ISSN: 2458-8989

Natural and Engineering Sciences

NESciences, 2024, 9 (2): 125-144 doi: 10.28978/nesciences.1569219

Comparative Study on Physical Education Learning Quality of Junior High School Students based on Biosensor Network

Yu Geng [1*]

[1*] Ph.D, Krirk University, International College, Bangkok, Thailand.

E-mail: zhihongtydz@163.com

Abstract

A biosensor is an innovative analytical detecting instrument utilized across many sectors due to its sensitiveness, precision, ease of use, and capability for in vivo surveillance via the internet. Biosensors provide extensive applicability in sports science, facilitating rapid physical activity tracking. This will emerge as a significant approach and technology for sports teaching and scientific study in sports. This study aims 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 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, biosensor.

Article history:

Received: 15/05/2024, Revised: 13/07/2024, Accepted: 15/08/2024, Available online: 30/09/2024

**Corresponding Author: Yu Geng, E-mail: zhihongtydz@163.com*

Introduction

Students' physical fitness is paramount in today's competitive culture, particularly during this "lifelong learning" period. In 2007, the state released the Opinions on Strengthening Youth Sports and Enhancing Youth's Physical Fitness, stating: "Enhancing youth's physical fitness and promoting their healthy development are critical matters concerning 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) reiterated the necessity to enhance the reform and development of the education system. The Ministry of Education promulgated the National Physical Health Standards for Students (updated in 2014) as a fundamental criterion for evaluating students' overall quality, reviewing school performance, and monitoring educational advancement across various regions (Zou et al., 2009). Consequently, in conjunction with social progress and development, the nation increasingly prioritizes physical development to improve student quality. In this context, it is essential to investigate "physical education learning quality" to enhance students' physical education outcomes and foster their physical growth.

Artificial Neural Networks (ANN) is an emerging field within the information technology sector. The theory of ANNs is among the most sophisticated fields globally. According to essential findings in neuroscience, ANNs are information-processing systems that emulate the structure and function of the human brain, suggesting their extensive potential use (Abiodun et al., 2018). The ANN possesses several attributes, including non-linear mapping, learning categorization, and real-time optimization, offering a novel methodology for model identification and non-linear classification study.

Numerous influencing factors complicate the assessment of junior high school students' physical education learning quality, each exerting varying degrees of impact. Consequently, a suitable mathematical analytical expression cannot adequately represent the evaluation results, rendering it a nonlinear classification problem. Based on this characteristic, the research developed a neural network model for evaluating junior high school pupils' physical education learning quality through network training (Chen et al., 2016). The study determines the level of physical education teaching among junior high school pupils.

A biosensor is a specialized instrument utilized in biotechnology. It employs biological molecules (such as enzymes, genes, proteins, antibodies, immunoglobulins, biological films, etc.) as identifying components to identify and track both living and chemical compounds (Lei & Guo 2022). Specific formulations developed by drug companies require injection into patients. The requisite purity is elevated. The advancement of high-resolution biotechnology enables the rapid and efficient detection and elimination of trace contaminants in goods, assuring safety in therapeutic applications. The electrode system for continual cardiac surgery tracking has pioneered the development of contemporary biosensors. Researchers progressively developed whole-cell biosensors and immune sensors. Biosensor technologies have proliferated swiftly across Europe since that time.

As living circumstances have improved, the public's enthusiasm for sporting activities has peaked. Sitting before the television while viewing the game makes it challenging to feel enthusiasm. The research consistently wants to understand why certain athletes cannot run immediately after halftime and why a minor head collision causes a particular foreign aid to collapse for an extended duration. Viewers will be more aware of these metrics during a live broadcast if each participant's running separation, heart rate, and buildup of lactic acid levels are displayed (Ye et al., 2020). Would real-time display of the effect of pressure on the athlete's face on the enormous screen enhance the fairness of penalties? The most recent biosensors can accomplish this task. They are slender and compact and transfer data securely. They can be utilized similarly to stitches and piercings. The performers exhibit more precision and functional diversity. The applicability of such a biosensor to a sporting system warrants our investigation.

This study seeks to assess the disparities in the quality of physical education learning among junior middle school pupils under various raising modalities; the ANN Expert System is utilized to investigate the issue. This study examines the training patterns of middle school pupils, explores the application of ANN in educational evaluation, and presents an ANN-based assessment model.

Relevant Theory and Concept Definition

The Basic Theory of ANNs

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.

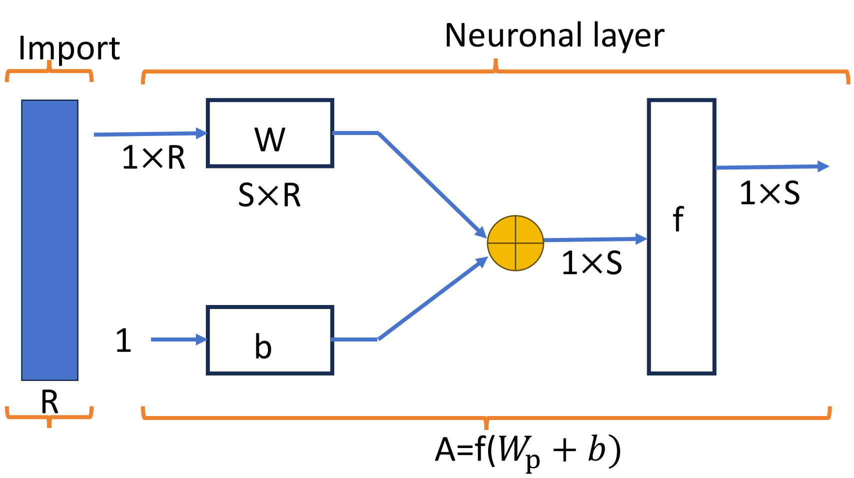

Figure 1. Model of single-layer neural network

Table 1. The development process of ANNs

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 ANNs
1980s	The proposal and application of multi-layer feedforward neural networks and backpropagation algorithms
1990s	The research on ANNs has entered a new era**
2000s	Deep learning based on neural networks has regained widespread attention
In recent years	ANNs have become essential tools and applications in various fields.

In Figure 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. Different neural networks abstract and simulate the biological nervous system from various angles and 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 its topology and learning methods (Islam et al., 2019). From the perspective of network topology, neural networks can be divided into (Mehrotra et al., 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.

Basic Concepts of ANNs

The current definition of ANNs lacks uniformity, with the most acknowledged and accepted definition being:

A neural network is a vast parallel distributed processor capable of storing empirical information and utilizing it efficiently. It resembles the human brain in two aspects: (1) a neural network assimilates knowledge via a learning process; (2) the intensity of the connections between neurons (termed synaptic weights) facilitates knowledge retention. Consequently, an ANN is conceptualized as a numerical operation employing a nonlinear processing technique for numerical information, signals, and pictures. These methods can be executed on standard computers or integrated into hardware.

ANN has Several Uses Across Various Domains, Including:

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 use the ANN as a flexible, nonlinear regression and mode classification model.

3. In many 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 brain activity levels).
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 use the ANN to simulate the phenomenon of statistics and deal with the experiment data 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 various reasons. The application of ANN.

Expert System Overview

A brief description of the expert system (ES), known as the knowledge-based system , 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 expertise supplied by one or more experts in a particular area and then simulates the experts' decisions. Solving complex problems requires expert decision-making.

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.

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 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, expert systems are superior to general program software. At the same time, an expert system differs from a standard 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. Solving the problem uses different strategies to deal with the symbolic knowledge to reason according to the rules and finally get the required conclusion (Buchanan & Smith, 1988).

The Architecture of the Expert System

The architecture of the expert system differs based on the issues addressed and the context of the application. The expert system has six components: an information base and its administration system, an inference engine, a translator, a knowledge acquisition company, an extensive database and administration system, and a human-machine interface, as illustrated in Figure 2. The knowledge base is utilized to retain professional information and expertise pertinent to the subject in a specific format, while the comprehensive database houses detection information and structural factors associated with problems. The knowledge-acquiring institution gathers the diagnostic subject's fault and characteristic data for the knowledge foundation. At the same time, the inference machine employs the knowledge inside the database of knowledge to deduce reasoning based on the features of fault indicators in a specific manner. The interpreter provides a coherent explanation of the system status and elucidates the diagnostic results and the rationale behind the conclusions drawn based on the user's needs. The man-machine interface serves as the connection between the technology and its users. Users enter defect data into the software via the man-machine interface and can pose inquiries to the system. The system conveys findings and responses to users via the human-computer interface.

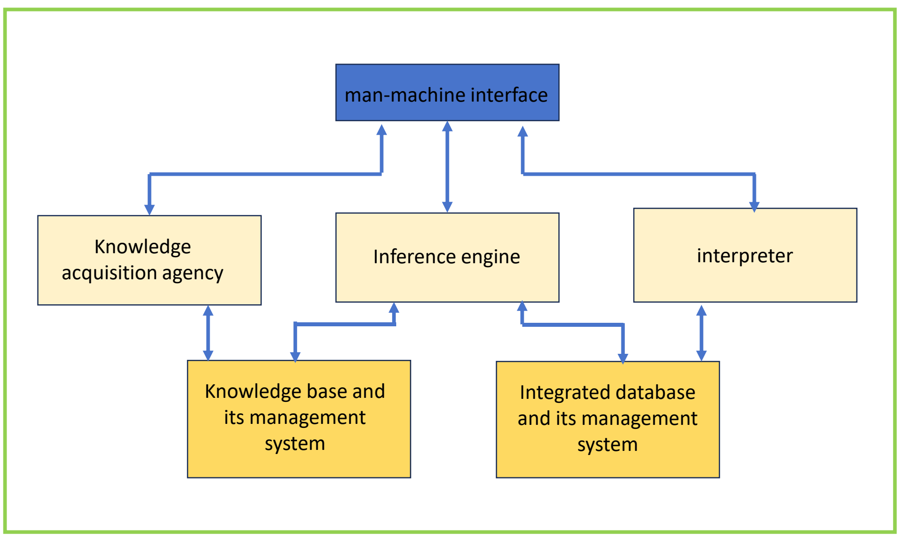

Figure 2. Expert system structure

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 various 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 et al., 1984; Wang, 2023). 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 et al., 1987). This shows that the quality of the study is essential for personal research to a certain degree.

Definition and Classification of Parenting Patterns

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(Gan, 2023)
Learning Resources and Technologies	The learning resources and technologies that students acquire and utilize, such as libraries, networks, electronic teaching aids, etc

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 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. Parents' and grandparents' educational ideas, attitudes, and behaviors impact children's physical and mental development.

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 contact their grandchildren for more time than the parents. This situation lasts for at least half a year (Lv et al., 2020).

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

Theory

Back Propagation (BP) Neural Network is sometimes called Multilayered Forward Neural Networks. The primary characteristic of this model is that each layer of the neural network is interconnected with the subsequent layer, devoid of any connections among them. A significant nonlinear correlation exists between input and output (Yang et al., 2009). The BP network constitutes an M-dimensional Euclidean space within an N-dimensional Euclidean space, where the input node is n, and the output node is m. The research uses the attribute value of each index as the input vector for the BP network model and employs it as the output of the BP network model (Jerbi et al., 2012). The research trains the BP network with adequate samples to acquire expertise, subjective judgment, and the evaluative expert's bias on the importance of the indicators. The weight metrics for this network model are an internal indicator of the network's positive confidence following self-adaptive learning. In contrast, the trained BP network model assesses the quality of education based on the evaluation price. The value of the attributes of each measure can yield the assessment results for instructional quality, reflecting the expertise, knowledge, and personal views of experts regarding the significance of indicators, thereby achieving an effective integration of qualitative as well as quantitative techniques to ensure the fairness and consistency of the evaluation.

Establishment of Teaching Quality Evaluation Indicator System

The assessment of educational quality refers to analyzing the influential elements and their impact on the student's education to get the correct 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:

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

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 learning rate. Based on Kolmogorov's Theorem, the 3-tier BP network can approach the arbitrary continuous function with the appropriate weight. Therefore, the research chooses a 3-layer BP network with a relatively simple structure.
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, the research gets an empirical equation $the\ ns = \sqrt{0.43\text{nm} + 0.12\text{m}^2 + 2.54\text{n} + 0.77\text{m} + 0.35} + 0.51$
5. Measurement of neural transmission function. BP Nerve Net Neuron Transformation Function, commonly used S Model, Function Format:

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

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

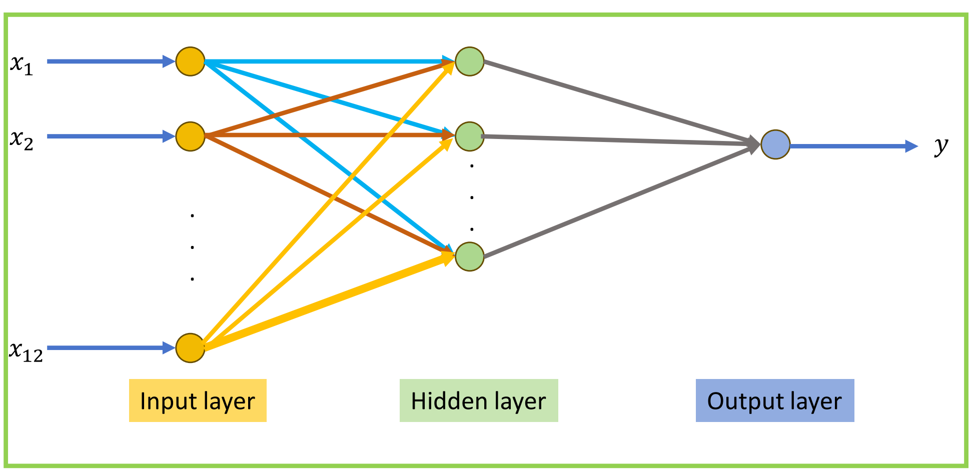

Figure 3. Structure of BP neural network model

Related Works

Biomedical detectors, semiconductors, and the application of flexible packaging technologies in a non-invasive way offer promising potential for the continuous and real-time measurement of individual physiological data (Kim et al., 2022). For instance, individuals with strokes or heart failure encounter issues related to networked body parts and cardiac monitoring systems. A solitary individual's name biosensor has demonstrated the capability to transmit data to an emergency and crisis alert system. The data is relayed to the ambulances, decreasing the individual's wait time.

Proposals have been made for intelligent shirts utilizing wireless sensor networks for comprehensive health and activity tracking (Roudjane et al., 2020). Intelligent shirt measurement, tracking, and data processing devices offer several frameworks. Bright shirts are utilized in several domains, such as military operations, public security, medical monitoring, and physical activity applications. This pertains to examining signal recordings from an intelligent shirt gyroscope while utilizing a treadmill at varying speeds.

These biosensors are indispensable for individuals requiring long-term care, performers, preterm newborns, and youngsters, as well as for monitoring the vital signs of people with a m and condition and those in rural medical areas (Lu et al., 2023). They are essential for avoiding illnesses and facilitate rapid evaluation, management, and treatment. A single use of telemedicine equipment is to deliver medical care to inmates, hence minimizing their transit to health centers.

The objective is to enhance specific analyses of sports ability. It aims to confer significant importance to individuals, particularly on a particular facet of great athletes. The designated training approach assesses athletes' results to determine the impact impartially. To evaluate the efficacy of the training course, efforts are made to implement a monitoring methodology. Examining sleep habits and markers includes research on the relationship between a particular form of physical activity and sleep hygiene. Several efforts will concentrate specifically on enhancing athletic technology.

Physical Education Learning Quality Assessment Model

Implementing the player monitoring method in physical learning is intricate, often including several players and activities, with demanding competition, training schedules, and considerations related to results and logistical requirements. The strategy is a multi-dimensional framework addressing a specific issue. The exercises are brief, team-oriented activities designed for the complete group of tracks, often lasting 3 to 5 minutes, and are utilized as a maximum-effort warm-up during exercise treatment. Assessing heart rate and motion is the most relevant tool for symptom assessment. Thorough tracking of the exercise procedure will influence all significant heart rate metrics and various responses, including stress, healing, and precise isolation adaption.

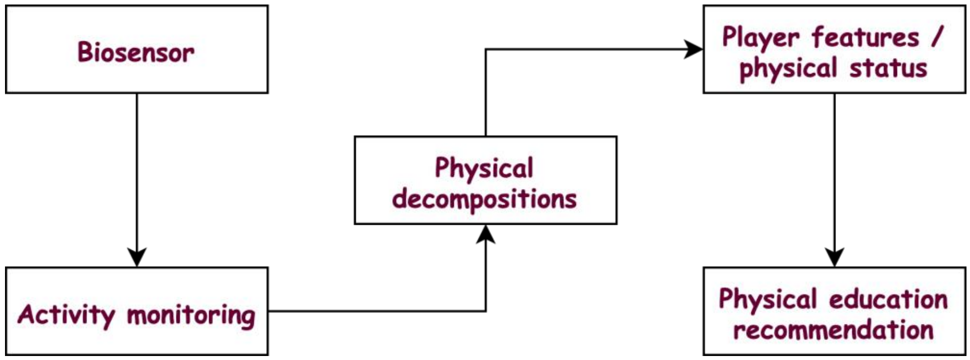

Figure 4. Biosensor-based sports education model

Fig. 4 illustrates that the biological signal connection delivers essential data reflecting the user's physiological state, and it is utilized in several other domains within the medical industry. The medical profession identifies a preliminary framework for continuous analysis or risk, alongside wellness and exercise, and the medical automated structure, which provides surveillance and services for rehabilitation. The utilization of physiological signals and automated stress monitoring yield practical findings based on reliable information obtained. The biological signal connection employed in a standard medical, physical structure for developing a mobile device for biological signal flow is inferior to that of the general populace. The biological signaling gateway is utilized in recovery, health, athletic endeavors, and breathing practices to regulate this type of coordinated physical training.

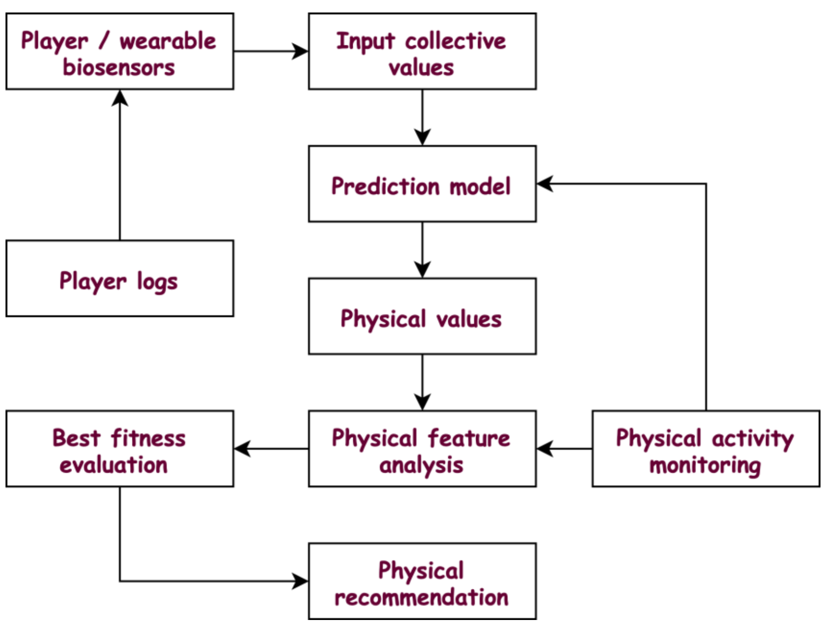

Figure 5. Biosensor-based physical education model

Fig. 5 shows the biosensor-based physical education model. Therefore, when analyzed alongside subjective health and tiredness indicators in the context of exercise and multiple variables, the training period, workload, and severity distribution should prompt consideration of alterations in the rate of heart response. This reviews contemporary heart rate tracks, including univariate and multivariate techniques and other ideas.

Evaluation of responses reveals significant modifications in the assessment of heart rate methodologies. The objective is to elucidate the context and instances for applying heart rate measurements and straightforward algorithms. The suggested approach facilitates the systematic assessment, support for decisions (group), and efficacy of many sports methodologies to address the existing deficiencies in understanding and contradictory practices.

Basic Architecture of ANN Expert System

From Fig. 6, 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). The sections are different. The difference with the traditional expert system lies in adding a neural network knowledge base, which has functions that the conventional 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 ANN is different from the traditional knowledge base in any aspect of knowledge expression, and it is better than the conventional 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.

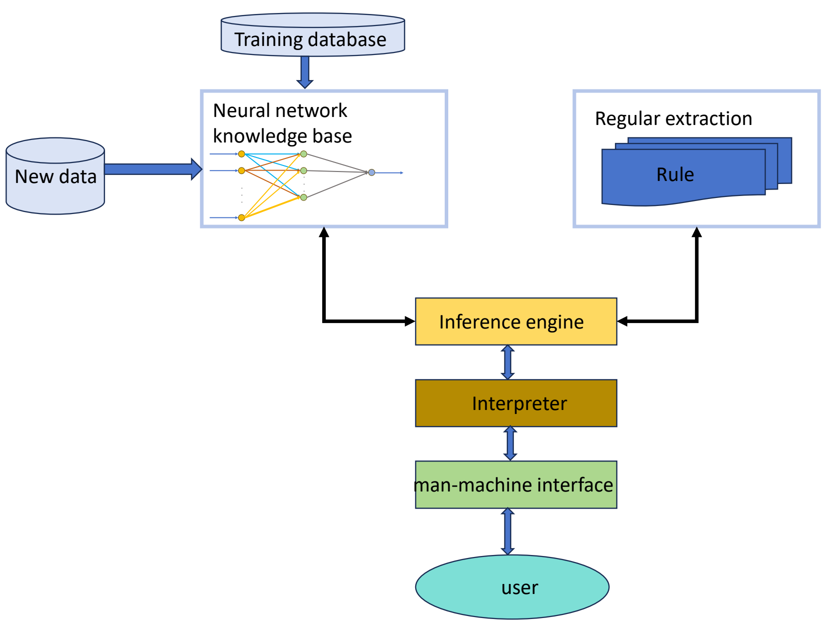

Figure 6. The basic structure of the ANN expert system

Design of Expert System Workflow in Neural Network

Before designing each component of the neural network expert system, there is important work to be completed, that is, to design the workflow of the neural network expert system, as shown in Figure 7.

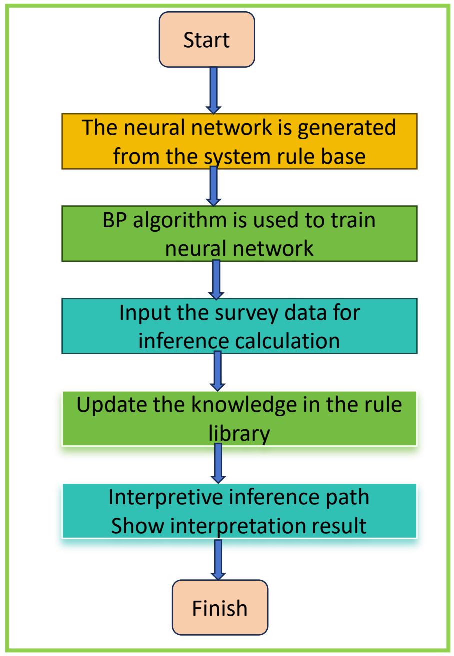

Figure 7. Workflow diagram of neural network expert system

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).

Design of Knowledge Base of Neural Network Expert System

Constructing a neural network knowledge base is the pattern conversion process, converting 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, the arrow points to R, B to R, 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 Figure 6.

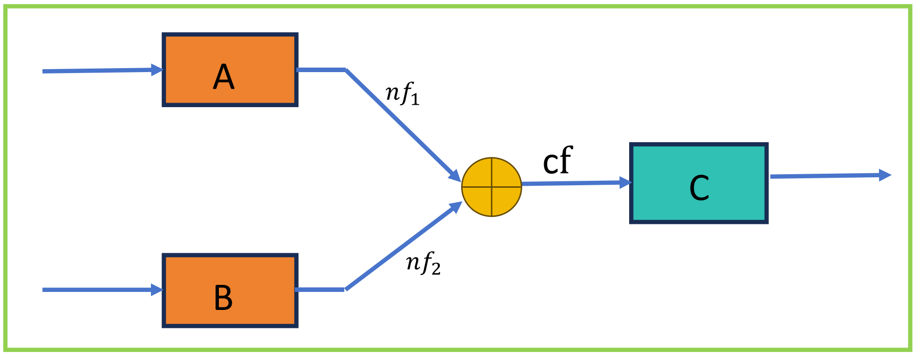

Figure 8. A knot point

Figure 8 illustrates a TF-THEN rule mapping node of a neural network model. How can the expert system knowledge base of multiple TF-THEN rules be mapped into the neural network model? An example illustrates the specific process: See Table 5.

Table 5. Expert system TF-THEN rule knowledge base

Rule1:	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)
Rule2:	Rule6:
IF a_1(0.4)AND a_4(0.3)THEN b_1(0.2)	IF a_1(0.5)ANDb_3(0.3)THEN c_1(0.7)
Rule3:	Rule7:
IF a_2(-0.6)ANDa_5(-0.3)THEN b_2(0.1)	IF b_2(0.5)THEN c_1(0.1)
Rule4:	Rule8:
IF a_3(0.5)ANDa_4(0.6)THEN b_3(0.9)	IF b_2(0.5)ANDb_3(0.4)THEN c_2(0.9)

The knowledge base formed by 8 TF-THEN rules can be transformed into a feed-forward neural network model, as shown in Fig. 9.

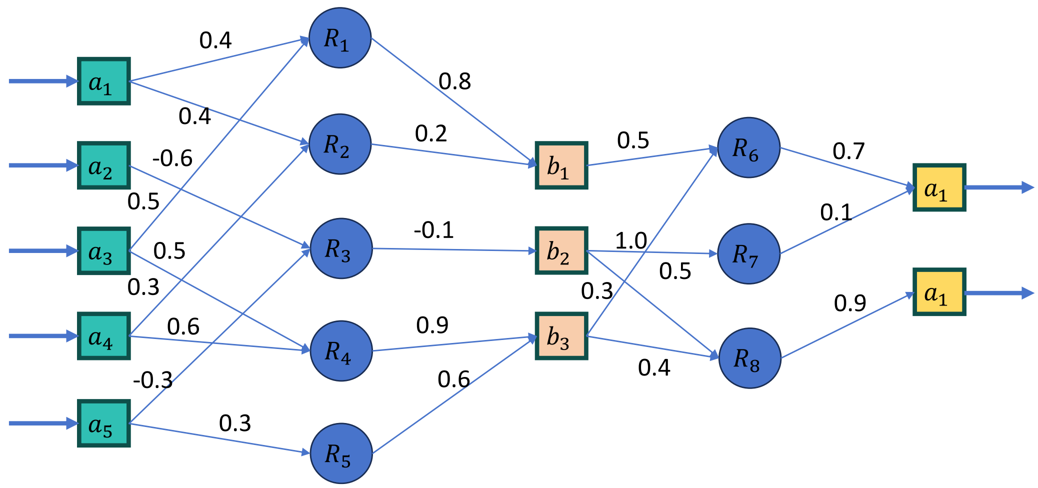

Figure 9. Feedforward neural network model mapped from TF-THEN rule base

(2) Select a learning sample

After the converted neural network model has been obtained, the next task is to select appropriate learning samples. How does the research choose representative learning samples? First, the sample mode is determined. The sample mode of the neural network model in Figure 7 represents the outgoing teacher signal. Then, it is determined that the total sample size specified 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 on the BP algorithm, and in step (3), based on the BP algorithm—the—Design of Neural Network Expert System Reasoning Machine. In the less of ANN, 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 inference process is over, which marks the completion of the expert system's inference machine design.

Results

This research examines the physiological state of athletes by employing biosensors and utilizes univariate analysis and statistical methods to document their condition throughout different physical activities. The advanced data intelligence surveillance system is used to construct nodes for networks. Networking technology facilitates immediate information transfer to monitor the well-being and performance of athletes. The feasibility of implementing an intelligent sports structure utilizing biosensor networking technology is validated compared to traditional distant recruitment methods, and the conceptualization of the clever sports structure is established under the circumstances. The analysis of the conventional group's achievements compared to the experimental group's reveals that the intelligent system utilizing biosensor networking technology has significant benefits. It can decrease the risk of injury to practitioners during performances, conserving expenses and time. The data indicates that the tracking of the conventional group is less accurate than that of the control group, resulting in significant mistakes that lead to inaccuracies in the entire procedure. Judgment is likely to affect athletes adversely. Figure 10 displays the results of experiments for the conventional group.

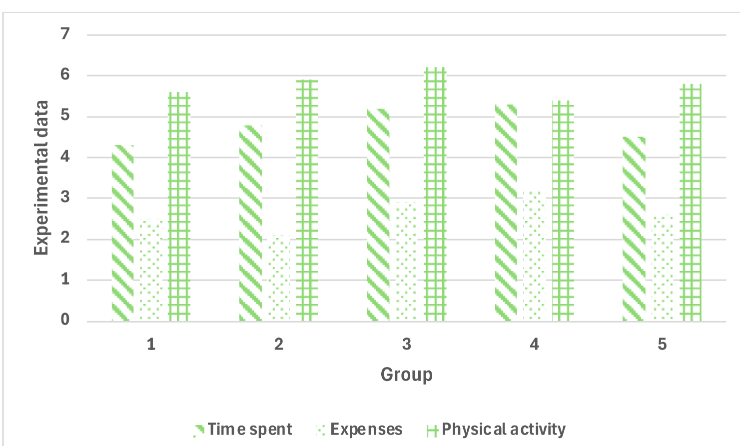

Figure 10. Experimental result analysis

Following the implementation of the novel technology in the study population, athletes exhibited immediate communication of physiological indications before and after activity, with blood pressure rising throughout the event. This article evaluates an advanced biosensor network system, focusing on hypersensitive biodevices, current use, packet loss, and collision rates. The quantitative outcomes of the communication tests are presented in Figure 11. Evaluate the current usage at several transmit power levels. The test and usage findings indicate that the approach examined in this study effectively addresses the issue of biased judgments encountered by athletes, decreasing node volume and demonstrating commendable adaptability.

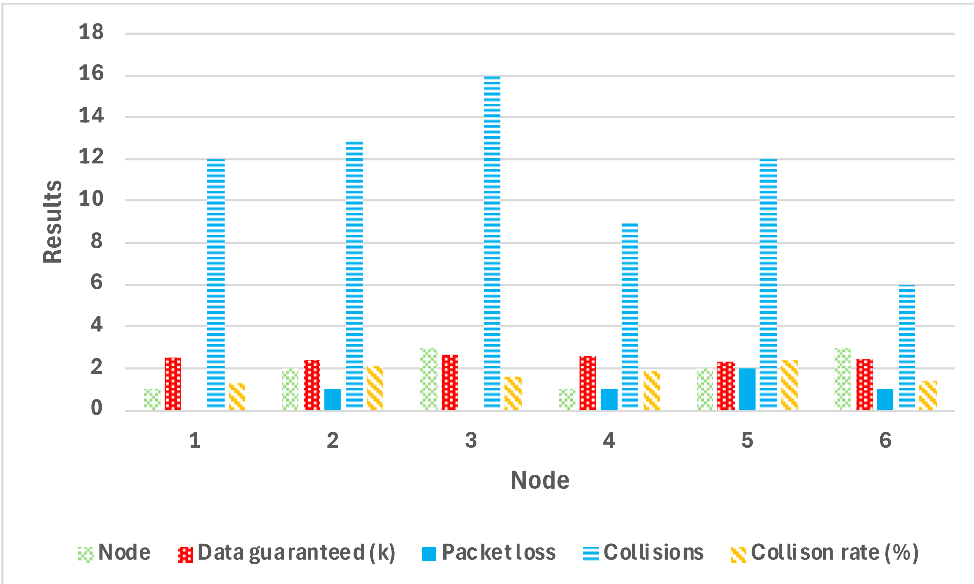

Figure 11. Data communication result

The ambiguous semi-structured or uncontrolled nature of athletes' compartments has posed challenges for athletes. The advancement of contemporary science has significantly progressed in index evaluation, assessment, and forecasting, yet coaches hardly utilize it due to the cumbersome methods involved. The personnel and decision-makers embraced it. Many exceptional seedlings were discarded due to improper evaluation, resulting in substantial loss of material, financial, and human assets. Following the experiment above, the fifty people who engaged in the randomized survey expressed satisfaction with the layout of the intelligent biosensor networking system, and the conventional impartial assessment was not matched relatively with one another. The participants in the two trials were randomly chosen. Most participants in the two studies favored the intelligent networking approach utilizing biological networks. The poll's information is presented in Figure 12.

Figure 12. Satisfaction result analysis

Conclusion

The efficiency of wearable devices and sensors is becoming available to the public and athletic teams. The layout of the intelligent sports network utilizing biosensor networks significantly enhances the working atmosphere, provides a rational and scientific management plan, and facilitates a more enjoyable participation experience for sportsmen in competitions. 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 can indeed 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.

Research evidence indicates that the layout of the intelligent sports technology utilizing biosensor networks safeguards performers, enhances efficiency, and mitigates injuries resulting from strenuous physical activity. The study results indicate that constructing an intelligent sports network utilizing biosensor networking technology is significant for advancing future sports systems.

Author Contributions

All Authors contributed equally.

Conflict of Interest

The authors declared that no conflict of interest.

References

Abiodun, O. I., Jantan, A., Omolara, A. E., Dada, K. V., Mohamed, N. A., & Arshad, H. (2018). State-of-the-art in artificial neural network applications: A survey. *Heliyon*, 4(11).

Agatonovic-Kustrin, S., & Beresford, R. (2000). Basic concepts of artificial neural network (ANN) modeling and its application in pharmaceutical research. *Journal of pharmaceutical and biomedical analysis*, 22(5), 717-727.

Beauchamp, L., Darst, P. W., & Thompson, L. P. (1990). Academic learning time as an indication of quality high school physical education. *Journal of Physical Education, Recreation & Dance*, 61(1), 92-95.

Buchanan, B. G., & Smith, R. G. (1988). Fundamentals of expert systems. *Annual review of computer science*, 3(1), 23-58.

Chen, W., Mason, S., Hypnar, A., & Hammond-Bennett, A. (2016). Association of quality physical education teaching with students' physical fitness. *Journal of sports science & medicine*, 15(2), 335-343.

Gan, Y., Wang, Y., Yu, F., Xiao, Q., Luo, X., Han, Z., & Ke, C. (2023). Genotype by environment interactions for productive traits of purebred and crossbred abalone strains under different rearing modes. *Aquaculture*, 563, 738966.

Goodenough, D. G., Goldberg, M., Plunkett, G., & Zelek, J. (1987). An expert system for remote sensing. *IEEE Transactions on Geoscience and Remote Sensing*, (3), 349-359.

Hendrickson, C., Zozaya-Gorostiza, C., Rehak, D., Baracco-Miller, E., & Lim, P. (1987). Expert system for construction planning. *Journal of Computing in Civil Engineering*, 1(4), 253-269.

Islam, M., Chen, G., & Jin, S. (2019). An overview of neural network. *American Journal of Neural Networks and Applications*, 5(1), 7-11.

Jerbi, M. A., Aubin, J., Garnaoui, K., Achour, L., & Kacem, A. (2012). Life cycle assessment (LCA) of two rearing techniques of sea bass (Dicentrarchus labrax). *Aquacultural Engineering*, 46, 1-9.

Kim, K., Yoo, H., & Lee, E. K. (2022). New opportunities for organic semiconducting polymers in biomedical applications. *Polymers*, 14(14), 2960. https://doi.org/10.3390/polym14142960

Lei, Z. L., & Guo, B. (2022). 2D material-based optical biosensor: status and prospect. *Advanced Science*, 9(4), 2102924. https://doi.org/10.1002/advs.202102924

Liao, S. H. (2005). Expert system methodologies and applications—a decade review from 1995 to 2004. *Expert systems with applications*, 28(1), 93-103.

Liu, H., Qi, J., Yang, Q., Tang, Q., Qi, J., Li, Y., & Li, L. (2022). Effects of cage and floor rearing systems on the metabolic components of the uropygial gland in ducks. *Animals*, 12(2), 214.

Lu, T., Ji, S., Jin, W., Yang, Q., Luo, Q., & Ren, T. L. (2023). Biocompatible and long-term monitoring strategies of wearable, ingestible and implantable biosensors: reform the next generation healthcare. *Sensors*, 23(6), 2991.

Lv, W., Yuan, Q., He, D., Lv, W., & Zhou, W. (2020). Microplastic contamination caused by different rearing modes of Asian swamp eel (Monopterus albus). *Aquaculture Research*, 51(12), 5084-5095.

Mehrotra, K., Mohan, C. K., & Ranka, S. (1997). *Elements of artificial neural networks*. MIT press.

Richer, M. H. (1986). An evaluation of expert system development tools. *Expert systems*, 3(3), 166-183.

Roudjane, M., Bellemare-Rousseau, S., Drouin, E., Belanger-Huot, B., Dugas, M. A., Miled, A., & Messaddeq, Y. (2020). Smart T-shirt based on wireless communication spiral fiber sensor array for real-time breath monitoring: Validation of the technology. *IEEE Sensors Journal*, 20(18), 10841-10850.

Shanmuganathan, S. (2016). *Artificial neural network modelling: An introduction,* 1-14. Springer International Publishing.

Shortliffe, E. H., Scott, A. C., Bischoff, M. B., Campbell, A. B., Van Melle, W., & Jacobs, C. D. (1984). An expert system for oncology protocol management. *Rule-Based Expert Systems, BG Buchanan and EH Shortiffe, Editors*, 653-65.

Wang, Y., Zhang, X., Liu, Y., Jiang, F., Liu, Y., Xu, F., & Liu, Y. (2023). The influence of parental rearing style on the incidence of panic disorder, major depressive disorder and the comorbidity among Chinese college students. *Journal of Affective Disorders*, 338, 100-106.

Waterman, D. A. (1985). *A guide to expert systems*. Addison-Wesley Longman Publishing Co., Inc..

Wu, Y. C., & Feng, J. W. (2018). Development and application of artificial neural network. *Wireless Personal Communications*, 102, 1645-1656.

Yang, Y., Fang, G., Li, Z., Liao, F., & Feng, Y. (2009). Effects of different rearing modes on chicken's muscular histological traits and meat tenderness. *Animal Husbandry and Feed Science*, 1(3), 24-27.

Ye, S., Feng, S., Huang, L., & Bian, S. (2020). Recent progress in wearable biosensors: From healthcare monitoring to sports analytics. *Biosensors*, 10(12), 205. https://doi.org/10.3390/bios10120205

Zakrajsek, D., Carnes, L., & Pettigrew, F. E. (2003). *Quality lesson plans for secondary physical education*, 1, Human Kinetics.

Zhou, Y., & Wang, L. (2019). Correlates of physical activity of students in secondary school physical education: a systematic review of literature. *BioMed Research International*, 2019(1), 4563484. https://doi.org/10.1155/2019/4563484

Zou, J., Han, Y., & So, S. S. (2009). Overview of artificial neural networks. *Artificial neural networks: methods and applications*, 458, 14-22.