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COMPARATIVE STUDY ON PHYSICAL EDUCATION LEARNING QUALITY OF JUNIOR HIGH SCHOOL STUDENTS UNDER DIFFERENT REARING MODES BASED ON ARTIFICIAL NEURAL NETWORK EXPERT SYSTEM

Yu Geng
PhD, Krirk University, International College,
Bangkok, Thailand, 10220
E-mail: zhihongtydz@163.com

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Abstract

The purpose of this study is to evaluate the variations in bodily schooling mastering exceptional junior center college students underneath exceptional rearing modes and to use the specialist gadget primarily based on the synthetic neural community for analysis. The contrast index of gaining knowledge first-rate is an index gadget composed of numerous one-of-a-kind parameters. It is tough to be particular and has apparent fuzziness due to its giant variety and complicated content. There are many obstacles in fixing the contrast hassle using the skill of frequently used assessment methods. This paper proposes an assessment mannequin of junior excessive college students' bodily schooling mastering excellent primarily based on a synthetic neural community specialist system. The purpose of this method is simply to put processed records in a community and generate results by computation, other than by manual computing. It decreases the number of people in the comparative procedure, enhances the credibility of the assessment, and makes the comparative result more enormous and objective. However, the neural community additionally has some limitations. It can obtain international optimization by continuously editing the connection weights between neurons; however, making the community fall into neighborhood minima is convenient.

Keywords: Artificial neural network, Expert system, Different rearing modes, Junior high school students physical education learning quality

1. INTRODUCTION

Contemporary society is very competitive; in this "lifelong learning" era, students' good physical quality is particularly important. In 2007, the state issued the Opinions on Strengthening Youth Sports and Enhancing Youth's Physical Fitness: "Enhancing youth's physical fitness and promoting the healthy growth of youth are important events related to the future of the country and the nation (Wu, & Feng, 2018)." The Outline of the National Medium - and Long-Term Plan for Education Reform and Development (2010-2020) once again mentioned the need to deepen the reform and development of the education system (Abiodun, 2018). The Ministry of Education issued the National Physical Health Standards for Students (revised in 2014) as an essential basis for evaluating students' comprehensive quality, assessing school work, and measuring education development in different places (Zou et al. 2009). Therefore, along with social advancement and social development, the country pays more and more attention to the development of the body to enhance the quality of the students. In this environment, it is significant to explore the concept of "physical education learning quality" to improve students' physical education learning effect and promote their physical development (Gupta, 2013).

ANN is a newly emerging discipline in the IT domain. The theory of ANN is one of the most advanced areas in the world. Based on neurosciences' fundamental results, ANN is a kind of information-handling system that simulates the structure and function of the human brain so that it will be widely used in the future (Krenker et al., 2011). The ANN has many features, such as non-linear mapping, learning categorization, and real-time optimization, which provide a new approach to model identification and non-linear classification research (Hassoun, 1995).

In the evaluation of junior high school students' physical education learning quality, due to the many factors affecting the quality of junior high school students physical education learning and the degree of influence of each factor being different, the evaluation result is complex to be expressed by proper mathematical analytic expression, which is a nonlinear classification problem (Maind & Wankar, 2004). According to this feature, we designed a neural network model of junior high school students' physical education learning quality evaluation system through network training. After that, we can grade junior high school students' physical education learning quality (Abraham, 2005).

This study aims to compare the differences in physical education learning quality of junior middle school students under different rearing modes; then, the ANN Expert System is applied to analyze the problem. In this article, the author analyses the training pattern of middle school students, probes into the use of ANN in educational assessment, and proposes an assessment model of ANN. This paper aims to offer some reference for the P. E.

2. RELEVANT THEORY AND CONCEPT DEFINITION

2.1 The Basic Theory of Artificial Neural Networks

ANN is a new cross-disciplinary discipline developed during the research and imitation of the human brain (Shanmuganathan, 2016). The course of its evolution is illustrated in Table 1. A neural network is a non-linear dynamical system consisting of many simple neural networks. It can study, remember, judge, and be intelligent. A nerve net is a kind of complicated net that is made up of many single nerve cells (Agatonovic-Kustrin & Beresford, 2000). Fig. 1 illustrates a typical single-layer neural network with R - R-dimension input and S-output neurons.

In Fig. 1, p is the input vector of the R×1 dimension. The single-layer network layer consists of weight matrix W (S×R), threshold vector b(S×1), summation unit ⊕, and transfer function operation unit f. S output neurons form the output vector a of the neural network of S×1 dimension.

Multi-layer neural networks can be constructed based on single-layer neural networks. Various types of neural networks abstract and simulate the biological nervous system from different angles and at different levels. Typical NN models include perceptron, linear, BP, RBF, RBF, self-organizing, and feedback. When the ANN model is defined, its properties and functions are determined by

Table 1 The Development Process of Aartificial Neural Networks.

Year	Develop
1943	McCulloch and Pitts proposed a neuron model
1956	The Dartmouth Conference has promoted research in artificial intelligence and sparked interest in neural networks
1960s	Rosenblat proposed the perceptron model
1970s	The downturn in the development of artificial neural networks
1980s	The proposal and application of multi-layer feedforward neural networks and backpropagation algorithms
1990s	The research on artificial neural networks has entered a new era**
2000s	Deep learning based on neural networks has regained widespread attention
In recent years	Artificial neural networks have become essential tools and applications in various fields.

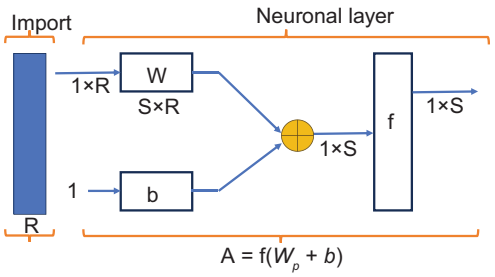

Fig. 1 Model of Single-layer Neural Network.

its topology and learning methods (Islam et al., 2019). From the perspective of network topology, neural networks can be divided into (Mehrotra, 1997): (1) a forward network; (2) A network with feedback from output to input; (3) an Intra-layer interconnection forward network; (4) an Interconnection network.

2.2 Basic Concepts of Artificial Neural Networks

At present, the definition of artificial neural network is not uniform, and the generally recognized and acceptable definition of artificial neural network is:

A neural network is a large-scale parallel distributed processor that can store empirical knowledge and effectively use it. It is similar to the human brain in two ways: (1) a neural network acquires knowledge through a learning process; (2) the strength of the connections between neurons (called synaptic weights) to store knowledge (Balci & Smith, 1986). Therefore, we can also think that an artificial neural network is based on numerical operation, a nonlinear processing algorithm for numerical data, signals, and images. These algorithms can be programmed on ordinary computers or implemented in hardware.

Artificial neural networks have found wide applications in many areas, such as:

(1) Computer scientists want to use neural networks to study and discover the properties of non-symbolic information processing systems and the overall performance of learning systems;
(2) Statistical researchers may use the ANN as a flexible, nonlinear regression and mode classification model.
(3) In a wide range of professions, the Neural Network is applied to signal processing and automation.
(4) Cognitive researchers see neural networks as a means of describing ideas and awareness (higher levels of activity in the brain).
(5) Neurophysiologists can use neural networks to describe and explore midbrain functions (such as the characteristics of the memory system, the sensory system, muscle physiological movement, etc.);
(6) Physicists make use of the ANN to simulate the phenomenon of statistics and deal with the experiment data so as to find out the intrinsic law of it.
(7) Biologists can use neural networks to interpret nucleotide sequences;
(8) Philosophers and others are interested in neural networks for a variety of reasons. The application of artificial neural network

2.3 Expert System Overview

A brief description of the expert system (ES), also known as the knowledge-based system [2], shows its development process as shown in Table 2. It includes a great deal of knowledge and experience. It uses AI techniques based on the information and experience supplied by one or more experts in a particular area and then simulates the decisions of the experts. Solving complex problems requires expert decision-making.

The fundamental difference between expert systems and traditional programs is that the former makes the knowledge base and the reasoning mechanism of using knowledge independent of

Table 2 Development of Expert Systems.

Year	Develop
1950s	The embryonic form of expert systems began to emerge, initially mainly based on rules
1960s	At first, expert systems could only solve some simple problems
1970s	Expert systems are beginning to be applied in fields such as medicine and engineering
1980s	The emergence of expert system development platforms such as CLIPS and D1 has driven the development of expert systems
1990s	Network-based expert systems are beginning to emerge
2000s	Expert systems have made progress in data mining and decision support
In recent years	The combination of expert systems with machine learning, deep learning, etc., has formed a hybrid intelligent system.

each other. The expression of knowledge is not a mathematical model but a method based on rules or frameworks. There is no need for mathematical simulation but inference judgment (Liao, 2005). Therefore, it can be seen that expert systems are superior to general program software. At the same time, an expert system differs from a common database system in that it stores the reasoning power but not the answers (Waterman, 1985). Compared with conventional programs and database systems, the expert system has the following characteristics: it can process knowledge and information. The expert system mainly uses symbols to represent the problem. In the process of solving the problem, it uses different strategies to deal with the symbolic knowledge to reason according to the rules and finally gets the required conclusion (Buchanan & Smith, 1988).

2.4 The Structure of the Expert System

The structure of the expert system varies according to the problems dealt with and the application environment. Generally, the expert system is composed of six parts: a knowledge base and its management system, an inference machine, an interpreter, a knowledge acquisition organization, a comprehensive database, and its management system, and a man-machine interface, as shown in Fig. 2. The knowledge base is used to store the expert knowledge and experience related to the field expressed in a certain form, and the comprehensive database stores the detection data and structural parameters related to faults. The knowledge acquisition institution obtains the fault data and characteristic information of the diagnosis object for the knowledge base, and the inference machine uses the knowledge in the knowledge base to reason according to the characteristics of fault symptoms in a certain way. Come to a conclusion. According to the requirements of the user, the interpreter can give a reasonable explanation of the system state and also explain the diagnostic results and the reasoning process to conclude. The Man-machine interface is the interface between the system and users. Users input fault data into the system through the man-machine interface and can put forward questions to the system. The system transmits conclusions and answers to users through the man-machine interface.

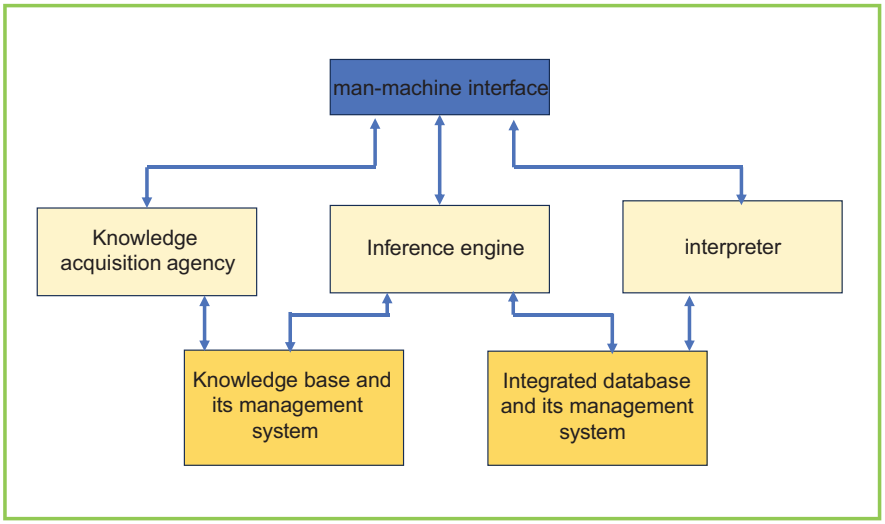

Fig. 2 Expert System Structure.

2.5 The Concept Definition of Physical Education Learning Quality of Junior High School Students

Learning quality was first proposed by NEGP in 1995, and its contents are shown in Table 3. It reflects students' attitudes and habits related to learning in a variety of ways. Specifically, learning quality includes five dimensions: curiosity and interest (whether you are interested in or show curiosity about new things), initiative (whether you can actively try things), persistence and attention (whether you can overcome difficulties and focus on completing tasks), creativity and invention, and reflection and explanation (whether you can explain your behavior) (Shortliffe, 1984). For students, the most important thing is not how much theoretical knowledge and skills they have mastered but whether they have a strong interest in learning, good learning habits, and can use learning strategies to solve problems. Improving students' learning ability has practical significance for students (Goodenough, 1987). This shows that the quality of the study is important for personal study to a certain degree.

2.6 Definition and Classification of Parenting Patterns

According to the summary of previous research results, the concept of rearing mode is stated. "Parenting style" or "parenting style" is the style shown by the parent in the process of raising the individual. Wu Xinchun (2009) proposed that the current family rearing of children can be divided into parental rearing, intergenerational rearing, and co-rearing of parents and grandparents (Richer, 1986).

(1) parenting: In English literature, the English word "parenting" is used to indicate that an individual is raised by his biological parents (Hendrickson et al., 1987).

(2) Parent-grandparent multiple support refers to the form in which parents and grandparents jointly raise and educate children. The educational ideas, attitudes, and behaviors of parents and grandparents have an impact on children's physical and mental development.

Table 3 Content of Learning Quality.

Content	Explain
learning motivation	The internal or external motivation of students to participate in learning activities, such as interest, autonomy, goal orientation, etc
learning strategy	The methods and techniques adopted by students in the learning process, such as memory strategies, inductive reasoning, problem-solving, etc
learning environment	The physical and social environment in which students learn, such as classroom atmosphere, interactive methods, family support, etc
Self-regulating learning ability	The ability of students to manage and control their learning process, such as goal setting, learning monitoring, and feedback
Learning achievements	The grades and performance of students in various learning tasks and evaluations
Learning satisfaction	Student satisfaction with the learning process and outcomes
Learning social interaction	Student participation and interaction in social environments, such as cooperative learning and group discussions
Learning Resources and Technologies	The learning resources and technologies that students acquire and utilize, such as libraries, networks, electronic teaching aids, etc

(3) Skip-generation foster refers to the form of upbringing in which grandparents raise their grandchildren alone or jointly raise their grandchildren with their parents. Still, the grandparents actually contact their grandchildren for more time than the parents. This situation lasts for at least half a year (Lv, 2020).

In order to pursue scientific and accurate research, this study selects students with the same parenting style from early childhood to junior high school.

3. APPLICATION OF ARTIFICIAL NEURAL NETWORK IN EDUCATIONAL EVALUATION: TEACHING QUALITY EVALUATION MODEL OF BP NEURAL NETWORK

3.1 Theory

Back Propagation (BP) Neural Network is also called Multilayered Forward Neural Networks (Gan, 2023). The main feature of this model is that each layer of NN is connected with the next layer of NN without any connection between them. There is a great nonlinear relationship between input and output (Yang et al., 2009). The BP network is an M-dimensional Euclidean space in N-dimensional Euclidean space if the input node is n and the output is m. So, we use the attribute value of every index as the input vector of the BP network model and use it as the output of the BP network model (Jerbi et al., 2012). Then, we train the BP network with sufficient samples to get the experience, knowledge, subjective judgment, and the evaluation expert's inclination to the

significance of the indicators. The set of weight values of the network model is the internal representation of the positive certainty of the network after self-adaptive learning, and the trained BP network model teaches the learning quality according to the price to be evaluated. The attribute value of each indicator can obtain the evaluation results of teaching quality, reproduce the experience, knowledge, and subjective judgment of experts and their tendency to the importance of indicators, and realize the effective combination of qualitative and quantitative methods to ensure the objectivity and consistency of evaluation (Wang et al., 2023).

3.2 Establishment of Teaching Quality Evaluation Indicator System

The assessment of educational quality refers to the analysis of the influential elements and their impact on the student's education so as to get the right grade. For this reason, it is possible to set up an indicator system as illustrated in Table 4 from an overall point of view of education.

3.3 Establishment of Teaching Quality Evaluation Model of BP Neural Network

It is essential to select the architecture of the net model, which can decrease the time spent training on the net and increase the precision of the study.

(1) Specify how many neurons there are in the input layer. Based on the target system, twelve major indexes influence the teaching quality, so the amount of input layers n=12.
(2) Specify how many neurons there are in the output layer. Assessment results are used as net output, so the number of output layers m=1.
(3) Determine how many hidden layers are in the network. The higher the number of hidden layers, the lower the rate of learning. Based on Kolmogorov's Theorem, the 3-tier BP network is able to approach the arbitrary continuous function with the appropriate weight. Therefore, we choose a 3-layer BP network with a relatively simple structure.

Table 4 Teaching Quality Evaluation Index System.

Project	Index
Teaching attitude	Serious and responsible teaching
	Adequate lesson preparation
	Tutoring Q&A and homework correction
Teaching content	Serious and responsible teaching
	Adequate lesson preparation
	Tutoring Q&A and homework correction
Teaching content	Language standardization, clear presentation, and appropriate blackboard writing
	Using advanced scientific teaching methods
	Teaching according to aptitude, inspiring
Teaching effectiveness	Mastery of knowledge
	Development of abilities
	The employment situation of graduates

(4) Determination of the number of hidden layer neurons. In general, the number of hidden layer neurons is determined according to the convergence performance of the network. Based on the summary of many network structures, we get an empirical equation:

$$s = \sqrt{0.43nm + 0.12m^2 + 2.54n + 0.77m + 0.35 + 0.51}$$

(5) Measurement of neural transmission function. BP Nerve Net Neuron Transformation Function, commonly used S Model, Function Format:

$$f(x) = \frac{1}{1 + e^{-x}}$$

(6) Determination of model structure. The BP neural network model structure can be determined from the above results, as shown in Fig. 3.

4. CONSTRUCTION OF PHYSICAL EDUCATION LEARNING QUALITY ASSESSMENT MODEL FOR JUNIOR HIGH SCHOOL STUDENTS BASED ON ARTIFICIAL NEURAL NETWORK EXPERT SYSTEM

4.1 Basic Architecture of ANN Expert System

From Fig. 4, it can be found that ANN has a similar structural architecture to a conventional Expert System, which consists of a reasoning machine, interpreter, and man-machine interface. The design of the human-machine interface part is the same, so only different parts are designed in detail, including the design of the knowledge base, inference machine, and interpreter (Liu et al., 2022).

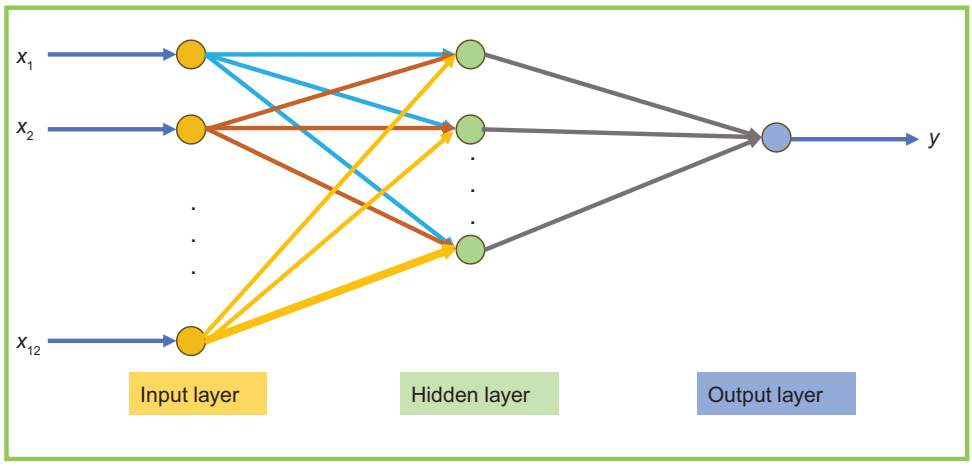

Fig. 3 Structure of BP Neural Network Model.

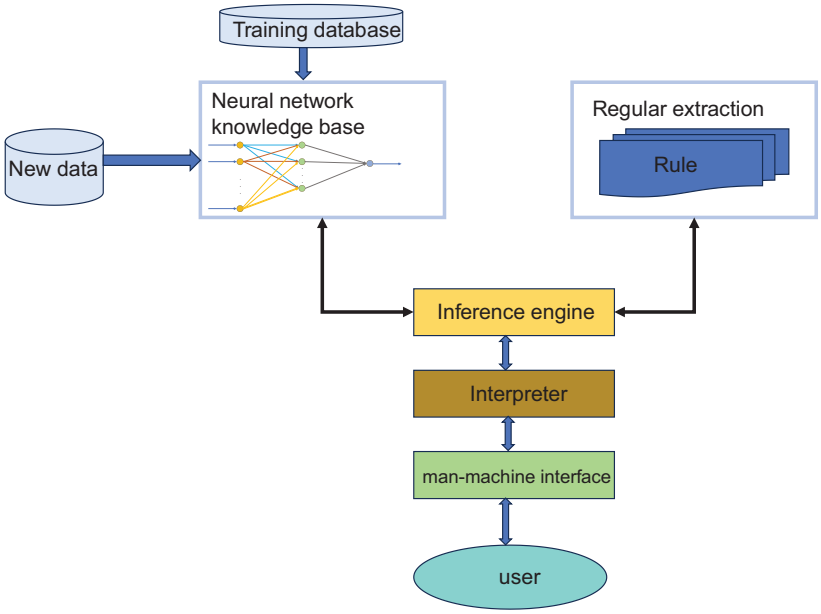

Fig. 4 The Basic Structure of Artificial Neural Network Expert System.

The sections are different. The difference with the traditional expert system lies in the addition of a neural network knowledge base, which has functions that the traditional expert system knowledge base does not have, such as automatic knowledge acquisition function, incomplete data knowledge reasoning function, and knowledge self-learning function (Beauchamp et al., 1990). However, the artificial neural network is not superior to the traditional knowledge base in any aspect of knowledge expression, and it is better than the traditional expert system in knowledge expression (Zhou, & Wang, 2019). So, NN's composing architecture keeps up the regularity of KB entirely and makes it easier to read.

4.2 Design of Expert System Workflow in Neural Network

Before designing each component of the neural network expert system, there is an important work to be completed, that is, to design the workflow of the neural network expert system, which is shown in Fig.5.

Based on the Neural Network Expert System Workflow Diagram, it can be found that the representation of the knowledge base has undergone two transformations; one is the transformation from regular form knowledge base to neural network form knowledge base, aiming to complete knowledge reasoning and knowledge acquisition state by the neural network; the other is the transformation from neural network form knowledge base to regular form knowledge base, aiming at Knowledge representation is completed by rule form knowledge base (Zakrajsek et al., 2003).

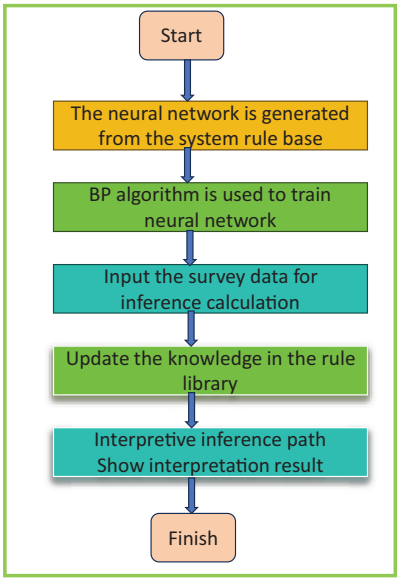

Fig. 5 Workflow Diagram of Neural Network Expert System.

4.3 Design of Knowledge Base of Neural Network Expert System

The process of constructing a neural network knowledge base is actually the process of knowledge base pattern conversion, that is, the conversion of a regular knowledge base to a neural network structure knowledge base. The specific process is as follows:

(1) A feedforward neural network model is constructed

The neural network model is mapped according to the rules in the rule-form knowledge base in the initial state. A TF-THEN rule is taken as an example to illustrate the mapping mode:

Rule:

IFA (nf_1) and B(nf_2) THENC(cf)

First, map the whole rule to a node at the first connection layer of the feedforward neural network denoted by R.

Then, the condition part of the rule, IFA and B, is divided into two input nodes, and these two input nodes are represented by A and B, respectively. The result part of the rule, THENC, is represented by C as the output node.

Then, connect A to the R arrow, and the arrow points to R, B to R, and the arrow points to R, and R to C, and the arrow points to C. Arrow Connection Arrow points to C.

Finally, the weights are marked on each arrow: the weights from A to R are "nf_1", the weights from B back to R are "nf_2", and the weights from R to C are "cf."

The above steps map a TF-THEN rule into a part of the neural network, as shown in Fig. 6.

Fig. 6 illustrates a TF-THEN rule mapping node of a neural network model. How can the expert system knowledge base composed of multiple TF-THEN rules be mapped into the neural network model? An example illustrates the specific process: See Table 5.

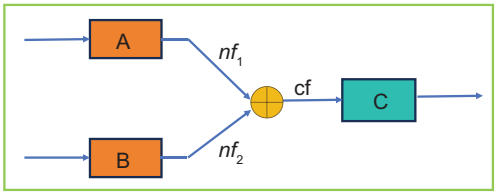

Fig. 6 A Knot Point.

Table 5 Expert System TF-THEN Rule Knowledge Base.

Rule 1:	Rule5:
IF a_1 (0.4) AND a_3 (0.5) THEN b_1 (0.8)	IF a_5 (0.3) THEN b_3 (0.6)
Rule 2:	Rule 6:
IF a_1 (0.4) AND a_4 (0.3) THEN b_1 (0.2)	IF a_1 (0.5) AND b_3 (0.3) THEN c_1 (0.7)
Rule 3:	Rule 7:
IF a_2 (–0.6) AND a_5 (–0.3) THEN b_2 (0.1)	IF b_2 (0.5) THEN c_1 (0.1)
Rule 4:	Rule8:
IF a_3 (0.5) AND a_4 (0.6) THEN b_3 (0.9)	IF b_2 (0.5) AND b_3 (0.4) THEN c_2 (0.9)

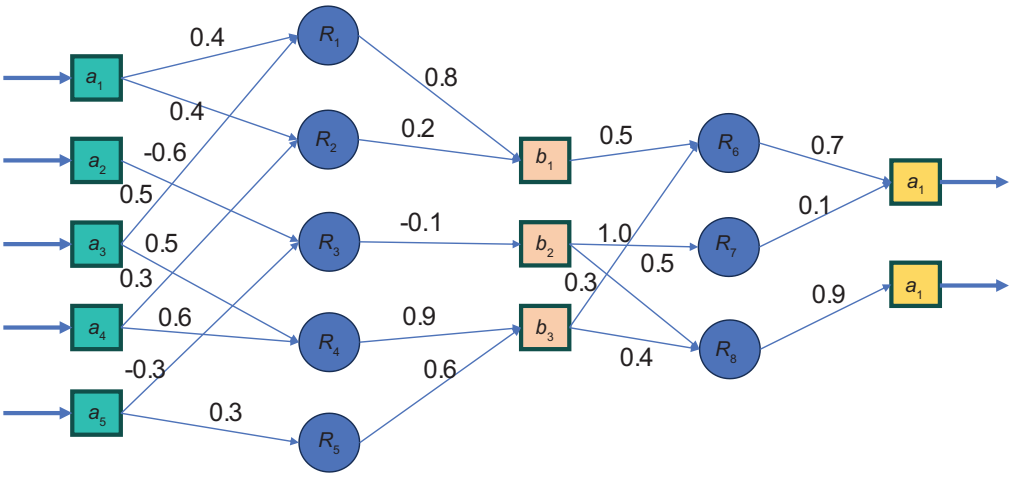

Fig. 7 Feedforward Neural Network Model Mapped From TF-THEN Rule Base.

The knowledge base formed by 8 TF-THEN rules can be transformed into a feed-forward neural network model, as shown in Fig. 7.

(2) Select a learning sample

After the converted neural network model has been obtained □, the next task is to select appropriate learning samples. How do we select representative learning samples?

The specific way is
First, the sample mode is determined. The sample mode of the neural network model in Fig. 7 is

$$(a_1, a_2, a_3, a_4, a_5, c_1, c_2)$$

a_1, a_2, a_3, a_4, a_5 represents the input signal. c_1, c_2 represents the outgoing teacher signal.
Then, it is determined that the total sample size determined by the sample pattern is 27.
Finally, the learning sample is selected, and the total sample size is randomly selected as the learning sample for the training of the neural network.
(3) The connection weights of the feedforward neural network model are initialized.
Initialization of connection weights The connection weights between the rule node and the conclusion node are initialized with cf values in the corresponding TF-THEN rule, and the remaining connection weights are initialized to 1.0.
(4) The learning sample selected in (2) is used to train the feedforward neural network initialized in step (3) based on the BP algorithm.

4.4 The Design of Neural Network Expert System Reasoning Machine

In essence, the reasoning process of ANN is that the middle hidden layer nodes compute the input signal, the output signal is acquired in the output layer, and the network path is acquired from the intermediate hidden layer. The specific process is as follows.
Step 1: Generate input signal vector;
Step 2: The input vector obtained in step 1 is input into the FNN model, and the output value of each node is computed based on the link weight, node threshold, and excitation function, and the calculation result to the corresponding component representing the vector of the first hidden layer If the difference between weighted and threshold values is greater than 0, the output value of node is "1"; otherwise, the output value of node is "0". The newly obtained vector representing the input signal from the node of the first hidden layer is taken as the input signal of the second hidden layer. The calculation process is repeated until the calculation result of each node is obtained in the output layer. The result is represented by the vector representing the output signal of the node in the output layer, and the final inference result is obtained.
Step 3 Establish an inference chain taking the node with component "1" in the input layer vector as the starting point , the node with component "1" in the input layer vector of each hidden layer in Step 2 as the middle node and the node with component "1" in the input layer vector as the endpoint. The information in this inference chain can be expressed as the nerve. The whole process of the network expert system starts from the fault provided by the user, gradually reasoning, and finally finding the cause of the fault.
The inference result is obtained from step 2, and the inference process is obtained from step 3. At this point, the whole inference process is over , which also marks the completion of the expert system's inference machine design.

5. CONCLUSION

The Learning Quality Evaluation Index is a kind of index system that is made up of different parameters. Because of its quantity and complexity, it is hard to get accurate and fuzzy. There are a

lot of limitations in the application of standard assessment methods to solve the problem. However, this method only needs to input the processed data into the network to produce the result through calculation without determining the weight manually. It is true that it can decrease the human factor in the assessment process, increase the reliability of the assessment, and make the evaluation result more efficient and objective. Of course, there are some limits to neural networks. It can achieve global optimization by constantly modifying the connection weights between neurons, but it can easily cause the network to fall into local minima.

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