

# Research on Online and Offline Mixed Education Mode in Post Epidemic Era Based on Fuzzy Neural Network-Taking Introduction of Petrochemical Equipment Management as an Example

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**Abstract.** In the post epidemic era, the online offline mixed teaching mode is in the development period, and college teachers and students are gradually familiar with this teaching mode. Taking the course introduction to petrochemical equipment management as an example, this paper deeply analyzes the development path of online offline mixed teaching mode. First of all, this paper explores the bottleneck of online teaching in the epidemic era, deeply analyzes the relationship between online teaching and offline teaching, and puts forward the possibility of integration of offline teaching and online teaching. Based on the above analysis results, this paper summarizes the opportunities of Blended Teaching in the post epidemic era. This paper puts forward the practice path of the online and offline mixed teaching mode of "Introduction to petrochemical equipment management". Finally, the online and offline mixed teaching quality evaluation model of "Introduction to petrochemical equipment management" is constructed, the mixed teaching quality evaluation index system is determined, and the evaluation model based on improved firefly algorithm optimization fuzzy neural network is constructed, and the example analysis is carried out, and the online and offline mixed teaching quality of "Introduction to petrochemical equipment management" is determined as good, It provides a favorable theoretical basis for the reform strategy of mixed teaching mode, and also verifies the effectiveness of the evaluation model.

**Keywords:** post epidemic era, online, offline and online mixed teaching mode, introduction to petrochemical equipment management, evaluation model

## 1 Introduction

On the eve of the Chinese New Year in 2020, a sudden COVID-19 epidemic broke people's normal life [1]. During the COVID-19 outbreak, the pattern of social and economic development had an immeasurable impact, including on the development of higher education. Faced with the general requirement of "non-suspension of classes and non-suspension of teaching" issued by the Ministry of Education, colleges and universities have adopted new ways of online teaching to ensure normal teaching. Online classes, online tutoring and online graduation defense have been adopted by colleges and universities to ensure that the impact of the epidemic on higher education has been minimized. Online education has a great change compared with traditional teaching. Online teaching also puts forward new requirements on teachers' teaching skills, requiring teachers to be able to master various online teaching software, adapt to the online teaching model, and master the online teaching management methods. In addition, online teaching has greatly changed the learning style of college students. Students' learning environment has changed from classroom to home. This new teaching mode requires students to have higher learning enthusiasm, and college students have also accepted a severe test. At present, the Spring Festival of 2021 is approaching, and the epidemic has been intermittent for one year. The new cases in all parts of China have been eliminated, but there are still sporadic new cases. The prevention of the epidemic cannot be ignored. During the epidemic period, higher education is abnormal, and after the epidemic, higher education has become the new normal [2]. The outbreak era, colleges and universities gradually restored the past offline teaching mode, after a semester of online teaching college teachers have accumulated certain experience, college students are used to the new teaching mode, therefore, in this period has started thinking about how the online teaching mode to together build a new teaching mode, Through sorting out the difficulties existing in the epidemic era and exploring the management of online teaching and traditional teaching mode, a new mode of online and offline teaching integration of higher education in the post-epidemic era can be explored [1-3]. COVID-19 has promoted

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the development of online teaching, at same time, the online and offline mixed teaching mode that combines information technology with traditional teaching has been accelerated by information technology.

This paper is organized as follows: In section 2, the relating researches are summarized. In section 3, the bottlenecks of online teaching in the epidemic era are analyzed. In section 4, relationship between online teaching and traditional offline teaching is discussed. In section 5, opportunities for mixed offline and online teaching in the post-epidemic era are studied. In section 6, practice of online and offline mixed teaching mode in introduction to petrochemical equipment management is introduced. In section 7, evaluation simulation analysis of online and offline mixed teaching of introduction to petrochemical equipment management is carried out.

## 2 Related Works

The online and offline mixed teaching mode can be favorable for improving the independent learning ability of students, which can increase students' input in learning, enhance participation in classroom activities and improve classroom teaching results. It has become an inevitable trend for the development of higher education to deeply integrate online teaching with offline teaching, realize complementary advantages and improve the teaching quality. Currently the online and offline mixed teaching mode has been concerned by many scientists, the existing problems of mixed teaching mode have been analyzed by some scientists, and some targeted improvement strategies are put forward. Scholars pay special attention to online and offline teaching and its teaching effect, the requirement of mixed teaching mode on students and the learning effect of mixed teaching mode on learning effect are also studied by some scholars. The main mixed teaching modes have been developed in recent years, which provides the basis for mixed learning, mobile Internet +MOOC classroom is an excellent method, which can contextualize the curriculum knowledge points and take achievement degree as the evaluation basis [4-5]. The constructed smart classroom and smart campus can realize the grand goal of educational informatization, improve the teaching quality and enhance the comprehensive quality of students. The micro curriculum is also an effective method of carrying out online and offline mixed teaching mode. It should not only take into account the autonomy of online mode and guidance of offline mode, but also take into account the timeliness of online evaluation and process of classroom test [6-7].

In recent years, the artificial neural network has been applied in many fields with the ability of approximating any nonlinear mapping, the artificial neural network has the advantages of quick training speed, simple structure and strong nonlinear mapping ability, it can well reflect the nonlinear relationship between evaluation factors and evaluation object. However, the affecting factors of mixed teaching mode exists fuzziness, the conventional BP neural network can not identify the fuzziness, therefore the evaluation results are not correct, and have big error. Fuzzy theory is a novel learning method, which concludes relative membership degree that can well describe the fuzziness of teaching effect of online and offline mixed teaching mode, therefore the fuzzy theory is combined with artificial neural network to establish the fuzzy neural network to evaluate the teaching effect of online and offline mixed teaching mode. And the reliable evaluation results can be obtained [8-9].

## 3 Bottlenecks of Online Teaching in the Epidemic Era

Everything in the world has its advantages and disadvantages. Compared with traditional teaching, online teaching method is free from time and space restrictions and can better share resources. However, this new teaching method also has some defects, and the comprehensive implementation of online teaching still faces bottlenecks, mainly reflected in the following aspects:

(1) At present, online teaching colleges and universities have been widely implemented in the epidemic era and are in the early stage of development. For college and university teachers and students who have been accustomed to offline teaching, they have not fully understood the connotation of this new teaching mode in terms of ideology, the quality and effect of online teaching vary greatly, and most college and university teachers and students have not fully adapted to the online teaching mode. At the beginning of online teaching, there may be some curiosity, but after a period of time, they lose interest in online teaching and fail to achieve the ideal learning effect.

(2) Online teaching needs to realize classroom interaction through information technology. Due to the limitations of information technology, the convenience and multi-orientation of classroom interaction of online teaching are not as ideal as that of offline teaching, and a good collective atmosphere cannot be effectively formed. For example, the existing online platforms such as Networking Live and Tencent Conference, although video can be made between teachers and students during the teaching process, there is only one person on the teacher side and dozens of students on the student side, so it is difficult to carry out effective classroom interaction, thus affecting

the actual effect of online teaching.

(3) With the rapid development of information technology, some breakthroughs have been made in online teaching. Online teaching platforms, such as classrooms and MOOCs, have emerged quietly and developed to a certain extent. However, existing technologies cannot meet the needs of large-scale online teaching and personalized teaching. On the one hand, the network communication platform is not perfect. Due to the limitation of the network conditions, the network congestion phenomenon often appears in the process of online teaching. Due to the excessive number of people online at the same time, the information of online class is very unstable, and the abnormal phenomenon of online education platform lag and paralysis often occurs, which affects the quality of teaching [10-12].

(4) The quality of online teaching is closely related to the quality of educational resources. Although many national high-quality courses and open video courses have been developed, quality teaching resources are still relatively scarce. Some university teachers have accumulated and preserved a large number of high-quality offline teaching resources, but it is still difficult to convert these offline resources into online resources. In addition, the existing teaching resources cannot meet the personalized needs of teachers and students in colleges and universities, cannot realize effective teaching, and cannot meet the actual needs of teachers and students in colleges and universities [13].

#### **4 Relationship between Online Teaching and Traditional Offline Teaching**

Offline teaching has been deeply rooted among teachers and students in colleges and universities. It is the traditional education mode that we have been receiving. The traditional offline teaching mode is mainly based on face-to-face teaching. In the teaching process, teachers take the leading position and impart the knowledge needed to be taught to students according to the teaching plan. And the students are in the object position, in the teaching activities in a passive state. Teaching on the front line of the epidemic has been applied to a certain extent, but it has not been promoted. However, during the epidemic period, online teaching has been adopted by all universities. At present, the epidemic situation in China has been improved and China has entered the post-epidemic era. Mixed offline and online teaching mode has become a new trend and is gradually recognized by teachers and students in various universities.

Online teaching will become the auxiliary teaching mode of college teaching. Although online teaching has its own advantages, at present, college teachers' mastery of this teaching mode is uneven, and students' acceptance of online teaching varies. At the same time, there are still some unsolved problems in the technical support of online teaching. Offline teaching is not limited by time and space, but it has higher requirements on online teaching software, hardware and network technology. With the online teaching experience in the process of colleges and universities, offline teaching will become a major trend of teaching reform in colleges and universities in the future, can be combined with offline teaching effectively solve the disadvantages of offline teaching, can improve the efficiency of the students professional knowledge, rich teaching resources and model, to promote the teaching level of ascension.

#### **5 Opportunities for Mixed Offline and Online Teaching in the Post-epidemic Era**

At present, the epidemic has got the basic control, universities have already resumption of schooling is still grim, but the epidemic form college teaching has entered the era after the outbreak, the outbreak time take teaching mode, online teaching replaced off-line, however, is not so in the outbreak time using online teaching entirely replace line, Online teaching can be regarded as a powerful supplement to offline teaching, and this kind of mixed offline and online teaching mode will become the normal teaching mode of colleges and universities in the future. The emergence of the online teaching model also reflects the shortcomings of the traditional teaching model, especially during COVID-19, when the offline teaching model was ineffective and the advantages of the flexibility and convenience of the online teaching were highlighted. However, online teaching also has some limitations. Due to the change of time and space, the orderly situation in the offline teaching process cannot be guaranteed by online teaching. Students' listening states are different, so it is difficult to effectively monitor, which will reduce the teaching effect of online teaching in the long run. In the post-epidemic era, with the rapid development of information technology, university teachers are faced with huge challenges. They should deeply analyze the differences between offline teaching and online teaching, constantly change teaching concepts, update teaching contents, master students' learning psychological states, and find an effective way to integrate offline teaching and online teaching [14].

Online teaching can make the communication between students and teachers more effective, students can express themselves bravely online, through this communication can improve the level of intelligence of students, through the network communication can improve the initiative of students' independent learning, constantly improve students' word self-discipline and adaptability. Building a mixed teaching model through the close integration of online and offline teaching is also the main research focus of teaching reform in the post-epidemic era. Mixed teaching mode is still in its early stage of development.

## 6 Practice of Online and Offline Mixed Teaching Mode in Introduction to Petrochemical Equipment Management

In the post-epidemic era, the impact of the epidemic has not stopped. The international situation of the epidemic is still grim, and a small number of cases have occurred in China. Therefore, universities should be well prepared for online teaching. Taking the course "Introduction to Petrochemical Equipment Management" as an example, this paper explores the practical approaches of online and offline mixed teaching mode. Introduction to Petrochemical Equipment Management is a characteristic course of Liaoning Petrochemical University. At present, the national energy strategy is constantly advancing, and the construction of clean, efficient, safe and sustainable energy system is the development focus of petrochemical enterprises, and strengthening petrochemical equipment management is the key to achieve this goal. The course "Introduction to Petrochemical Equipment Management" adheres to the principle of "student-centered", carries on the teaching reform continuously, adheres to the idea of "cultivating people by virtue", and constantly improves students' innovation consciousness and spirit [15].

Through online teaching, use WeChat group and QQ group to publish classroom teaching content, so as to guide students to preview before class, and determine the key and difficult points of classroom teaching through the communication between teachers and students. Online teaching is conducted through Tencent Classroom. Attendance is checked before and after class through this software, and students' learning status is guaranteed through random questions. In class, students can put forward questions at any time through the dialog box, and teachers can also give timely answers. After class, students can be arranged to watch relevant online courses in the classroom, so as to expand their knowledge and enhance their understanding of theoretical knowledge. By releasing homework online, students can complete homework and teachers can correct homework online. Both mid-term and final exams will be completed online. Through practice, a set of Online And Offline Mixed Education Mode has been formed.

## 7 Quality Evaluation Model of Online, Offline and Online Mixed Teaching of Introduction to Petrochemical Equipment Management

### (1) Construction of evaluation index system

In order to effectively evaluate the quality of hybrid teaching mode of "Introduction to petrochemical equipment management", this paper analyzes the relationship between students' learning behavior and teaching quality, and analyzes the influence of teachers' teaching process on students' learning effect, so as to build the evaluation index system of online and offline hybrid teaching quality of "Introduction to petrochemical equipment management", the evaluation index system is listed in Table 1.

**Table 1.** Mixed teaching quality evaluation index system of introduction to petrochemical equipment management

First level index	Second level index
Targeting of mixed teaching I1	Matching degree of learning objectives I11
	Rationality of Teaching Focuses and Difficulties I12
	Adaptability of students' learning I13
	Adaptability of teaching time and space I14
Students' learning motivation in process of mixed teaching I2	Students' Initiative to Participate in Mixed Teaching I21
	Students' think way in the teaching process I22
	Proportion of Students Adapted to Mixed Teaching Model I23

Diversity of mixed teaching models I3	Degree of meeting the teaching objectives I31
	Degree of meeting the content of the course I32
	Adaptability of teaching conditions I33
Study Autonomy in Mixed Teaching Mode I4	Learning situation of teaching resources I41
	Students' responses to requests in the teaching process I42

Based on the evaluation index system of offline mixed teaching quality built above, the data generated by students in the process of mixed teaching can be counted, and different indicators can be assigned through questionnaires and expert interviews. The teaching effect of the course “Introduction to the Management of Petrochemical Equipment” is evaluated comprehensively with the advanced evaluation technology.

(1) Evaluation model of fuzzy neural network based on improved firefly algorithm optimization

In the design process of the fuzzy neural network, the first evaluation index I1~I4 in the evaluation system of offline mixed teaching quality is taken as the input variable of the fuzzy neural network, and the offline mixed teaching quality level is taken as the output of the fuzzy neural network. The basic structure of the fuzzy neural network is shown in Fig. 1.

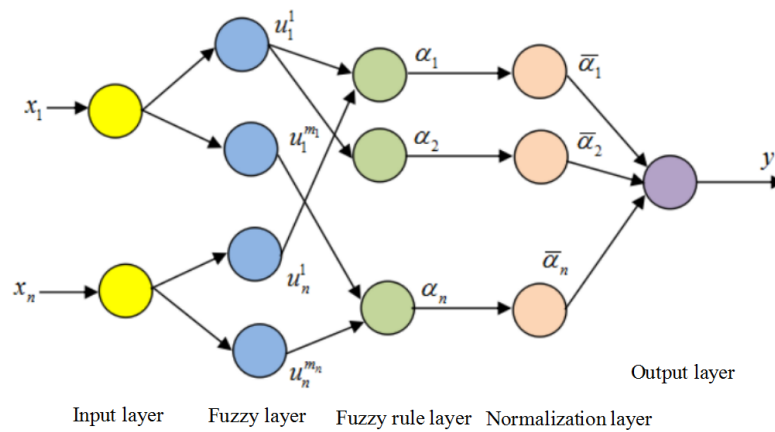


Fig. 1. Structural diagram of fuzzy neural network

The structure of fuzzy neural network is listed as follows:

Input layer: this layer of fuzzy neural network inputs evaluation indexes to the next layer, and the number of nodes is that of evaluation indexes.

Fuzzy layer: The fuzzy layer of fuzzy neural network can quantify the output index value by membership function. For different membership functions of different neurons, the form of membership function is as follows:

$$u_i^j = e^{-\frac{(x_i - c_i^j)^2}{\sigma_j^2}} \tag{1}$$

where,  $c_i^j$  represents the center of membership degree,  $\sigma_j$  represents the width of  $j$ th Gaussian membership degree function,  $i = 1, 2, \dots, n, j = 1, 2, \dots, m_j$ .

Each node corresponds to a language variable, including Nb (negative large), nm (negative middle), NL (negative small), Ze (zero), pl (positive small), PM (positive middle), Pb (positive large).

Fuzzy rule layer: The fuzzy rule layer of fuzzy neural network can match the antecedents of fuzzy rules. Each node corresponds to a fuzzy rule. The fitness expression of each rule is as follows:

$$\alpha_j = \min\{u_j^{i_1}, u_j^{i_2}, \dots, u_j^{i_n}\} \tag{2}$$

where,  $i_1 = \{1, 2, \dots, m_1\}, i_2 = \{1, 2, \dots, m_2\}, i_n = \{1, 2, \dots, m_n\}$ .

Normalization layer: the normalization layer of fuzzy neural network can realize the normalization of fitness, and the number of nodes is the same as that of fuzzy rule layer. The calculation formula of normalization is as follows:

$$\bar{\alpha}_j = \frac{\alpha_j}{\sum_{j=1}^m \alpha_j}, j = 1, 2, \dots, m. \quad (3)$$

Output layer: The output layer of fuzzy neural network is also called anti fuzzification layer, which can output the mixed teaching quality level of online, offline and online. According to the actual situation of online, offline and on-line mixed teaching quality, it will be divided into five levels, as shown in Table 2.

**Table 2.** Evaluation grade table of online, offline and online mixed teaching quality level

Score	The quality level of mixed teaching on the offline
(0.85, 1.00]	Excellent
(0.70, 0.85]	Good
(0.55, 0.70]	Medium
(0, 0.55]	Poor

The center  $c_i^{ij}$  and width  $\sigma_j$  of membership function, fitness  $\alpha_j$  and normalized fitness  $\bar{\alpha}_j$  of fuzzy neural network need to be optimized in the process of online, offline and online mixed teaching quality evaluation. In order to improve the evaluation efficiency and accuracy of fuzzy neural network, the improved firefly algorithm is applied to the parameter optimization of fuzzy neural network.

The two key parameters of firefly algorithm are attractiveness and step size. In traditional firefly algorithm, these two parameters are fixed, which lead to premature algorithm and limit the efficiency of the algorithm. Therefore, the chaos theory and firefly algorithm are combined to improve the traditional algorithm.

(1) The initial position of population is optimized by iterative chaotic map

The iterative chaotic map is used to generate the initial population, so as to avoid the defect of the traditional algorithm which generates the initial population randomly and leads to the lack of diversity of the population, and make the initial population have better ergodicity and non repeatability

$$x_{k+1} = \sin\left(\frac{b\pi}{x_k}\right). \quad (4)$$

Where,  $b$  is the controlling coefficient between 0 and 1, it is taken 0.55 in this research.

(2) Optimization of the maximum attraction  $\beta_0$  of the algorithm by using Henon chaotic mapping

The maximum attraction degree  $\beta_0$  is optimized by Henon chaotic mapping method, and the optimal results can be obtained, and the corresponding model is expressed by

$$\beta_0(k+1) = 1 - s\beta_0^2(k) + t\beta_0(k). \quad (5)$$

where,  $0.52 < s < 2$ ,  $0 < |t| < 1$ ,  $s$  takes 1.5,  $t$  takes 0.4 in this research.

The optimization process of the improved firefly algorithm is as follows:

Step 1: initialize firefly parameters, including population size, iteration times, step size factor and maximum attraction, and generate initial population by iterative chaotic map.

Step 2: train the fuzzy neural network to get the target value, and the firefly's target is the accuracy of the evaluation.

Step 3: using Henon chaotic map to obtain the attractiveness of fireflies.

Step 4: update the position of firefly by using adaptive step size algorithm.



$$\eta(k+1) = \left(\frac{1}{I_{\max} + 1}\right)^{1/I_{\max}} \eta(k). \quad (6)$$

where,  $\eta$  represents the step size,  $I_{\max}$  represents the maximum iteration times.

Step 5: judge whether the algorithm termination condition (whether the maximum iteration times are reached) is met, and if the condition is met, the algorithm ends, and the optimal result will be output; Instead, return to step 2.

(3) Evaluation results of online and offline mixed teaching quality of introduction to petrochemical equipment management

In order to verify the application effect of fuzzy neural network in the quality evaluation of on-line and off-line Hybrid Teaching of “Introduction to petrochemical equipment management”, the on-line and off-line Hybrid Teaching of “Introduction to petrochemical equipment management” in 2020 was taken as the research object, and its quality level was comprehensively evaluated. Through the questionnaire survey of 100 students of process equipment and control engineering, the training samples of fuzzy neural network are determined.

The input layer of fuzzy neural network is 6 neural units, and four primary evaluation indexes are used; The fuzzy layer consists of six neural units; The number of neural units in fuzzy rule layer and normalization layer is 2; The output layer has four nodes, corresponding to four evaluation levels. The size of the improved firefly algorithm population is set to 85 and the maximum iteration number is set to 800. In order to verify the effectiveness of the proposed algorithm, the traditional neural network based on particle swarm optimization is used to evaluate the same training samples. The model and maximum iteration times of the PSO population are consistent with the improved firefly algorithm.

The error iteration curve of fuzzy neural network based on Improved Particle Swarm Optimization and traditional neural network based on particle swarm optimization is shown in Fig. 2. From Fig. 2, it can be seen that the traditional neural network based on particle swarm optimization converges after 600 iterations, while the fuzzy neural network optimized by the improved firefly algorithm has convergence after 400 iterations, which shows that the fuzzy neural network optimized by the improved firefly algorithm has better convergence efficiency and can improve the evaluation efficiency of Hybrid Teaching Quality on the offline.

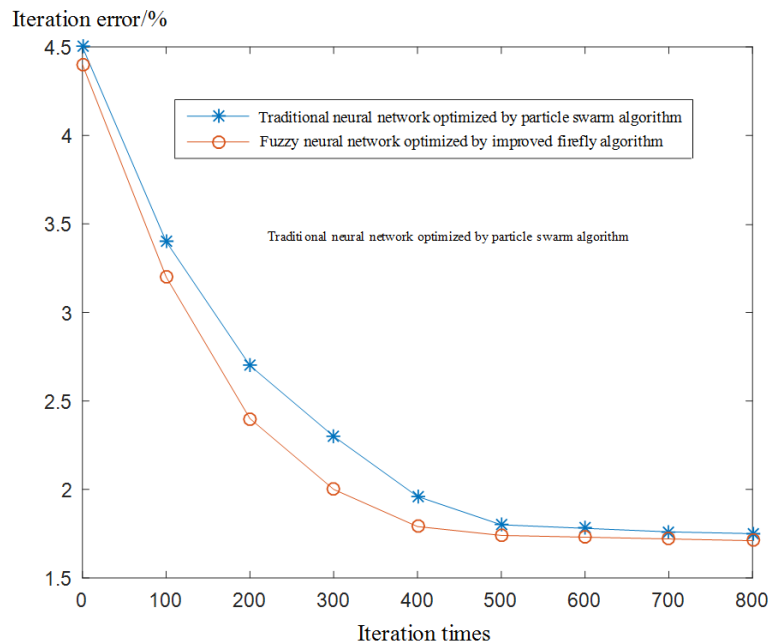


Fig. 2. Comparison of error iteration curve between two evaluation models

The trained fuzzy neural network and traditional neural network are used to evaluate the test samples. The evaluation results are shown in Table 3.

**Table 3.** Evaluation results of online and offline mixed teaching quality of introduction to petrochemical equipment management

Number of sample	Real value	Evaluation value	
		Traditional neural network optimized by particle swarm algorithm	Fuzzy neural network optimized by improved firefly algorithm
1	0.88 (Excellent)	0.91 (Excellent)	0.89 (Excellent)
2	0.80 (Good)	0.84 (Good)	0.81 (Good)
3	0.82 (Good)	0.86 (Excellent)	0.83 (Good)
4	0.73 (Good)	0.77 (Good)	0.73 (Good)
5	0.65 (Medium)	0.71 (Good)	0.67 (Medium)
6	0.59 (Medium)	0.64 (Medium)	0.60 (Medium)

From the comparison results in Table 3, it can be seen that the evaluation results of online and offline mixed teaching quality of “Introduction to petrochemical equipment management” course are good. For samples 2 and 5, the traditional neural network optimized by particle swarm algorithm gets mistake evaluation results, therefore the proposed fuzzy neural network optimized by improved firefly algorithm has better evaluation accuracy.

The running time of different methods is listed in Table 4, the running time of fuzzy neural network optimized by improved firefly algorithm is less than that of traditional neural network optimized by particle swarm algorithm for different testing samples, therefore the proposed fuzzy neural network optimized by firefly algorithm has higher evaluation efficiency.

**Table 4.** Running time of different methods

Number of sample	Running time/s	
	Traditional neural network optimized by particle swarm algorithm	Fuzzy neural network optimized by improved firefly algorithm
1	32.552	22.544
2	30.434	21.054
3	31.550	21.693
4	34.024	23.795
5	33.507	22.843
6	29.535	19.069

According to the evaluation results, effective measures to improve the online and offline mixed teaching quality of “Introduction to petrochemical equipment management” course are put forward. In addition, the fuzzy neural network is used to evaluate the online and offline mixed teaching quality of the course introduction to petrochemical equipment management, and the evaluation result is closer to the actual value than the traditional neural network, which shows that the evaluation value of the fuzzy neural network is closer to the actual value than the traditional neural network, and the prediction error is smaller. Therefore, the fuzzy neural network has better evaluation accuracy. It can effectively evaluate the online and offline mixed teaching quality of “Introduction to petrochemical equipment management”.

## 8 Conclusion

Offline teaching and online teaching have their own advantages and disadvantages. By combining the advantages of offline teaching and online teaching to build a mixed teaching model, it can better meet the needs of students for humanized education. Students can better learn theoretical knowledge in the mixed teaching mode, improve students’ initiative, and improve the teaching effect of the course. Teachers can also improve the teaching quality of the mode by improving their mastery of information technology, setting up rich mixed offline and online teaching resources and optimizing the mixed offline and online teaching methods. With an introduction to the petrochemical equipment management course as an example, puts forward the course offline online mixing way of teaching model, and constructed based on the course offline online mixed teaching quality evaluation model, through the actual evaluation of the results of simulation shows that at present an introduction to management of petrochemical equipment line of online teaching quality evaluation result is good, therefore. There are still many aspects to be further improved, so as to continuously promote the rapid development of the teaching model. The



proper evaluation index system of online and offline mixed teaching mode should be constructed, the structure of fuzzy neural network should be optimized, and the training algorithm of fuzzy neural network should be improved.

## References

- [1] H. Qian, N. Su, Y. Su, Psychological crisis intervention for college students during novel coronavirus infection epidemic, *Psychiatry Research* 289(2020) 113043.
- [2] D.H. Ma, Y.X. Shi, G. Zhang, J. Zhang, Does theme game-based teaching promote better learning about disaster nursing than scenario simulation: A randomized controlled trial, *Nurse Education Today* 103(8)(2021) 104923.
- [3] D.H. Zhang, The development and research of higher education in the post epidemic Era, *Higher education research* 41(12)(2020) 105-107.
- [4] L.H. Kong, The prospect and thinking of college teaching mode in the post epidemic Era, *Adult education in China* (15)(2020) 49-53.
- [5] Y. Yu, S.W. Zhang, L.T. Zhang, On the integration of online teaching and traditional teaching in Colleges and universities in the post epidemic Era, *Educational exploration* (12)(2020) 42-46.
- [6] S.L. Zheng, Research on the quality assurance subsystem of online teaching in Colleges and universities in the post epidemic Era, *Journal of North China University of water resources and hydropower (Social Science Edition)* 36(6)(2020) 52-56.
- [7] G.Q. Zhang, X. Li, Z.L. Guo, Construction of teaching supervision index system of network course, *Research on Open Learning* 251(2020) 48-55.
- [8] W.D. Fu, H.Y. Zhou, Novel coronavirus pneumonia's challenge to China's online education and Its Countermeasures, *Journal of Hebei Normal University (Education Science Edition)* 22(2)(2020) 14-18.
- [9] L.Q. Song, L. Xu, Y.X. Li, Precise online teaching + Home Learning Mode: the way to improve students' learning quality during the epidemic period, *China Educational Technology* (3)(2020) 114-122.
- [10] S. Li, S.Y. He, Research on the problems and Countermeasures of online teaching in Colleges and universities in ethnic areas during the epidemic period -- Based on the questionnaire survey of teachers and students in Xichang University, *Journal of Xichang University Social Science Edition* 32(4)(2020) 111-119.
- [11] B. Yan, Evaluation and Reflection on the effect of online teaching for college students under public health emergencies, *Journal of Higher Education* (27)(2020) 97-100.
- [12] Y. Cui, H. Bo, Q.F. Guo, Exploration of online teaching quality assurance under New Coronavirus pneumonia epidemic prevention and control, *Research on medical teaching in Colleges and Universities* 10(2)(2020) 31-35.
- [13] H.L. Zhao, C.Y. Song, Novel coronavirus pneumonia: the advantages and disadvantages of webcast Teaching. Exploration of decision making (5)(2020) 63-64.
- [14] L.L. Kang, W.J. Li, Research on the satisfaction of network teaching platform -- Taking Inner Mongolia Medical University as an example, *Science and technology economy guide* 28(2)(2020) 97-98.
- [15] Y. Xia, X.F. Pang, B.L. Han, The current situation, problems and thinking of online learning of lifelong education in Shanghai under the background of epidemic situation, *Adult education in China* (17)(2020) 8-12.