective of self-organization theory", took American disabled people sports organizations as research objects, explained reasons that all disabled population almost would participate in sports in America. The article pointed out such phenomenon couldn't do without American mainstream society supports. And meanwhile, it pointed out American disabled people sports lacking of interaction with mainstream sports. The author put forward in the aspect of disabled people sport development, China should selective and positive learn and refer to American. In 2013, Wei Xiao-Hai in the article "Chinese and American disabled people sports status comparative research", applied quantitative estimation methods, took American disabled people sports as benchmark values, utilized analytic hierarchy process method, made comprehensive evaluation on Chinese disabled people sports, result showed that Chinese shows well in disabled people competitive sports aspect, but their employment situations weren't going well. In 2012, Tao Jie in the article "Hubei Universities disabled students participating in physical exercises study", made investigation on disabled students participating in physical exercises' purposes, attitudes as well as preferred sports events and other problems, and analyzed investigation results, analysis showed that most of students participated in physical exercises were for recovering and strengthening physique; about 70% students thought physical exercises were quite necessary; disabled students favorite sports events were walking and running.

To congenital deaf people, long time deaf will cause dumb. In real life, we are difficult to directly judge a student is deaf-mute or mute. On the basis of consulting relative literatures, the paper works on researching on judging disabled students types problems according to disabled students fondness status on sports events.

MODEL ESTABLISHMENT

Deaf-mute lives in the word of "unknown to public"; people in the world also have differences. They are people with both hearing and speech disturbance, and are also people only with speech disturbance. The two kinds of people are quite different for physical educators, which will affect their working procedures. Considering students' self-esteem, they are hard to directly judge students' types. Therefore, physical educators judge students' types by students' favorite sports events will be very beneficial to work.

Data processing

By consulting relative literatures, we find deaf-mute students fond sports events statistical table, as TABLE 1 shows.

Take person-time percentage as measurement criterion, random select 100 speech-impaired students as research objects, investigate their fond sports events, result is as TABLE 2.

In the research process, it involves in eight sports events, in order to convenient for future researching and the model's application, we adopt principle component analysis method, extract principal component, and scree plot is as Figure 1 shows.

TABLE 1: Deaf-mute students' fond sports event statistics

Sports event	Frequency	Frequency percentage	Person-time percentage
Running	12	11	20
Basketball	32	29	53
Badminton	32	29	53
Table tennis	8	7	13
Football	0	0	0
Volleyball	0	0	0
Sports dance	16	14	27
Martial arts	12	11	20

TABLE 2 : Speech-impaired students' fond sports events investigation

Sports event	Person-time percentage
Running	10
Basketball	56
Badminton	62
Table tennis	15
Football	25
Volleyball	32
Sports dance	55
Martial arts	12

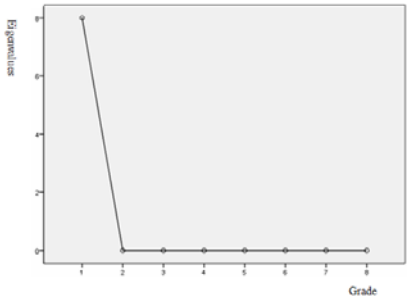

Figure 1 : Scree plot

From Figure 1, we can see that eight sports events can be divided into two items, one is running, and the other is basketball badminton table tennis football volleyball sports dance and martial arts comprehensive item. In the comprehensive item, seven sports weights are equal.

With cooperation of deaf-mutes school professional teachers, we sample five deaf-mute schoolboys and five deaf-mute schoolgirls from each layer of elementary school, secondary school and university three teaching layers, ask them to score running item and comprehensive item, full scores are one score. And then respectively solve average value of five students' scores, result is as TABLE 3.

TABLE 3 : Deaf-mute student feature value

Running item	0.23	0.31	0.29	0.19	0.25	0.18
Comprehensive item	0.43	0.35	0.28	0.41	0.32	0.36

With the cooperation of deaf-mutes school professional teachers, we sample five mute schoolboys and five mute schoolgirls from each layer of elementary school, secondary school and university three teaching layers, ask them to score running item and comprehensive item, full scores are one score. And then respectively solve average value of five students' scores, result is as TABLE 4.

TABLE 4 : Speech-impaired student feature value

Running item	0.21	0.19	0.23	0.15	0.22	0.19
Comprehensive item	0.56	0.49	0.57	0.53	0.51	0.58

After extracting two types of students feature values, random select six disabled students in another deaf-mutes school, collect data that needs to predict as TABLE 5.

TABLE 5 : Data to be predicted

No.	1	2	3	4	5	6
Running item	0.24	0.20	0.26	0.18	0.14	0.16
Comprehensive item	0.38	0.32	0.40	0.52	0.46	0.57

BP neural network model

Neural network model is originated from neurobiology. Its computation process is similar to biology nerve cell reaction process, as Figure 2.

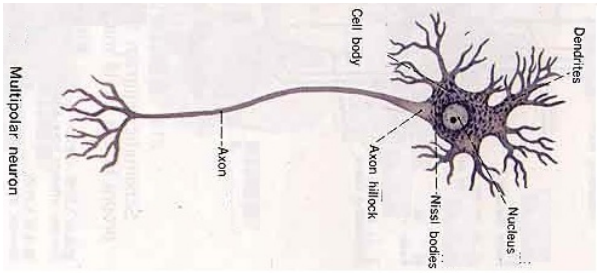

Figure 2 : The structure of neurons

In neural network, lots of different nerve cells included axon end can enter into the same nerve cell Dendron and form into a large number of synapses. All synapses of different origins released neurotransmitters can exert on same nerve cells'membrane potential changes. Thereupon, nerve cells space comprehensive information ability that is nerve cell can integrate input information of different origins in Dendron. Base on the ability, people simulate nerve cell reaction process and create artificial nerve cell model, as Figure 3 shows, symbols definition in figure is as TABLE 6 shows.

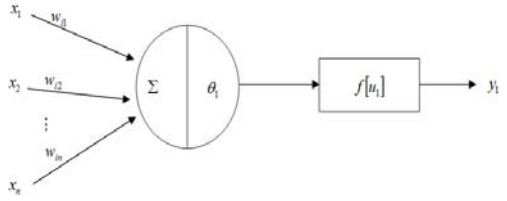

Figure 3 : The schematic of mathematical models of neurons

TABLE 6 : Mathematical model's symbol definition

Symbol	Definition
$x_1, x_2, \cdots, x_n$	Nerve cell input part that is information released by previous level
θ_i	Nerve cell threshold value
y_i	Nerve cell output
$f[u_1]$	Excitation function

$f[u_1]$ decides that output form that arrives at threshold value θ_i under common effects of inputting $x_1, x_2, \cdots, x_n$. Figure 4 shows two kinds of excitation functions images. The paper adopted models use the second kind excitation function.

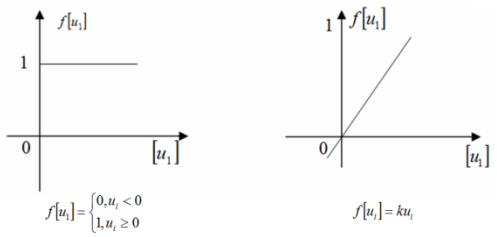

Figure 4 : Typical excitation functions

Among them:

$$\mathbf{u_i = \sum_j w_{ij} x_i - \theta_i} \quad \textbf{(1)}$$

So:

$$\mathbf{y_i = f[u_i] = f\left(\sum_j w_{ij} - \theta_i \right)} \quad \textbf{(2)}$$

Formula (2) is each nerve cell full mathematical model expression.

BP neural network is a kind of multiple layer forward network, adopts minimum mean square error computational way. When apply counter propagation algorithm into feedforward multiple network, utilize *Sigmoid* as excitation function, use following steps to make recursion solving on w_{ij} that is network weight coefficient. In case every layer has n pieces of nerve cells, for the k layer the i nerve cell, then it has n pieces of weight coefficients $w_{i1}, w_{i2}, \cdots, w_{jn}$. In addition, select one more w_{jn+1} to express θ_i. When input sample x, take $x = (x_1, x_2, \cdots, x_n, 1)$.

Align value to w_{ij}. To every layer w_{ij}, align a very little nonzero random number, and meanwhile $w_{jn+1} = -\theta_i$. Due to the model utilizes Matlab to operate, the alignment process is computer's random process, and just because of that, same programming codes in different running processes, the results may appear differences.

Input sample value $x = (x_1, x_2, \cdots, x_n, 1)$, and corresponding expected output $y = (y_1, y_2, \cdots, y_n, 1)$.

Calculate each layer output, for the k layer the i nerve cell output x_{ik}, it has:

$$\mathbf{y_i^k = f\left[u_i^k\right]} \quad \textbf{(3)}$$

Among them,

$$\mathbf{u_i^k = \sum_j w_{ij} x_j^{k-1} - \theta_i^k} \quad \textbf{(4)}$$

In formula, $x_{n+1}^{k-1} = 1$, $w_{i(n+1)} = -\theta$

Solve each layer computation error d_i^k, for output layer, it has $k = m$, then it has:

$$d_i^m = x_i^m\left(1 - x_i^m\right)\left(x_i^m - y_i^m\right) \quad (5)$$

For other layers, it has:

$$d_i^k = x_i^k\left(1 - x_i^k\right)\left(\sum_j w_{ij} x_j^{k-1} - \theta_i^k\right) \quad (6)$$

Correct w_{ij} and θ_i, it has:

$$w_{ij}(t+1) = w_{ij}(t) - \eta d_i^k x_j^{k-1} \quad (7)$$

(6) After solving each layer each weight coefficient, it can judge whether it conforms to requirements according to established criterion. If it don't conform, then return to the step (3), on the contrary, end computing.

Matlab computing and computed result

Matlab running program

```
p=[0.23 0.31 0.29 0.19 0.25 0.18 0.21 0.19 0.23 0.15 0.22 0.19;
0.43 0.35 0.28 0.41 0.32 0.36 0.56 0.49 0.57 0.53 0.51 0.58];
t=[1 1 1 1 1 1 0 0 0 0 0 0];
plot (p (1, find (t>0.5)), p (2, find (t>0.5)), 'o');hold on;
plot (p (1, find (t<=0.5)), p (2, find (t<=0.5)), '*');hold on
net=newff (minmax (p), [2, 1], {'tansig', 'purelin'});
net.trainParam.show=50;
net.trainParam.epochs=300;
net.trainParam.goal=1e-2;
net=train (net, p, t);
pp=[0.24 0.20 0.26 0.18 0.14 0.16;0.38 0.32 0.40 0.52 0.46 0.57];
y=sim (net, pp);
plot (pp (1, find (y>0.5)), pp (2, find (y>0.5)), 'ro');hold on
plot (pp (1, find (y<=0.5)), pp (2, find (y<=0.5)), 'r*');hold on
plot ([0.14 0.25], [0.30 0.52], 'k')
```

Above is *Matlab* running program. From program codes, it is clear, the program running selects training error being 10^{-2} as stop condition. Due to disabled students fondness extent in running item and comprehensive item's data are both between $0 \sim 1$, selected stop condition is proper. In following schematic diagram, "*" represents speech-impaired students, "o" represents deaf-mute students.

Due to TABLE 3, TABLE 4 provides two kinds of disabled students' sports events fondness extent feature values, utilize *Matlab* to draw the two kinds of students' distribution conditions as Figure 5. Figure 6 is discriminant result schematic diagram.

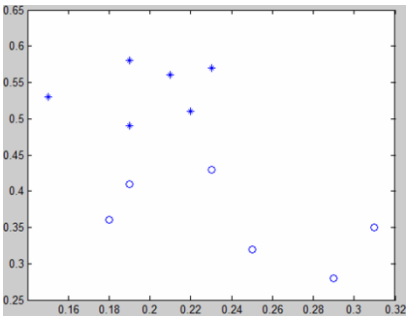

Figure 5 : The schematic of two kinds of students with disabilities

From Figure 5, we can see that two types of disabled students fond sports events distribution has obvious boundary. According to Figure 5 distribution status, define discriminant straight line $(0.14,0.30)$, $(0.25,0.52)$.

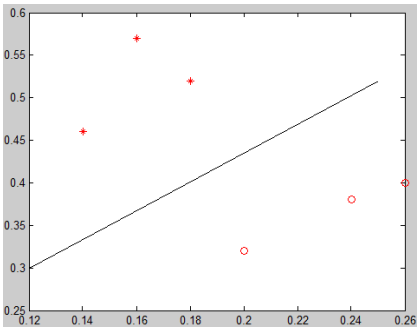

Figure 6 : The schematic of discrimination results

From Figure 6, it is clear that among data to be predicted, there are three people number $(1,2,3)$ are deaf-mute students, and three people $(4,5,6)$ are speech-impaired students. It is not difficult for us to find that deaf-mute students lay particular stress on running, and only deaf students lay particular stress on comprehensive item. For deaf-mute students, due to their audition will be limited, exercises in comprehensive item will have certain difficulty, and it is not easy to arrive at ideal effects.

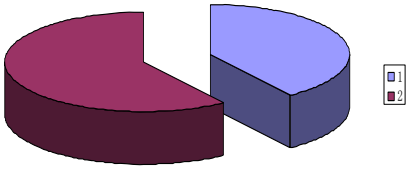

Figure 7 : The schematic of deaf students enjoyed sports case

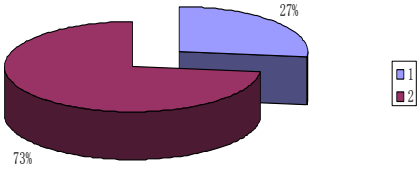

Figure 8 : Ability to speak obstacles students enjoy sports case

Figure 7, Figure 8 are respectively deaf-mute students feature values average values computed result graph and students with speak obstacles feature values average values computed result graph. In figure, "1"represents comprehensive item, "2"represents running item. By comparing two graphs, it is clear that deaf-mute students lay particular stress on running, and then verifies model judgment accuracy.

CONCLUSION

BP neural network implements reflection process from input information to output result. *BP* neural network can make comprehensive handling with multiple kinds of input information; it lets complicated problems to be simple and easier operating in solving process. However, if there is a large number of data to be analyzed, neural network may not truly reflect practical status due to too much computation process. In addition, neural network should reasonable estimate training errors, once the error estimation is improper, it may occur to computed result incorrect.

The paper detects established model rationality from the perspective of practical investigation. In the view of real life, some have bias on disabled people in society, so partial disabled people will have inferiority complex. The model can let sports educator to judge disabled students types by disabled students fondness extent on sports events, so that avoid embarrassing situation that sports educators directly check with students.

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