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Exploration on the New Model of Internet of Things Vocational Education in Cultural Ecological Field

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Abstract: A firm cultural stand is the foundation of a nation, and students are undoubtedly the easiest to accept and learn about culture. In the current environment of multicultural coexistence in the world, maintaining the national culture is the bottom line of education. Therefore, this paper aimed to explore the new model of vocational education under multiculturalism based on the perspective of cultural ecological field and taking the vocational education of the IoT (Internet of Things) as the object. For the vocational education of the IoT, this paper integrated the construction of class culture and teaching design, and combined the characteristics of the vocational education and training of the IoT, so that the cultural construction runs through the whole process of vocational education. In order to better promote the development of IoT vocational education, this paper also proposed a neural network teaching evaluation method based on AHP (Analytic Hierarchy Process), which can standardize the teaching effect of teachers and evaluate the learning effect of students. The survey results showed that 97.6% of teachers and students conducted practical training in the computer room, and most of the students were dissatisfied with the current IoT vocational education model, which showed that there are still major problems in the current IoT vocational education. Compared with the traditional neural network model, the teaching evaluation model in this paper had a smaller error of 0.602-0.697. When the error was the smallest, the error of the algorithm in this paper was 17.1% less than that of the traditional neural network algorithm.

1. Introduction

Today's information society is an interconnected world. In terms of economy, the trend of regional economic integration is becoming more and more obvious, and the economic relations between countries and regions and between regions are also increasing. In terms of politics, the multi-polarization of the world political pattern has become an important feature of the harmonious development of world politics, economy and culture. In terms of culture, social contradictions caused by cultural conflicts between different ethnic groups are increasingly concerned by people. Economic integration, political multi-polarization, and cultural pluralism are an important feature of the contemporary world. Economic, political and cultural exchanges would be more extensive, which requires people to have multicultural awareness. There are many different cultural characteristics in the campus cultural environment, which have played a great role in the construction of the campus environment, the formulation of rules and regulations, the implementation of behavioral activities, and the construction of students' ideological values. Therefore, it is necessary to carry out the research on the new model of vocational education in the field of cultural ecology.

The IoT has a wide range of applications and has applications in many scenarios. Therefore, the vocational education of the IoT has also become hot, and there are many researches on it. The purpose of Salsabila A's research was to identify the needs of learning media for the development of IoT-based smart building installation systems in vocational high schools, so as to gain a more comprehensive understanding of the current state of IoT vocational education [1]. In order to analyze the potential impact of IoT on education, Rodney B D conducted a survey of vocational education students to analyze the popularity of IoT in vocational education education. His results showed that the emergence of the IoT had greatly promoted the development of vocational education to high-tech [2]. Sultana N mainly analyzed the benefits and challenges experienced by Bangladesh's education, business and service sectors when using IoT services during COVID-19 to explore the need for IoT technology education in vocational education [3]. Focusing on the relationship between Japan's "Industry 4.0" and vocational education, Liu L discussed the combination of Japanese professional universities, industry, government and the IoT, and hoped to provide some useful experiences for China's vocational education and "Made in China 2025" [4] . At present, the development of the IoT industry is in the ascendant, and a large number of compound talents are needed. Xuli Y U applied the "three-independent" education model to the education system of the whole process of training talents with IoT application technology in vocational education colleges, so as to coordinate the management of secondary vocational education students and effectively improve the quality of teaching [5]. It can be found that the current research on vocational education in the IoT is to serve the industry and cultivate technical talents. The research on the methods and methods of cultivation is not in-depth enough.

Vocational education is a training method for technical talents, which is of great help to national construction. For the teaching methods of vocational education, many scholars have done research. Nofriansyah D's research focused on developing a new learning model in vocational education to meet the challenges of the Industrial Revolution 4.0 era [6]. According to changes in market demand, Wang Y built an evaluation system suitable for students' growth, in order to promote the curriculum reform of vocational schools. It can also further promote exchanges and cooperation between schools and industry-specific enterprises, and cultivate outstanding vocational education talents [7]. Yang L analyzed and discussed the new ideas and new strategies for eliminating barriers to the integration of production and education in vocational education. His research results showed that the integration of industry and education in vocational education is an inevitable requirement for the establishment of a modern vocational education system [8]. Purnomo studied the important role of vocational education in the printing industry in Indonesia and Malaysia [9]. In the new period of transformation and upgrading of China's economic development, Chen J studied the innovative ways of vocational education personnel training mode, and continuously deepened the vocational education personnel training mode [10]. However, the research focus of vocational education is to acquire skills better and enter society faster. There is a lack of cultural construction and cultural training in vocational education.

In order to better understand the predicament of the "Internet of Things" training and teaching in higher vocational colleges, this paper discussed the cultural construction and curriculum design of the "Internet of Things" major in higher vocational colleges in Guangdong Province. This paper transformed the results of workflow analysis into the key to the course project, and applied it to the comprehensive training of actual workflow. Finally, based on this model, a set of systematic practice project courses and a set of teacher evaluation system suitable for IoT vocational education were designed, which provided an operational example for IoT professional teachers in higher vocational colleges.

2. Methods of IoT Vocational Education

2.1 Multicultural Field

The French master of sociology supplemented the "field" through the sociological research of his predecessors. The society is likened to a large field, and the "field" is analytically defined: it is a network composed of objective connections of different places [11]. "Cultural ecological field" originates from field theory, which absorbs the essence of field. It combines "ecology" with nature, order and benign interaction, and takes culture as its ideological implication [12].

The multicultural field is a special research field, and its scope is mainly concentrated in the western region where the economy is relatively backward, the educational foundation is weak, and the multi-ethnic coexistence. Therefore, generally speaking, the weak link of education development should be given top priority, so education issues are of great significance in the field of humanities. The construction of multicultural fields generally includes spiritual culture construction, material culture construction, behavioral culture construction and institutional culture construction. The specific classification is shown in Figure 1.

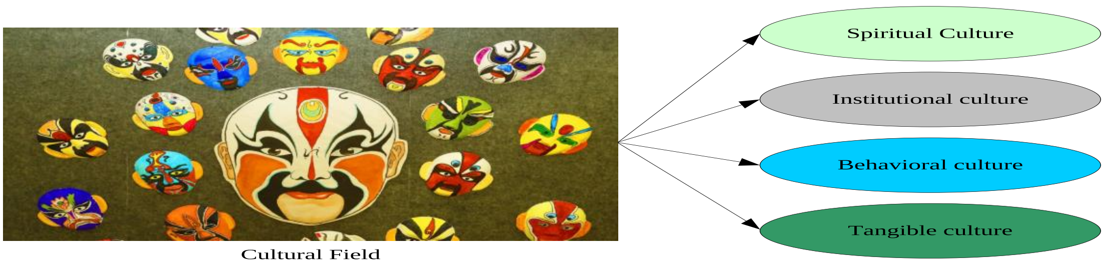


Figure 1. Cultural field

Application of AHP in Teaching Evaluation

AHP is an effective means to solve complex problems. Its level refers to the overall goal to be achieved by the problem, and the elements of each level are specific measures that must be taken to achieve the goal. In the target layer, it is formulated to complete the task. AHP has no strict requirements on the number of layers. In practical applications, the problem can be decomposed layer by layer until a feasible solution is finally determined. Therefore, it is very useful in solving complex teaching evaluation problems [13].

Determination of scale

In AHP, after completing the first stage of stratification, it is necessary to compare the various elements of the same group [14]. Table 1 fixes the qualitative results at the time of judgment by a quantitative method. Determination of the proportional scale: a_{ij} represents 9 levels from 1 to 9, and the inverse number represents a_{ji} .

Table 1. Proportional scale value table

Serial number	Scaling a_{ij}	Meaning
1	1	C_i has the same impact as C_j
2	3	C_i is a bit stronger than C_j
3	5	C_i has stronger influence than C_j
4	7	C_i is significantly stronger than C_j
5	9	C_i is definitely stronger than C_j
6	2,4,6,8	The influence of C_i and C_j is between the two adjacent grades
7	$\frac{1}{2},\cdots,\frac{1}{9}$	The influence of C_i and C_j is the opposite of the above

Hierarchy diagram

When AHP solves the problem, the first thing to solve is how to decompose the target problem hierarchically in the model, and then use the decomposed units to construct a model similar to a tree [15]. A typical tree structure is shown in Figure 2.

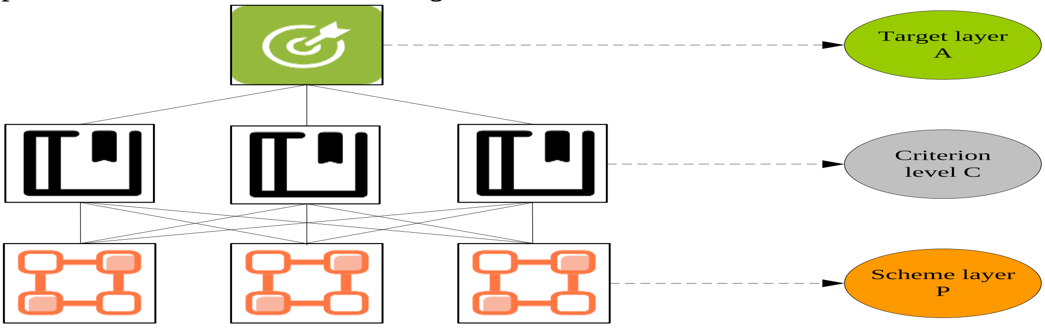


Figure 2. Hierarchical structure diagram

The hierarchical structure diagram contains only the target layer (A) of one target unit; the standard layer (C) and the measure layer (P) complete the transition stage decomposed by the target. Top-down is a measure of the target layer. The different specific measures to implement the target are also special extensions of the guideline level [16].

In this paper, the power method is used as an example to calculate the weight of each indicator and standard level. The calculation process is as follows.

W_i' is calculated, and W_i' represents the nth root of the judgment matrix:

$$W_i' = \sqrt[n]{\prod_{j=1}^{n} a_{ij}} \quad (1)$$

W_i' is normalized:

$$W_i = \frac{W_i'}{\sum_{i=1}^{n} W_i'} \quad (2)$$

The corresponding weights can be calculated from the judgment matrix and Formula (1). It is assumed that the criterion layer has three data, then there are:

$$W_1' = \sqrt[3]{a_{11} \cdot a_{12} \cdot a_{13}} \quad (3)$$

$$W_2' = \sqrt[3]{a_{21} \cdot a_{22} \cdot a_{23}} \quad (4)$$

$$W_3' = \sqrt[3]{a_{31} \cdot a_{32} \cdot a_{33}} \quad (5)$$

Formula (2) is used to process the indicator. The relative weights of the obtained indicators are:

$$W_1 = \frac{\sqrt[3]{a_{11} \cdot a_{12} \cdot a_{13}}}{\sqrt[3]{a_{11} \cdot a_{12} \cdot a_{13}} + \sqrt[3]{a_{21} \cdot a_{22} \cdot a_{23}} + \sqrt[3]{a_{31} \cdot a_{32} \cdot a_{33}}} \quad (6)$$

$$W_2 = \frac{\sqrt[3]{a_{21} \cdot a_{22} \cdot a_{23}}}{\sqrt[3]{a_{11} \cdot a_{12} \cdot a_{13}} + \sqrt[3]{a_{21} \cdot a_{22} \cdot a_{23}} + \sqrt[3]{a_{31} \cdot a_{32} \cdot a_{33}}} \quad (7)$$

$$W_3 = \frac{\sqrt[3]{a_{31} \cdot a_{32} \cdot a_{33}}}{\sqrt[3]{a_{11} \cdot a_{12} \cdot a_{13}} + \sqrt[3]{a_{21} \cdot a_{22} \cdot a_{23}} + \sqrt[3]{a_{31} \cdot a_{32} \cdot a_{33}}} \quad (8)$$

Next, the evaluation weights of each level of the above calculation standard level are repeated, and the relative weights of each evaluation index related to the corresponding normative level and the corresponding normative level are obtained [17]. However, when adopting the AHP, it is necessary to ensure the consistency of the logic before and after. From Formula (9), it can be known whether the three position-related elements in the judgment matrix satisfy the following conditions:

$$a_{ij} = \frac{a_{ik}}{a_{jk}} (i, j = 1, \Lambda\ , n) \quad (9)$$

k can be any one of l, 2, ..., n. However, since the operation of Formula (9) is very troublesome, in practice, Formula (10) is usually used to determine whether the decision maker's thinking is consistent [18].

$$CI = \frac{\lambda_{\max} - n}{n - 1} \quad (10)$$

$\lambda_{\max}$ corresponds to the largest eigenroot of this eigenvector. The feature vector *W* is composed of the corresponding criterion of the standard layer *C* and the correlation weights of all the second indicators of the target layer *A* or the scheme layer and the first-level indicators of the same standard layer [19]. For example:

$$W = (W_1, W_2, W_3)^T \quad (11)$$

then there are:

$$\lambda_{\max} = \frac{1}{n} \sum_{i=1}^{n} \frac{(AW)_i}{W_i} \quad (12)$$

Among them, *A* represents the row vector of the scheme layer, which corresponds to the criterion layer one-to-one.

In this paper, when the order is greater than 2, the CR (consistency ratio) is used to test the index, and the test process is shown in Formula (13):

$$CR = {CI}/{RI} < 0.10 \quad (13)$$

Among them, CI and RI are the consistency index and the average random consistency index, respectively. If CR satisfies Formula (13), the judgment matrix is considered to have good consistency [20].

During inspection, CR is calculated layer by layer. The superscript in Formula (14) is expressed as the *p*-th layer, then the CR of the *p*-th layer and the first layer is:

$$CR^{(P)} = CR^{(P-1)} + \frac{CI^{(P)}}{RI^{(P)}} \quad (14)$$

Among them, P can take any value within 3, 4, ..., n, and there are:

$$CI^{(P)} = \left[CI_1^{(P)}, \Lambda, CI_n^{(P)}\right] W^{(P-1)} \quad (15)$$

$$RI^{(P)} = \left[RI_1^{(P)}, \Lambda, RI_n^{(P)}\right] W^{(P-1)} \quad (16)$$

From formulas (14), (15), (16), it can be obtained:

$$\frac{CI^{(P)}}{RI^{(P)}} = \frac{\left[CI_1^3, CI_2^3, CI_3^3\right] W^{(2)}}{\left[RI_1^3, RI_2^3, RI_3^3\right] W^{(2)}} \quad (17)$$

$$CR_{sum} = CR^{(2)} + \frac{CI^{(P)}}{RI^{(P)}} \quad (18)$$

After the consistency check, a critical point is determined, and the weight of each evaluation index is judged in the index system. By comparing with the critical point, the evaluation indicators below the threshold are eliminated [21].

3. IoT Vocational Education Model Design

3.1 Status Quo of Comprehensive Ability Requirements of Vocational Education IoT Majors

This article is mainly aimed at students majoring in the IoT in higher vocational colleges, and their future jobs are mainly skilled jobs. The engineering technology architecture of industrial IoT includes application layer, network layer and perception layer. It refers to the installation of intelligent instruments or controllers on various equipment in industrial production, and the use of mobile communication, intelligent analysis and big data technology to transmit the operating status of each equipment to the network terminal for data collection and sharing. In order to better understand the relevant work done by graduates of higher vocational colleges in actual work, the entire industrial IoT project of an aluminum company was visited. At the same time, this paper also summarized all the tasks that technicians need to complete in the industrial IoT project, and made a detailed analysis of their typical tasks at various technical levels. The results are shown in Table 2.

Table 2. Screening of typical work tasks for IoT application technology majors (vocational education)

Typical work tasks			
1	Understand project requirements	8	Install debugging tools on the user terminal
2	Project environment inspection	9	Use of debugging tools
3	Submit project overall planning report	10	User terminal configuration management platform
4	Drawing Circuit Diagram with AutoC AD/Visio	11	Web configuration meter management information parameters
5	Project requirements are submitted to developers in text form	12	Web page configuration user information
6	Labeling and selection of communication line materials	13	Web page configuration department information
7	Intelligent instrument material labeling and selection	14	Draw meter monitoring interface with Visio

3.2 Teaching Status of Vocational Education IoT Training Courses

3.2.1 Survey Design

The main content of the survey is the degree of connection between the IoT training platform and courses in Guangdong Province and the actual work. As a major that attaches equal importance to both practice and theory, the evaluation of the teaching effect of the IoT major in higher vocational education should be comprehensively analyzed and judged from the dimensions of the rationality of curriculum arrangement, platform operability, and practicality of curriculum content. The design of the questionnaire should be simple and clear. This survey used single and multiple-entry questions, with a total of 18 questions in addition to the personal information of the school and students. This questionnaire used a random sampling method. The purpose is to understand the specific teaching situation of the IoT major in the above-mentioned middle and higher vocational colleges, and to analyze and sort out the research results, so as to form a research report with reference value.

3.2.2 Survey Objects and Methods

Online and offline questionnaires were conducted on the "Questionnaire Star" platform. From July 19, 2020 to December 26, 2020, a total of 278 questionnaires were collected, of which 250 were valid questionnaires, with an effective rate of 89.9%. There were 228 questionnaires for students and 22 questionnaires for teachers. In order to carry out the training and teaching smoothly, it is necessary to have a comprehensive understanding of the IoT professional curriculum system in higher vocational colleges in Guangdong Province. In addition, it is necessary to analyze and organize the existing professional courses, so as to obtain the training modules for the IoT in higher vocational education. The training courses include two categories: professional and comprehensive. In order to better understand the arrangement of practical training, the application of the platform, and the specific situation of practical training, this paper investigated the above aspects of practical training based on the composition of practical training modules.

3.2.3 Survey Results of the Current Situation of IoT Education in Vocational Schools

(1) Composition of training modules

On the basis of the workflow, the construction of the curriculum system is the "transformation of the learning domain", which is transformed into the "activity domain" through the "teaching" of the activity domain. This article took some higher vocational colleges in Guangdong Province as an example to investigate the courses of the IoT major, and classified them as shown in Table 3.

The content of the investigation is the summary and analysis of practical teaching. In a nutshell, each course is an area of study, and the 22 specialized IoT specializations are listed in Table 3. Judging from the above curriculum settings, the current learning scope of vocational basic courses and specialization courses can meet the requirements of the IoT market for vocational and technical talents.

(2) Arrangements for practical training

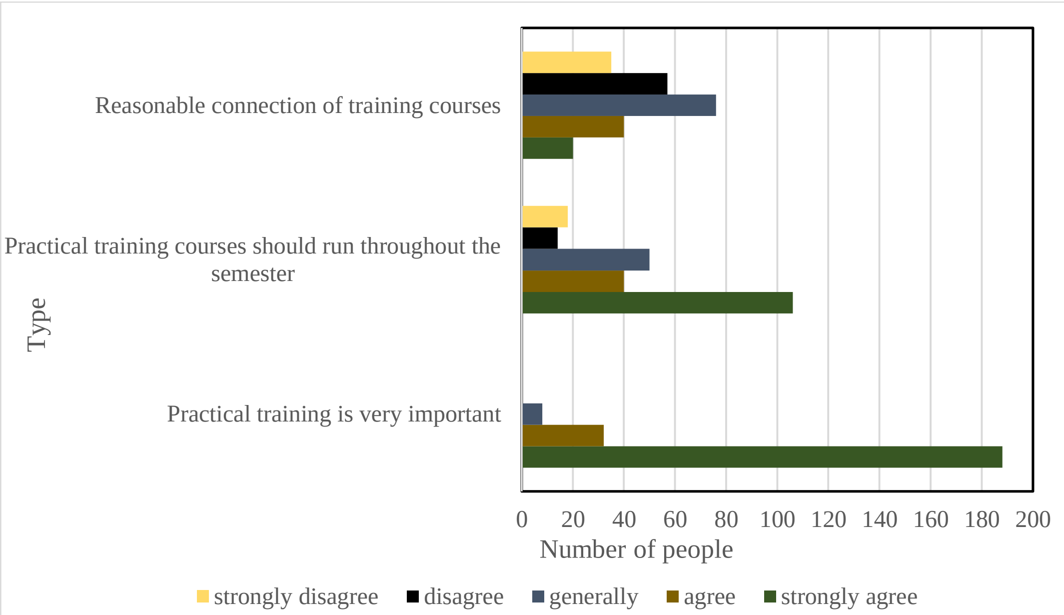
According to the differences in training content and methods, this paper divided practical training into two types: off-campus and on-campus. Off-campus training includes on-the-job training, and on-campus training includes special training and comprehensive training. According to the highly controllable characteristics of students in practical training teaching in colleges and universities, the teaching arrangement was analyzed.

Table 3. Vocational education IoT application technology professional curriculum system

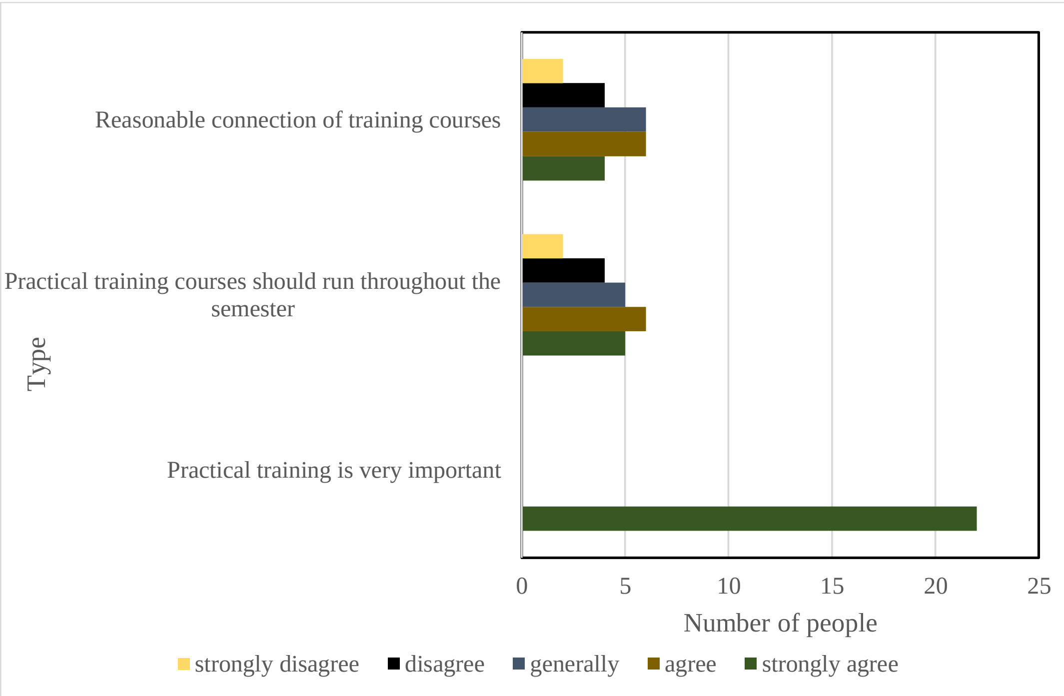
Serial number	Vocational Basic Course	Specialization courses	Training module
1	Middle math	Vocational qualification certificate	Electronic and electrician basic skills training
2	Electrical and electronic technology	Sensors and Detection Technology	Basic skills training of IoT technology
3	Communication principle	Radio Frequency Identification Technology	Computer network application training
4	Computer Networking Fundamentals	Structured Cabling	Comprehensive training of wireless sensor network technology
5	Android system software development	Wireless networking and maintenance technology	Comprehensive training of typical IoT system projects
6	Electronic drawing and CAD	Zigbee Technology and Application	Internships
7	Single chip principle	IoT middleware technology	/
8	Introduction to Internet of Things Technology	/	/
9	Python programming	/	/

The survey results showed that only 3 of the 8 colleges and universities have set up special practice courses, but not including comprehensive practice. Thematic training is usually carried out in the second to fourth semesters. The emphasis is on strengthening the basic knowledge that students have learned so far, so that they can transfer theoretical knowledge to practical work, such as computer assembly and maintenance, routing switching, and the network topology of Cisco simulators. The comprehensive training course is set for the fourth and fifth semesters to train students' hands-on skills and practical operation skills, such as the establishment of smart home models and the debugging of Raspberry Pi software and hardware. The survey results of teachers and students on the current situation of vocational education are shown in Figure 3.

From Figure 3A, it can be seen that 188 people strongly agreed that the comprehensive training course can train themselves, and 32 people agreed that the comprehensive training course can train themselves; 96.5% of the students thought that the comprehensive training course can train themselves. As for whether the comprehensive training course should run through the whole semester, 64.0% of the students also expressed their approval. However, the survey students showed different views on the situation of comprehensive training courses; the percentages of strongly agree, agree, moderate, disagree, and strongly disagree were 8.8%, 17.5%, 33.3%, 25.0%, and 15.4%, respectively. This showed that for students, most of them knew the importance of comprehensive training in IoT vocational education. However, for the current training situation, most students felt that the connection was not good enough, and there was no connection between different training courses. From Figure 3B, it can be seen that for teachers, their views on issues were relatively unified, and their views on the current status of IoT vocational education were also relatively consistent with students.



A. Student questionnaire

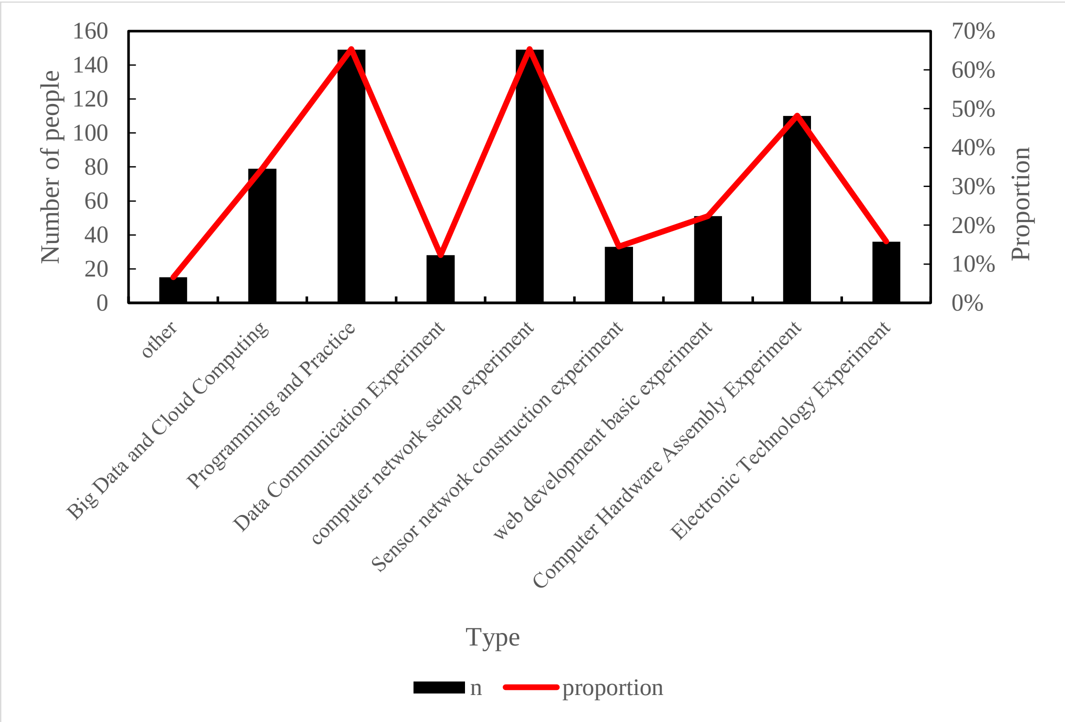


B. Teacher questionnaire

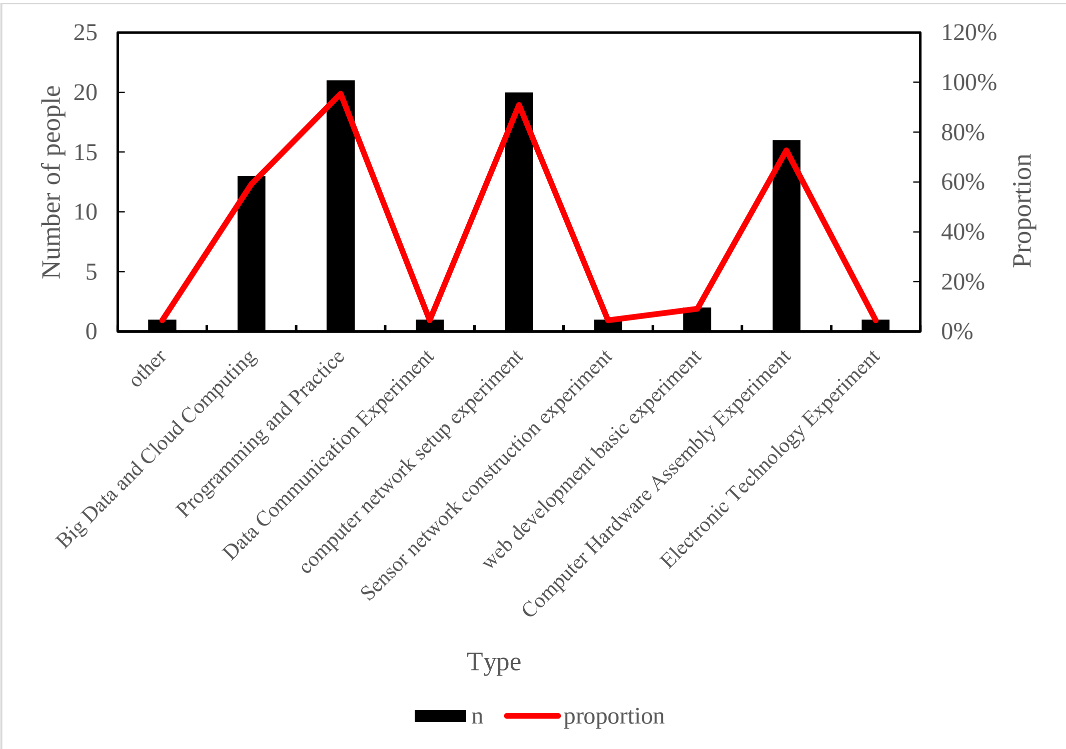
Figure 3. The satisfaction of teachers and students with the arrangement of practical training

Special training courses

In order to understand the connection between the "Internet of Things" professional training courses and the "market" in higher vocational colleges in Guangdong Province, relevant questions such as "course" and "name" were set up in the questionnaire. In the question "What topics are covered in your school's IoT practice curriculum", the survey results are shown in Figure 4.



A. Student questionnaire



B. Teacher questionnaire

Figure 4. The distribution of teaching courses of vocational education IoT special training courses in Guangdong Province

From Figure 4A and Figure 4B, it can be seen that 65% of the students and 95% of the teachers of the survey respondents indicated that the school had offered programming and practice courses; 65% of the students and 91% of the teacher surveyors indicated that they had opened a practical training course on computer network construction; 48% of the students and 73% of the teacher surveyors said that they had set up computer hardware assembly experimental courses; 35% of the students and 59% of the teachers and surveyors said they had set up big data and cloud computing training courses.

(3) Comprehensive training platform

The setting of comprehensive practice courses requires a corresponding training platform. Therefore, in the survey, the survey object was transformed into the comprehensive training platform of the IoT in various vocational colleges. At present, in the field of IoT, various higher vocational colleges have invested considerable funds in software and practice platforms. In terms of specific construction, the topic of this questionnaire was "What are the IoT training platforms or equipment put into use in your school?". Its findings are shown in Figure 5.

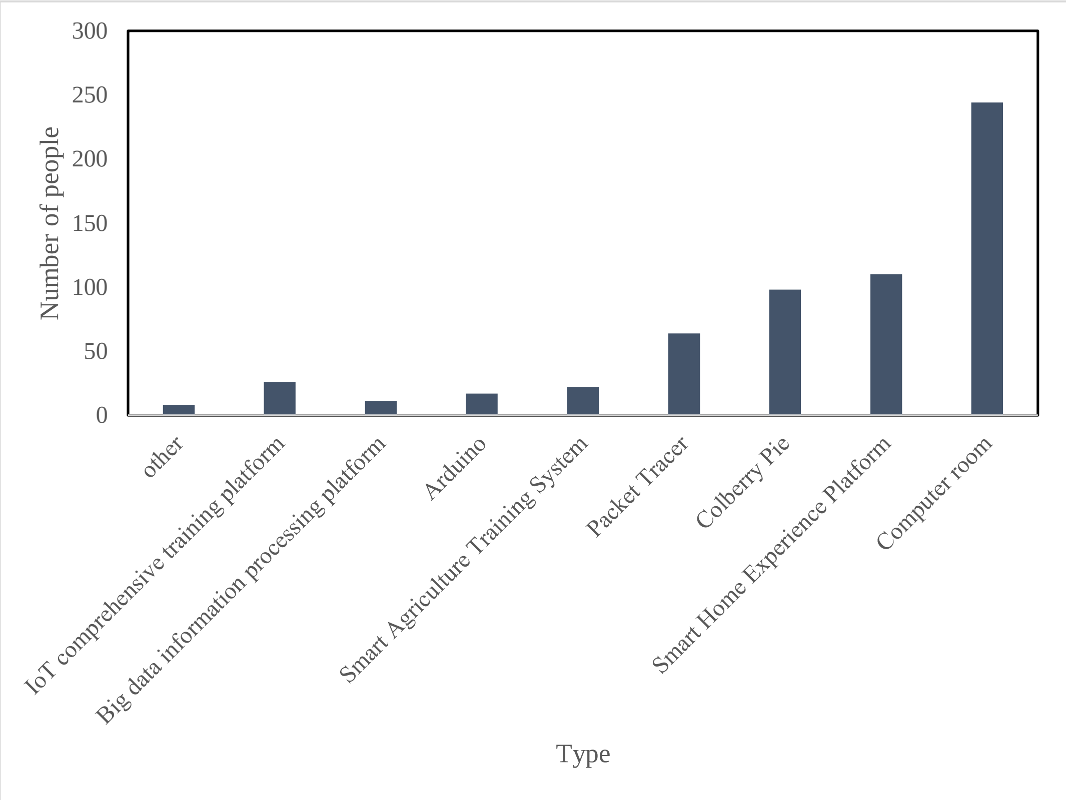


Figure 5. Construction of IoT training platform or equipment for vocational education in Guangdong Province

It can be seen from Figure 5 that the current teaching platforms of Guangdong vocational colleges were mainly computer rooms, followed by smart home experience platforms, Raspberry Pi, and Packettracer simulation platforms. In the aspects of computer program design, computer network establishment, computer assembly and maintenance, etc. that have been established, individual practice was the main one; 97.6% of teachers and students said that the computer room was the place for training.

Regarding the implementation of the IoT teaching practice platform in higher vocational colleges in Guangdong Province, the question of the questionnaire was "Which projects are mainly used for the construction of the IoT practice platform in your college?". Its findings are shown in Figure 6.

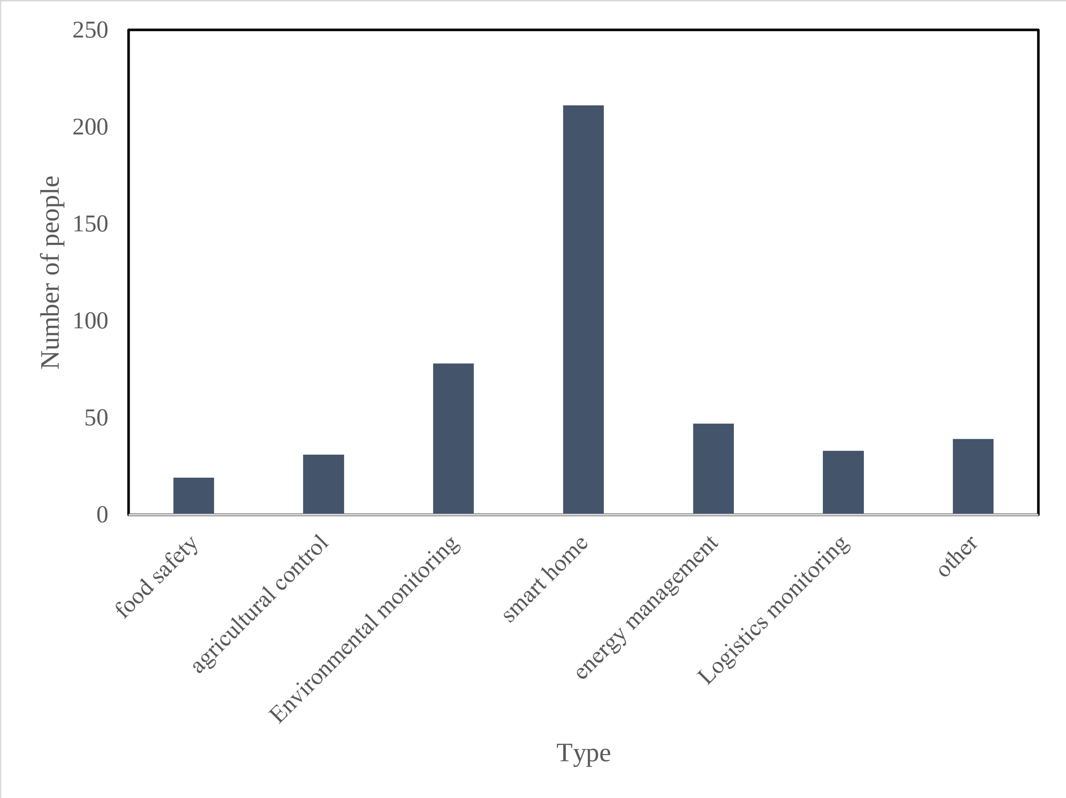


Figure 6. The application direction of the training platform project

It can be seen from the survey results that most colleges and universities had their own training platforms, which were built in the way of school-enterprise cooperation and had strong pertinence. From Figure 6, it can be seen that most of the training platforms were mainly based on smart home and environmental monitoring.

4. A New Model of IoT Vocational Education in the Field of Cultural Ecology

4.1 Class Culture Construction

Material culture construction

Material culture is the class culture of the "external layer", which is the sum of the external appearances of various cultures that can be seen by the human eye. It is the easiest to distinguish from other cultures, and it is also the cornerstone of class culture [22-23]. The external material culture has a wide range of time and scope in contact with students, and can have a more profound impact on students. For students in multicultural fields, reasonable construction of material culture can create a good cultural atmosphere. In this way, the material culture construction of the class can be more colorful and interesting, and it can better meet the actual needs of students with different cultural backgrounds. The composition of classroom material culture can be divided into three aspects: the first is the physical environment of the classroom, including the arrangement of desks, chairs, and seats, and the design of the blackboard newspaper; the second is the material culture of the dormitory; the third is the material culture in the virtual network environment.

Behavioral culture construction

Class behavior culture refers to various activities organized by the class under the guidance of specific goals and concepts, and is the most active and most mobilized form of culture [24-25]. The behavioral culture of Class X also presents some unique characteristics in the multicultural context. Through the questionnaire survey of students in class X, it was found that class X organized a variety of class activities. There are various forms such as class meetings, smart classrooms, class civilization construction, class culture construction, and class cultural exchanges, which make the cultural activities of the class more colorful.

Institutional culture construction

Institutional culture is people's rational requirements for personal views and group relations in communication. The class system cannot be simply summarized as the formation and implementation of a system or a set of systems. Students must have a correct understanding of their roles and be able to consciously use their own class system to solve these problems. Under the leadership of the class teacher and class committee, class X has formulated a series of curriculum rules and regulations on thought, behavior, physical and mental development, etc. On this basis, the whole class discussed and solicited the opinions and suggestions of the classmates, and finally formed the class rules of class X.

Spiritual culture construction

Class spiritual culture is the core and most essential level of class culture, and is the inner culture of class material culture, institutional culture and behavioral culture. It is the basic reflection of the essence, style, characteristics and spiritual outlook of the class spiritual culture, and it has a "silent" effect on students' behavioral cognition. Class spirit is a collective consciousness gradually formed and developed by teachers and students in various fields of practice under a specific historical environment. Secondly, it is a comprehensive reflection of the values and attitudes of all students, teachers and students. Class X's class style, class appearance, values, ideology, etc., are produced in a multicultural environment and by the combined effects of different nationalities and social mainstream cultures.

4.2 Development of a Comprehensive Training Course for the Industrial IoT based on the Systematization of the Work Process

Course goal setting

The comprehensive training of the IoT in higher vocational colleges is one of the contents of the professional teaching system of the IoT in higher vocational colleges. It focuses on improving the professional and technical level of higher vocational colleges. In view of the outstanding problem that the current comprehensive training courses of the IoT are out of touch with the market demand, this paper selected a series of universal industrial IoT projects as the main content. In view of the teaching objectives of the comprehensive practical course of industrial IoT, the professional skills and basic knowledge required should be clearly defined first. Secondly, according to the previous research results, conduct in-depth screening and analysis to determine the professional skills and basic knowledge that the major should have. In addition, according to the characteristics of higher vocational colleges, the work flow is systematized to form a reasonable curriculum goal.

Curriculum objective design

Based on typical work tasks, a comprehensive industrial IoT training course was designed. It aimed to cultivate students' practical ability, so that they can achieve the combination of theory and practice to a certain extent.

Course unit structure planning

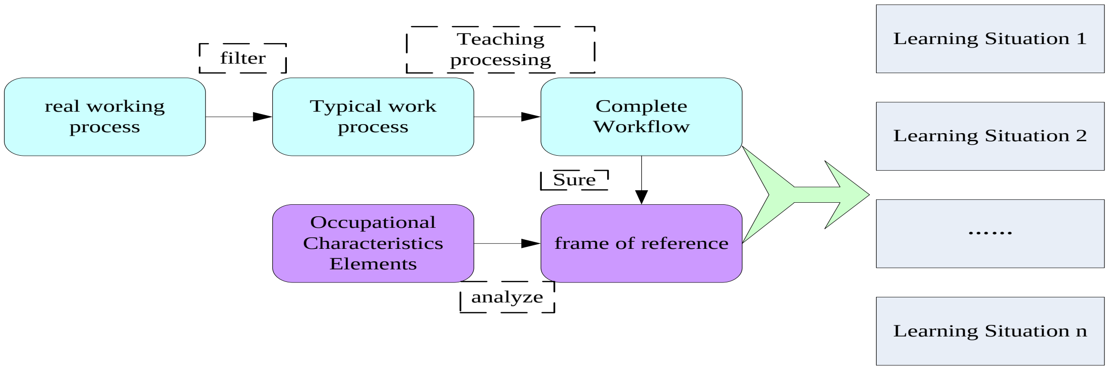


Figure 7. Scenario design of the department of chemistry of work process systems

The determination of each learning scenario must be combined with the actual workflow, as shown in Figure 7. Through the teaching analysis, the representative workflow is selected. After teaching typical workflows, the overall workflow to be completed in each learning environment is identified. Finally, the teaching environment design principle of "workflow systematization" is combined with the method. According to the six elements and the complete work flow, the working environment of the industrial IoT technicians is determined, and the comprehensive practice teaching environment is designed in a way of comparison, progression and deduction.

4.3 Teaching Evaluation of the New Model of IoT Vocational Education

According to the weight ratio of the two elements and the rounding method, the corresponding decision matrix is constructed. Table 4 shows the decision matrix for evaluating the indicators and target structures according to each of the above-mentioned standard levels.

Table 4. Judgment matrix

	C_1	C_2	C_3
C_1	1	1/2	1/4
C_2	1/2	1	1/3
C_3	4	3	1

According to the above method, the decision matrix is input into the system, and the method of AHP is adopted. Through repeated inquiries, the administrator determines the importance of two metrics and compares them with the importance of the previous metric. After filling in the form, the user clicks "Filter Indicators". The system asks the user to select a "Filter Threshold" and then press the "Start Screening" button. By using the AHP method, a comprehensive ranking of each scoring factor is obtained. Finally, it is compared with the initial threshold, and the corresponding comparison result is obtained.

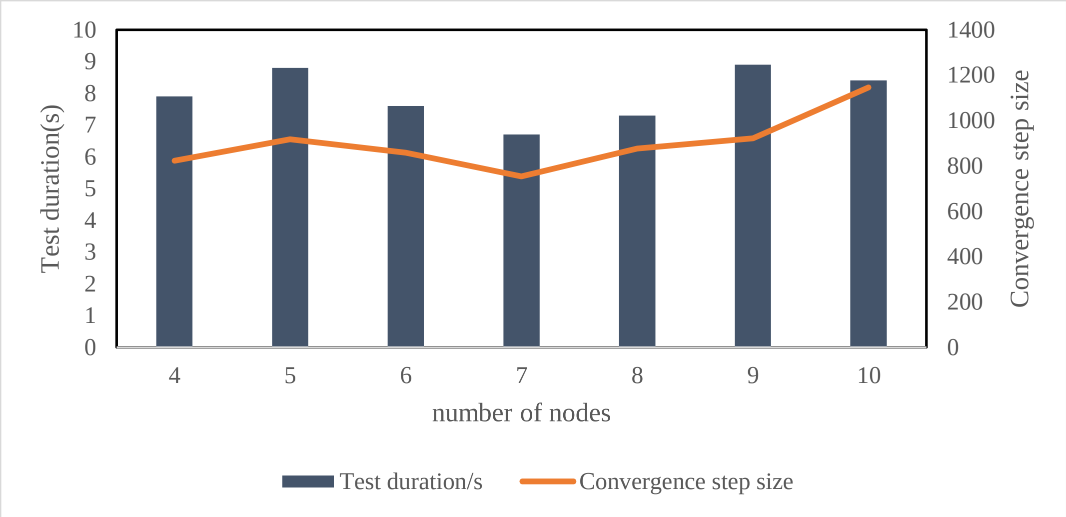
In order to obtain all the parameters of the AHP method in the neural network teacher evaluation model, the number of hidden layer nodes and the weights of each node must also be considered. This paper collected 400 teaching evaluation materials from Guangdong Vocational and Technical College. The data are shown in Table 5 and used for Matlab training experiments. First, three hundred datasets were selected for training and one hundred for testing. Finally, through experimental verification, an effective model was obtained.

The experimental data in Table 5 was compressed to 0 to 1 using the introduced data normalization formula. Normalized values were used to learn training data using a neural network, and tested using a standardized test set. The training time and step size of the algorithm in this paper and the traditional neural network algorithm in different hidden layer neurons are shown in Figure 8.

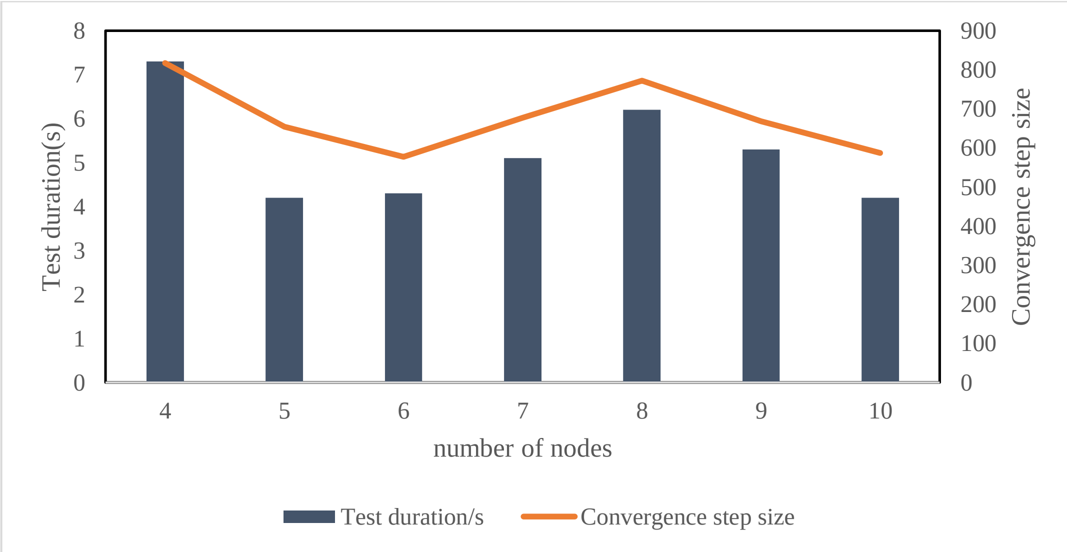
Figure 8A is the traditional neural network model, and Figure 8B is the algorithm model of this paper.

Table 5. Experimental data

Numbering	x_1	……	x_{10}	y
1	78	……	86	84
2	91	……	92	84
3	76	……	89	91
4	93	……	98	77
……	……	……	……	……
400	88	……	83	85



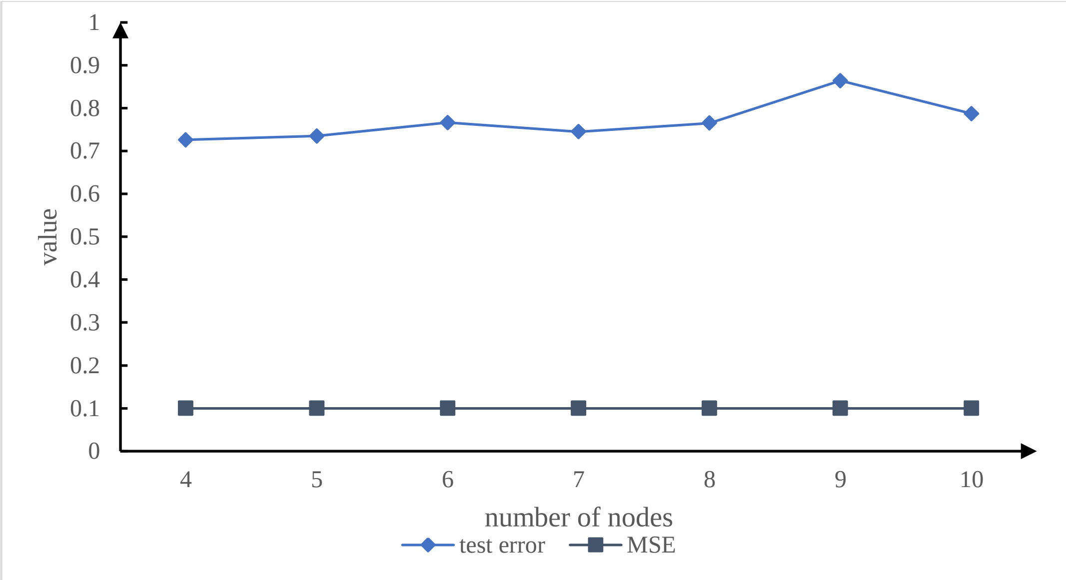
A. Neural network algorithm training time and step size



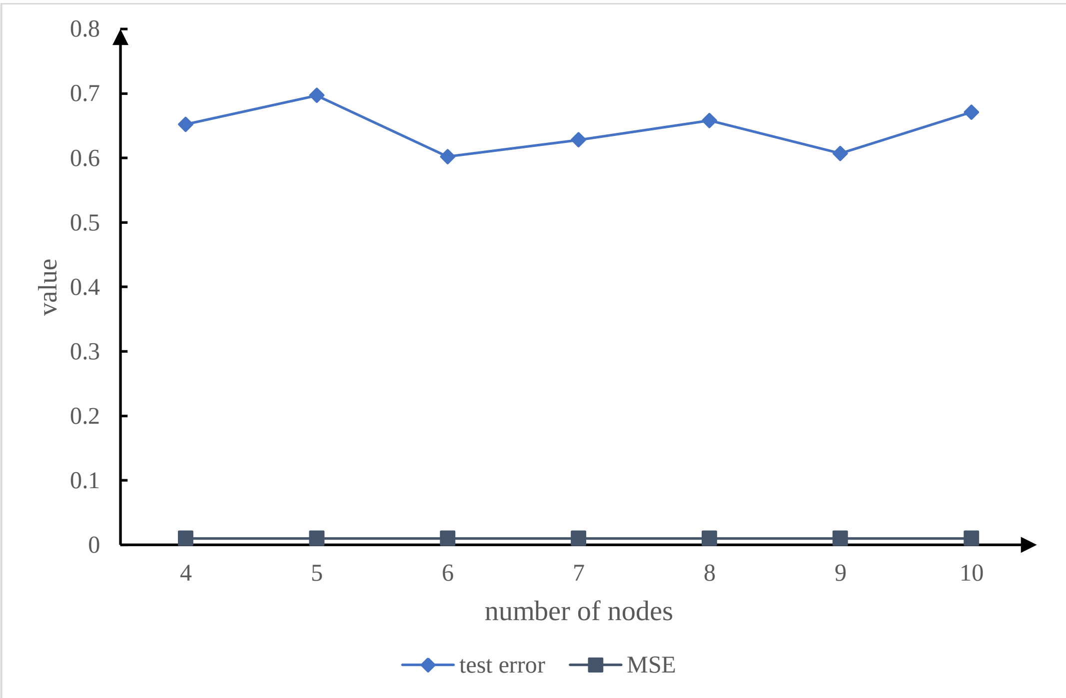
B. The training time and step size of the algorithm in this paper

Figure 8. Comparison of the training situation between the algorithm in this paper and the traditional algorithm

The algorithm of this paper adopted the method of combining AHP and neural network. By using the above training sets and tests, only five evaluation indicators were retained, and the corresponding neural network testing and training were carried out. When the number of neurons in the hidden layer was 4-10, the comparison of the training performance of the network is shown in Figure 9. Figure 9A is the traditional neural network algorithm, and Figure 9B is the algorithm of this paper.



A. Neural network algorithm error



B. The algorithm error of this paper

Figure 9. Error comparison between the algorithm in this paper and the traditional algorithm

By comparing with figures 8 and 9, it can be seen that the evaluation method combining AHP and neural network was much better than the method using only neural network in terms of accuracy and evaluation speed. It can be seen from Figure 9 that when the number of hidden layer nodes was 6, the performance and experimental performance of the method were both the best; the measurement error was 0.602, and a relatively satisfactory result was obtained. On this basis, a method based on hidden layer nodes was proposed, and the training curve of this method achieved the best results at 577 steps. The specific results are shown in Figure 10.

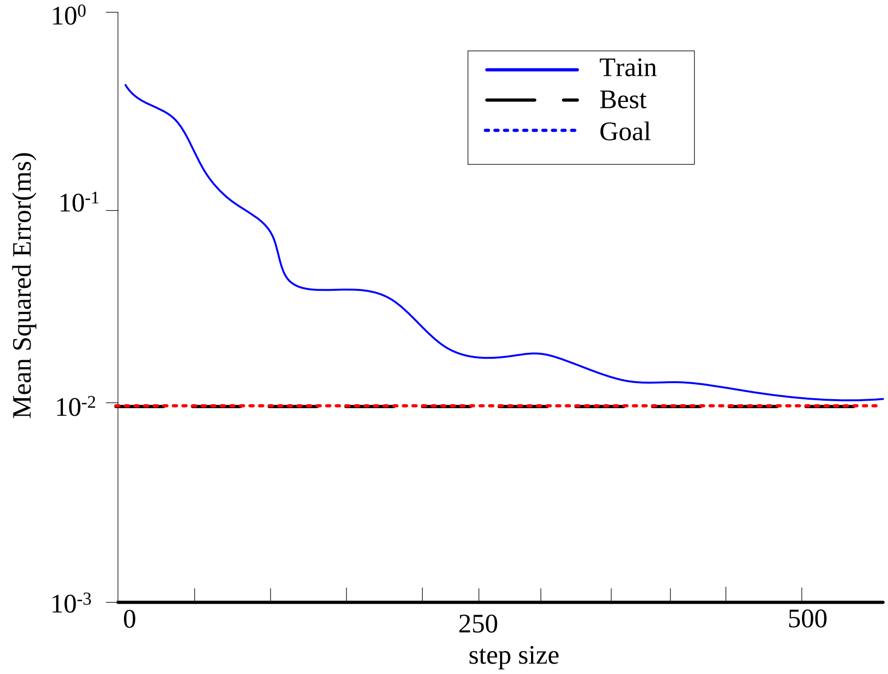


Figure 10. Training and fitting of the teaching evaluation model

5. Conclusions

In the vocational education of the IoT, cultural construction is particularly important. Workflow systematization comprehensive internship course creates an environment for trainees that is adapted to the actual work environment. Most of the work tasks can be carried out in the internal environment of schools or companies, and a few basic work tasks such as integrated wiring, project cognition, and equipment installation related to project inspection with high environmental requirements can be trained in the actual environment of the enterprise. The advent of secondary vocational training equipment has effectively solved the problem of single training content and difficult access to typical work tasks. It not only integrates it with the actual situation of real life, but also enables the corporate interns to have a clearer understanding of the future work direction and a higher enthusiasm for learning the internship program. It is guided by engineering results, and the evaluation results are intuitive.

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If any, should be placed before the references section without numbering.

Data Availability

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

Conflict of Interest

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

References

[1] Salsabila A , Khairudin M . Analysis of the need for the development of learning media for IOT-Based smart building installation systems . Journal of Physics: Conference Series, 2021, 1833(1):012064-012070.

[2] Rodney B D . Understanding the paradigm shift in education in the twenty-first century: The role of technology and the Internet of Things . Worldwide Hospitality and Tourism Themes, 2020, 12(1):35-47.

[3] Sultana N , Tamanna M . Evaluating the Potential and Challenges of IoT in Education and Other Sectors during the COVID-19 Pandemic: The Case of Bangladesh . Technology in Society, 2022, 68(5):101857-101868.

[4] Liu L . The Enlightenment of Japan "Industrial 4.0" & Vocational Education Development to China . Journal of Tianjin Sino-German University of Applied Sciences, 2018,9(MAR.):19-23.

[5] Xuli Y U , Qin Y , Chen L . Exploration and Practice of "Three Autonomy" Education Mode in Middle and Higher Vocational Education Connection in Internet of Things Application Technology Specialty——Taking Chongqing College of Electronic Engineering as an Example . Journal of Chongqing College of Electronic Engineering, 2019,56(4):14-17.

[6] Nofriansyah D , Ganefri G , Ridwan R . A new learning model of software engineering in vocational education . International Journal of Evaluation and Research in Education (IJERE), 2020, 9(3):572-582.

[7] Wang Y , Xu D , Luo T , Lai Y. The Realistic Dilemma and Promoting Path of Secondary Vocational Education Talent Training Model under the Background of Education Supply-side Reform . Contemporary Education Research, 2021, 5(4):4-7.

[8] Yang L . New Ideas and Strategies for Eliminating Obstacles to the Integration of Industry and Education in Vocational Education . Frontiers in Educational Research, 2019, 9(3):4-16.

[9] Purnomo, Ananto, Adi, Susanto, Eko, Nur , et al. Building Innovation Technology Concept in Creative Industry into Vocational Education Study Case in Indonesia, Malaysia and Thailand Industries . Journal of Printing Science and Technology, 2019, 56(1):27-36.

[10] Chen J . Exploration on the Innovation of Vocational Education Talents Training Model in the New Period . The Theory and Practice of Innovation and Entrepreneurship, 2019,15(4):17-22.

[11] Asadullah M A , Ullah A Z . Social-economic contribution of vocational education and training: an evidence from OECD countries . Industrial and Commercial Training, 2018, 50(4):172-184.

[12] Amelia A , Rahman A , Nursiah, Sitorus N , Sundawa B V , Roslina. The importance of safety learning to increase student awareness when working in laboratories in vocational education institutions . Journal of Physics: Conference Series, 2021, 1830(1):012002-012013.

[13] Oviawe J I , Uwameiye R , Uddin P . Bridging Skill Gap to Meet Technical, Vocational Education and Training School-Workplace Collaboration in the 21 st Century . International Journal for Research in Vocational Education & Training, 2017, 3(1):7-14.

[14] Lavrijsen J , Nicaise I . Returns on vocational education over the life cycle: Between immediate labour market preparation and lifelong employability . International Review of Education, 2017, 63(3):257-280.

[15] Karlsson T , Nilsson F L , Nilsson A . Vocational Education and Industrial Relations: Sweden 1910-1975 . Nordic Journal of Educational History, 2018, 5(1):2001-7766.

[16] Freund L , Gessler M . Book Review: Vocational Education and Training in Times of Economic Crisis . International Journal for Research in Vocational Education and Training, 2017, 4(4):382-386.
[17] Yudiono H . The alignment of productive competence on machinery between vocational education institutions and industry . World Transactions on Engineering and Technology Education, 2017, 15(3):256-259.
[18] Hyland T . Craft Working and the "Hard Problem" of Vocational Education and Training . Open Journal of Social Sciences, 2017, 05(9):304-325.
[19] Nooruddin S . Technical and Vocational Education and Training for Economic Growth in Pakistan . Journal of Education and Educational Development, 2017, 4(1):130-135.
[20] Fieger P , Villano R A , Rice J , Cooksey R. Two dimensional efficiency measurements in vocational education . International Journal of Productivity and Performance Management, 2017, 66(2):2017-2023.
[21] Karminskaya T D , Islamutdinov V F . Influence of Higher and Vocational Education on the Economic Development of the KhMAO-Yugra Region . Economy of Region, 2021, 17(2):445-459.
[22] Baumeler C , Engelage S , Strebel A . The Dilemmas of Flexibilisation of Vocational Education and Training: A Case Study of the Piano Makers . International Journal for Research in Vocational Education and Training, 2021, 8(1):115-135.
[23] Ismara K I , Suharjono A , Supriadi D . Ubiquitous learning in occupational health and safety for vocational education . International Journal of Evaluation and Research in Education (IJERE), 2021, 10(1):285-293.
[24] Jovanovi S S , Stojanovi-Jovanovi B N . Physiotherapy in contemporary higher vocational education . Sinteze, 2021, 2020(18):65-78.
[25] Hu S , Huang M . Design and Implementation of Vocational Education Cross Border E-Commerce Comprehensive Training System Based On Big Data Analysis . Journal of Physics: Conference Series, 2021, 1881(3):032037-032044.