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Reform of Instructional Assessment System and Cultivation of Students' Core Literacy

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Abstract. This article aims to explore the shortcomings of traditional instructional assessment system, and proposes a multi-dimensional student assessment system based on back propagation neural network (BPNN). By constructing a multi-dimensional assessment index system, this article uses BPNN algorithm to predict and analyze the sample data. Methodologically, abundant student data are collected and a comprehensive assessment index system is constructed. Through BPNN training and prediction, the results are compared with the actual and teachers' subjective scores. The results show that the assessment algorithm based on BPNN has high prediction accuracy and strong consistency with teachers' subjective scores. The reformed assessment system has significantly improved students' core literacy, especially in innovative ability and critical thinking. The multi-dimensional student assessment system based on BPNN is helpful to promote students' comprehensive development and provides a new idea for the reform of instructional assessment system. In the future, we will continue to optimize the algorithm and expand its application to better serve the development of education.

Keywords: Instructional assessment; Core literacy; BPNN; Educational business.

1. Introduction

As a key link in shaping future members of society, education is self-evident. The traditional instructional assessment system often pays too much attention to knowledge memory and test-taking ability, ignoring the cultivation of students' comprehensive quality and core literacy [1]. This single-dimensional assessment method may limit students' comprehensive development, and it is also difficult to adapt to the demand for diversified talents in the 21st century. Therefore, exploring and implementing the reform of instructional assessment system to promote the overall improvement of students' core literacy has become an important topic of global education reform [2]. In the instructional assessment system, test scores are the main criteria for evaluating students' learning achievements. Although this "score first" assessment model ensures the fairness and measurability of education to a certain extent, its limitations are increasingly prominent [3]. It overemphasizes the memory and reproduction of knowledge, but ignores the cultivation of students' comprehensive abilities such as innovative thinking, practical ability and teamwork [4]. Under such an assessment system, students' personality and potential are often suppressed.

Every student has his own unique interests, specialties and development rhythm, but the current assessment system often cannot effectively identify and encourage these diversities. Education is a dynamic development process, and students' learning attitude, effort and progress track are all important dimensions to evaluate their learning effect [5]. The core of the reform of instructional assessment system is to build a comprehensive, fair and all-round assessment system [6]. This new assessment system should truly reflect students' comprehensive quality and core literacy, and provide support for students' personalized development [7]. The reformed assessment system should cover students' knowledge mastery, skill development, emotional attitude, social practice and other dimensions to comprehensively evaluate students' learning achievements [8]. Such an assessment system can more accurately reflect the real level of students and provide more targeted guidance for their comprehensive development.

Every student is a unique individual with different interests, specialties and development needs [9]. The new assessment system should be able to recognize and respect these differences and provide students with personalized assessment and development paths. Through personalized assessment,

students can more clearly understand their own strengths and weaknesses, so as to make a more targeted study plan [10]. Students' core literacy refers to the necessary character that students gradually form in the process of receiving education to meet the needs of personal lifelong development and social development. It covers many aspects, such as cognition, emotion, attitude and values, and is the basis of students' comprehensive development. The reform of instructional assessment system is closely related to the cultivation of students' core literacy [11]. Under the new assessment system, students' innovative thinking, practical ability, teamwork and other core qualities will become the important content of assessment. This will encourage students to actively participate in various practical activities and social services, and constantly improve their comprehensive quality. Through the feedback mechanism of the assessment system, students can also understand their core literacy development more clearly, so as to make a more targeted promotion plan.

2. Theoretical framework for the reform of instructional assessment system

2.1 Definition of core literacy

As the core of the educational goal in the 21st century, core literacy refers to the key ability and quality that individuals must have in adapting to future social life, solving complex problems and promoting personal and social development. It goes beyond simple knowledge and skills, covers many dimensions such as cognition, emotion, attitude and values, and embodies the comprehensiveness and lifelong nature of education. The cultivation of core literacy aims to enable students to have the abilities of critical thinking, innovation, teamwork and cross-cultural communication, as well as the qualities of responsibility, compassion and civic awareness.

The proposal of core literacy is a transcendence and sublimation of traditional educational goals. It pays attention to students' academic achievements and pays more attention to their comprehensive development and lifelong learning ability. Therefore, building a student-centered and core literacy-oriented instructional assessment system has become an important direction of education reform.

2.2 Limitation and reflection of traditional assessment system

The traditional assessment system mostly takes test scores as the main criterion to evaluate students' learning achievements, and its limitations are mainly reflected in the following aspects: first, the assessment content is single, and the memory and reproduction of knowledge are overemphasized; Second, the assessment method is mechanical, and standardized tests are often used, which is difficult to truly reflect the individualized development of students; Thirdly, the subject of assessment is single. As the leader of assessment, teachers lack opportunities for self-assessment. Fourth, the utility of assessment purpose, excessive pursuit of high scores and rankings, leading to educational alienation. Faced with many limitations of the traditional assessment system, it is needed to carry out profound reflection and reform. The goal of reform should be to build a comprehensive, fair and all-round assessment system to promote students' comprehensive development.

2.3 Direction and goal of reform

The reform of instructional assessment system should focus on students' core, take core literacy as the guide, and emphasize the diversity, process and individuality of assessment methods. It should comprehensively consider students' performance in knowledge understanding, skill application, emotional cultivation and social practice, so as to comprehensively judge their learning effectiveness and the achievement of core literacy. Evaluators need to change their perspective, not only pay attention to students' academic scores, but also pay attention to the cultivation of their comprehensive abilities such as innovative thinking, practical operation and teamwork.

In order to break away from the traditional single standardized examination, the reform should carry out diversified assessment mechanisms and strive to show students' learning trajectory and achievements more accurately. In addition, information technology, such as big data analysis and

intelligent tools, should be actively introduced to empower the assessment work and improve efficiency and accuracy.

Another focus of the reform is to promote the diversification of assessment subjects, encourage students, teachers, parents and even the community to participate together and build an open assessment ecosystem. This change is helpful to improve students' self-reflection ability and subjective status, and promote the democratization and openness of the assessment process. The reform should be devoted to making assessment a driving force to promote students' comprehensive development and lifelong learning. Assessment should not only be a tool for screening and ranking, but also a catalyst for students to explore themselves, make continuous progress and realize their potential.

3. Multi-dimensional assessment system integrating BPNN

In the wave of instructional assessment system reform, it is particularly important to design and implement an assessment algorithm that can fully reflect students' core literacy and adapt to individual differences. This section will discuss a multi-dimensional assessment system based on BPNN to realize a scientific and fair assessment of students' comprehensive quality. BPNN has been widely used in many fields because of its powerful nonlinear mapping ability and self-learning ability. Introducing BPNN into instructional assessment can make full use of its characteristics of parallel processing, distributed storage and adaptive learning, and effectively deal with complex and multi-dimensional student data.

BPNN can learn the complex relationship between data by simulating the connection and information transmission process between neurons in human brain. By training neural network, it can output a score or classification result that comprehensively reflects students' core literacy. When constructing BPNN, it is needed to determine the number of layers of the network, the number of neurons in each layer and the activation function according to the number and complexity of assessment indexes. Generally speaking, the three-layer BPNN is enough to deal with most instructional assessment problems. The number of neurons in the input layer corresponds to the number of assessment indexes, and the output layer can be set as one neuron or multiple neurons according to the assessment requirements. In this article, a three-layer BPNN model consisting of only one input layer, one hidden layer and one output layer is designed for teaching effectiveness assessment, as shown in Figure 1.

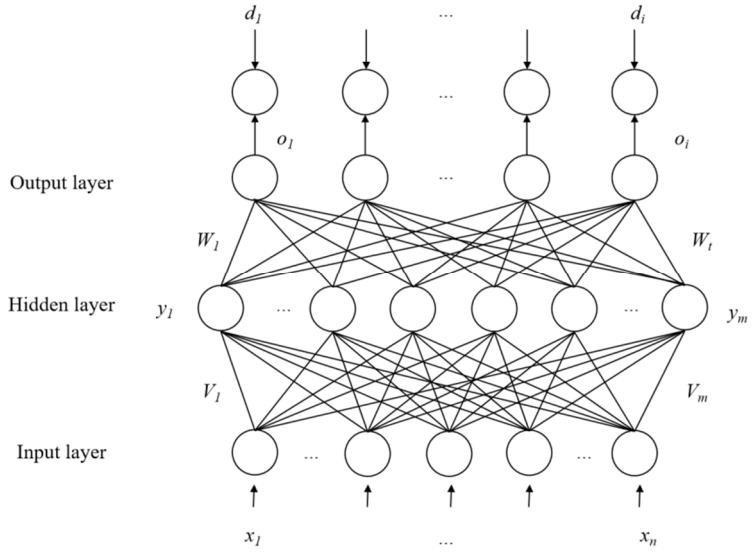

Figure 1 BPNN model

Select formula (1) and determine the optimal number of neurons by trial and error.

$$n_i = \sqrt{n+m} + a \tag{1}$$

The number of neurons in the input layer is n, the number of neurons in the output layer is m, and a is a constant between [1,10].

The weights of BPNN are adjusted as follows:

$$w(n+1)=w(n)-\mu(n)\sum_{t=0}^{N}\alpha^{n-1}\frac{\partial E(n)}{\partial w(n)} \tag{2}$$

Where $\alpha(0<\alpha<1)$ is the momentum term, w is the weight, μ is the learning rate, and $E(n)$ is the error.

According to the framework of students' core literacy in the 21st century, it is the basis of designing assessment algorithm to construct a multi-dimensional assessment index system including knowledge and skills, thinking ability, emotional attitude, social practice and leadership. Each dimension can be refined into specific assessment indicators, and subject knowledge can be refined into mathematics, Chinese, English and other subjects. Thinking ability is evaluated through project-based learning and innovation competition. Emotional attitude is obtained through daily behavior observation and peer assessment. Social practice and leadership are measured according to social activities and positions.

Before inputting data into BPNN, data preprocessing and feature extraction are needed. Data preprocessing includes data cleaning and data normalization to ensure the accuracy and comparability of data. Feature extraction is to extract the key information from the original data that has important influence on the assessment results.

Determine the network's initial output and error, resulting in:

$$w_{ji}(n+1)=w_{ji}(n)+\eta(n)D(n) \tag{3}$$

Where $D(n)$ represents the negative slope at n:

$$D(n)=-\frac{\partial E}{\partial w_{ji}}=\delta_j x_i \tag{4}$$

Altering η influences weight changes; thus, selecting an optimal rate enhances the system's learning approach. The selected speed should avoid causing shock while being as high as feasible. This approach incorporates a momentum term into the adjustment value, which must be recorded each time. The formula for the weighted adjustment is:

$$\Delta\omega(t+1)=\eta\frac{\partial E}{\partial\omega}+\alpha\Delta\omega(t) \tag{5}$$

Typically, α is around 0.9, with α representing the momentum coefficient.

When training BPNN, it is needed to use historical data as the training set, and constantly adjust the weight and bias in the network through the back propagation algorithm, so as to minimize the error between the network output and the actual assessment results.

4. Result analysis and discussion

Multiple linear regression and BPNN-based assessment algorithm are used to predict the comprehensive assessment results of students in sample data, and the predicted results are compared with the actual results, as shown in Figure 2. When the assessment algorithm based on BPNN predicts the students' comprehensive assessment results, the coincidence between the predicted value and the actual value is higher, and the error distribution is more concentrated and smaller. This shows that BPNN has obvious advantages in dealing with complex and nonlinear relations, and can more accurately reflect the internal relations among students' indicators.

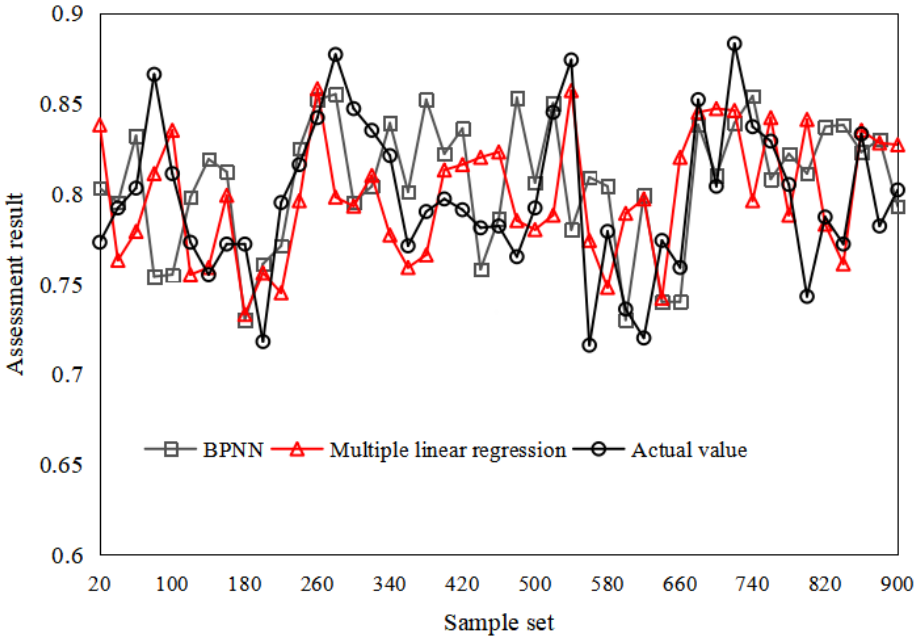

Figure 2 Comparison between predicted results and actual results

In order to further verify the reliability of the algorithm assessment, a number of senior teachers were invited to give subjective scores to students, and these scores were compared with the assessment results of the algorithm, as shown in Figure 3. On the whole, teachers' subjective assessment and algorithm assessment are highly consistent.

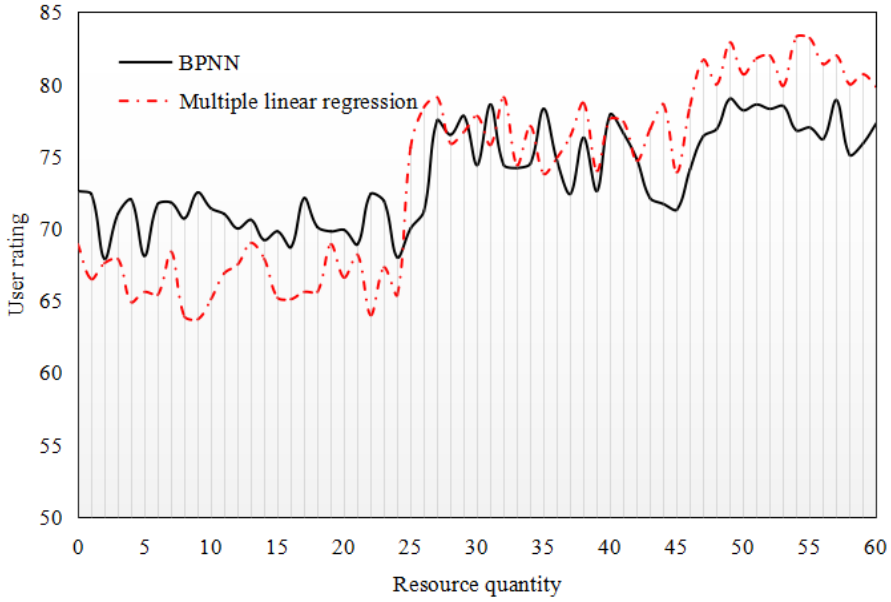

Figure 3 Teachers' subjective rating

There is a certain complementarity between teachers' subjective assessment and algorithm assessment. Teachers' subjective assessment is more based on students' daily observation, classroom performance and teacher-student interaction, which can capture some characteristics of students that are difficult to quantify by algorithms. The algorithm assessment depends on a large number of quantitative data, which can provide a more objective and quantitative assessment basis.

In order to show the influence of the reform of instructional assessment system on students' core literacy more intuitively, the data of students' core literacy before and after the reform are collected respectively, as shown in Table 1 and Table 2.

Table 1: Simplified Comparison of Students' Core Competencies Before and After Reform

Student ID	Pre-Reform Score	Post-Reform Score	Improvement

001	65	80	+15
002	70	85	+15
003	55	70	+15
004	60	78	+18
005	68	83	+15

Table 2: Comparison of Students' Core Competencies Before and After the Reform by Dimension

Dimension	Pre-Reform Average	Post-Reform Average	Improvement Rate (%)
Academic Performance	71.6	84.0	+17.3
Innovation Ability	20.4	35.6	+74.0
Critical Thinking	25.8	39.2	+52.0
Teamwork Ability	30.4	42.8	+40.8
Emotional Attitude (Self-Confidence)	31.0	46.2	+49.0
Core Competency Total	66.2	81.1	+22.5

After the reform, the total score of students' core literacy and the scores of all dimensions have been significantly improved. Especially in the core literacy of innovation ability, critical thinking, teamwork ability and emotional attitude, the improvement of students is particularly significant. After the reform, students' academic performance has also improved. This is not an accidental phenomenon, but the reformed assessment system pays more attention to the cultivation and assessment of students' comprehensive quality, which stimulates students' interest and motivation in learning.

5. Conclusions

Aiming at the simplification and one-sidedness of the traditional instructional assessment system, this study designed and implemented a multi-dimensional student assessment system based on BPNN. By constructing an assessment index system covering knowledge and skills, thinking ability, emotional attitude, social practice and leadership, a comprehensive assessment of students' core literacy is realized. The results show that the assessment algorithm based on BPNN shows high accuracy in predicting students' comprehensive assessment results. This verifies the effectiveness of the algorithm in dealing with complex relationships and capturing students' characteristics. After the reform, the assessment system has improved the students' total score of core literacy and the scores of each dimension.

This study provides a new vision for the reform of instructional assessment system, and also promotes the comprehensive development of students and improves the quality of education. By combining modern scientific and technological means with educational ideas, a more scientific, fair and personalized assessment system is constructed.

The future work will continue to deepen the research, optimize the algorithm model and expand the assessment dimension, so as to evaluate students' core literacy more accurately. The research results are of great value to promote the modernization and scientificity of instructional assessment system, and also provide useful reference for the reform of assessment system in other fields.

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