Research on the University Education Management System Design Based on the Complete Credit System

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Abstract

With the continuous social development, the demand pattern for talents has become diversified with more and more demands for high-calibre compound talents. Accordingly, colleges and universities are required to adjust their own teaching management system according to the demand pattern of society for talents, thus cultivating talents for the society. The complete credit system is an education management mode which can comprehensively examine the overall quality of students and an inevitable result for colleges and universities to foster high-calibre compound talents for the society. To design a university education management system based on the complete credit system is a huge systematic project subject to a variety of subjective or objective factors. There are still some problems and deficiencies in China’s complete credit system of college education management, so the departments of colleges are required to cooperate in establishing a sound complete credit education management system, thus enhancing the teaching management level and promoting the comprehensive development of students’ overall quality. This paper first analyzed the evaluation model of the university education management system, and then elaborated the application status of the complete credit system in the university education management. Finally, the design idea of the university education management system was put forward based on the complete credit system, which provides a reference for the reform in university education management system.

Keywords: Complete Credit System, Education Management, Reform Design.

1. RESEARCH OVERVIEW

1.1 Research background

China’s education reform and development plan have clearly put forward that colleges and universities should realize the individualized quality education to unleash the potential and advantages of students. Also, the hierarchical teaching method should be adopted according to the students’ learning abilities and levels. Tutor system, credit system and other special teaching management models should be implemented to promote the overall development of students’ comprehensive quality. The credit system, a key issue attracting extensive attention from educators in China, can examine students’ academic and practical outcomes more intuitively, thus reflecting their comprehensive quality. However, in the practical application, the construction of credit education management model in China is only superficial without establishing a strict credit system. Thus, very few students fail the test under the credit system, which challenges the credit system in motivating students’ learning initiative and testing their overall quality. There are many types of credit system (Chen, 2011), among which the complete credit system is the most widely used and the appropriate for college education management system reform. Therefore, it is necessary to carry out an in-depth research on the complete credit system and to establish the university education management system according to the complete credit system, thus optimizing the traditional teaching mode and achieving the goal of improving the teaching level of colleges and universities (Fan et al., 2011).

1.2 Literature review

The complete credit system is the inevitable path of the reform of university education management system and the definite product of social development, which plays an important role in improving the quality of university teaching. The construction of the complete credit system is a huge systematic project that requires the overall consideration and the organic integration of multiple departments (Wang, 2014). Demands for the diversity of talents training and high-calibre compound talents have increased in the current society. Curricula construction is
the major issue in constructing the university education management system under the complete credit system, and only the employment-oriented curriculum construction can effectively promote the development of the complete credit system. The application of the complete credit system in the reform of university education management system involves a variety of aspects and requires the adjustment in working contents of various parties (He, 2008). To construct the university education management system based on the complete credit system, we need to closely integrate it with social security and enterprise demands while paying attention to the internal aspects of the school itself. In this case, we can achieve the all-round promotion of the construction and popularization of the complete credit system and secure its important status among students, motivating the innovativeness and creativity of students and promoting the overall progress and development of the school (Zhu, 2014).

2. The evaluation model of university education management system

2.1 Evaluation of university education management system based on BP neural network

The college education management is influenced by a variety of factors, and the relationship between the evaluation results and the influencing factors is too complicated to be expressed through the traditional mathematical formulas. Thus, the BP neural network can be adopted to evaluate the university education management system (Zhao et al., 2013).

2.1.1 Basic model of artificial neural network

The artificial neural network is a special mathematical model, which can achieve the distributed information processing through the imitation of animal’s neural network. The artificial neural network, composed of many interlinked neurons, can express and analyze complex problems by adjusting the weights between different neurons and finally solve the problems. The artificial neural network processes complex problems in a different way from the traditional one (Zhao, 2013). The comparison is shown in Figure 1:

**Figure 1.** Comparison of traditional methods with artificial neural networks

Compared with the traditional method, the artificial neural network can realize self-learning and associative storage, so as to find the optimized solution with greatly improved efficiency.

2.1.2 BP neural network based university education management model

BP neural network mainly includes the input layer, the middle layer and the output layer, and the neurons of each level will adjust the output value through the weight. The BP neural network model is shown in Figure 2:
Figure 2. BP neural network model

Assuming that the total number of samples is P, the input value of the Pth sample is \( x(P) = (x_1(P), x_2(P), \ldots, x_n(P)) \), the output value is \( t(P) = (t_1(P), t_2(P), \ldots, t_l(P)) \), and the network output is \( y(P) = (y_1(P), y_2(P), \ldots, y_k(P)) \). The main steps are the following:

The first is the positive calculation link. On the one hand, the middle-layer input and output values are calculated. The formula to calculate the input value is as follows:

\[
R = \left[ \begin{array}{c} \bar{r}_{ij} \\ \bar{r}_{ij} \end{array} \right], i = 1, 2, \ldots, n; j = 1, 2, \ldots, m \\
\bar{r}_{ij} \in [0, 1]
\]  

(1)

The output value \( O_{ip} \) of the middle layer is:

\[
O_{ip} = f(I_{ip}) = \frac{1}{a + be^{-cl_{ip}}}
\]  

(2)

On the other hand, the neuron output of the output layer is calculated. The formula for output value \( y_{kp} \) is:

\[
y_{kp} = \sum_{i=1}^{m} (v_{ki}O_{ip})
\]  

(3)

In the three formulas, \( W_{ij} \) represents the weight between the middle-layer neuron \( i(i=1, 2, \ldots, m) \) and the input-layer neuron \( j \); \( X_p \) represents the output value \( j \) of the sample \( P \); \( V_{ki} \) represents the weight between the output-layer neuron \( k(k=1, 2, \ldots, l) \) and the middle-layer neuron \( i \).

The next is errorback propagation.

The errors in the BP neural network mainly include the output error and sample error of the defined network, among which the former is expressed by \( d_p \) and the latter is expressed by \( e_p \). The formula is as follows:

\[
d_p = I_{ip} - y_{kp}
\]

\[
e_p = \frac{1}{2} \sum_{k=1}^{l} (t_{kp} - y_{kp})^2
\]  

(4)

Where \( t_{kp} \) and \( y_{kp} \) represent the actual output and network output, respectively. Provided \( W = [w, \theta, v] \), where \( \Delta W = [\Delta w_{ij}, \Delta \theta_i, \Delta v_i] \), it can be obtained according to the back propagation algorithm:

\[
\Delta W^{(p)} = -\eta \frac{\partial E}{\partial W} + \alpha \Delta W^{(p-1)}
\]  

(5)
And then the calculation is conducted with the following formulas:

\[
\Delta v_i = \eta d_p \frac{\partial y_p}{\partial v_i} = \eta d_p o_{ip}
\]

\[
\Delta \theta_i = \eta d_p \frac{\partial y_p}{\partial \theta_i} = c\eta d_p v_i o_{ip} (1 - \alpha_o_{ip})
\]

\[
\Delta w_{ij} = \eta d_p \frac{\partial y_p}{\partial w_{ij}} = c\eta d_p v_i o_{ip} (1 - \alpha_o_{ip}) x_{ip}
\]

Finally, the original connection weight \( W \) is corrected and put into the formula \( W + \Delta W \rightarrow W \) to obtain the positive calculation of the sample \( P + 1 \) (Fan, 2015). The output value function \( E \) of the \( P \)th sample is:

\[
E = \sum_{p=1}^{P} e_p = \frac{1}{2} \sum_{p=1}^{P} (t_p - y_p)^2
\]

If the error of the obtained result is within the acceptable range, the calculation is completed; otherwise, the iterative calculation should be continued until the error reaches the acceptable range (Yin and Zheng, 2008).

### 2.2 The evaluation index weight of university education management based on hierarchical analysis

The allocation of the weights of the evaluation indicators of university education management mainly involves the following steps:

First, with large survey samples, a sound evaluation system is established under the support of comments made by relevant experts, scholars, students and school leaders. The system determines the indicators influencing college education management evaluation and clarify the relationship between the indicators. The judgment matrix \( U \) is established as shown by the following formula:

\[
U = \begin{bmatrix}
    a_{11} & a_{12} & \cdots & a_{1n} \\
    a_{21} & a_{22} & \cdots & a_{2n} \\
    \vdots & \vdots & \ddots & \vdots \\
    a_{n1} & a_{n2} & \cdots & a_{nn}
\end{bmatrix}
\]

Where \( a_{ij} (i, j \in N) \) are the influencing factors of the university teaching management evaluation index. The matrix in the analytic hierarchy process must meet the following conditions:

1. \( a_{ij} = 1 \)
2. \( a = \frac{1}{a_{ij}} (i, j = 1, 2, 3, ..., n) \)

Next, the different influencing indicators are classified and compared after establishing the judgment matrix to determine their importance degree. And then the indicators are ranked by their importance degree according to the following equation:

\[
UX = Y_{max} * X
\]

where \( X \) is the eigenvector of each weight. After the matrix is calculated in a normalized way and put into the formula, the final weighting coefficient of each influencing factor is obtained. The formula is:

\[
CR = \frac{CI}{CR}
\]

Where \( CR \) represents the consistency ratio and \( CI \) represents the consistency indicator.

Then, the consistency test is carried out on the quality evaluation matrix of university education management by substitution of the indicator comparison into the matrix to calculate the maximum feature and vector. If the test
succeeds, the vector is a weight vector; if it fails, it needs to be reconstructed for comparison. Assuming that the largest eigenvalue is $\lambda_{\text{max}}$, the formula is as follows:

$$\text{CI} = \frac{\lambda_{\text{max}}}{n} - \frac{n}{n-1}$$

$$\lambda_{\text{max}} = \frac{1}{n} \sum_{i=1}^{n} (Aw)^i$$

(12)

Where $Aw$ represents the scores of the matrix and the eigenvector, and $RI$ represents the average random consistency index. The $RI$ values are shown in Table 1:

<table>
<thead>
<tr>
<th>Order number</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>RI</td>
<td>0.00</td>
<td>0.00</td>
<td>0.58</td>
<td>0.90</td>
<td>1.12</td>
<td>1.24</td>
<td>1.32</td>
<td>1.41</td>
<td>1.45</td>
<td>1.49</td>
<td>1.52</td>
<td>1.54</td>
</tr>
</tbody>
</table>

When $CR<0.1$ or $K_{\text{max}}=n$, $\text{CI}=0$, it can prove that the matrix is consistent with the university education management quality evaluation index, and the obtained weight may greatly influence the quality of university education management. If $CR>0.1$, the matrix needs to be readjusted until the two are consistent (Wei K.W. 2011).

3. THE APPLICATION STATUS OF THE COMPLETE CREDIT SYSTEM IN UNIVERSITY EDUCATION MANAGEMENT

To investigate the application status of the complete credit system in university education management, this paper carries out a questionnaire survey on some university students, teachers, faculty and staff and the leaders. The results are as follows:

3.1 Teaching environment

The teaching environment has a direct impact on the students' enthusiasm for learning. The teachers and students evaluate the teaching environment from different perspectives. The statistical results are shown in Table 2:

<table>
<thead>
<tr>
<th>project</th>
<th>Teacher(%)</th>
<th>Student(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>cultural environment</td>
<td>82</td>
<td>71</td>
</tr>
<tr>
<td>physical environment</td>
<td>63</td>
<td>45</td>
</tr>
</tbody>
</table>

In this experiment, the teaching environment is divided into two levels: one is cultural environment, including campus culture, teaching atmosphere and learning environment; the other is physical environment, including the school's infrastructure construction, teaching resources and green level. The statistics show that 82% of the teachers are relatively satisfied with the cultural environment of the school, and only 63% of the teachers are satisfied with the physical environment. 71% of the students are content with the cultural environment, and only 45% of the students are content with the physical environment. This indicates that the school possesses a high-level construction of campus culture and teaching atmosphere but a less satisfactory construction of infrastructure and teaching equipment. And the information teaching facilities are not popularized enough to meet the overall learning needs of students.

3.2 Teaching management

The application of the complete credit system will subvert the traditional university teaching management model. If the university wants to know whether the problems in reform can be solved, it is necessary to investigate the satisfactory degree of teachers and students towards teaching management. The results are shown in Table 3:
In this paper, the teaching management is divided into the above five aspects. As is shown by the survey results, 70% of the teachers are satisfied with the curriculum management, 74% with the classroom management, 90% with the management of teaching staff, 88% with the teaching quality management and 28% with the management of student status and degree. From the perspective of the students, 51% of the students are satisfied with the curriculum management, 60% with the classroom management, 85% with the management of teaching staff, 96% with the teaching quality management and 21% with the management of student status and degree. The important feature of the complete credit system is that students can freely choose the courses, contents and time for learning, which increases the difficulty in education management while reflecting a high degree of freedom.

3.3 Teaching effectiveness

After adopting the university education management model based on complete credit system, the teaching quality is shown in Table 4:

<table>
<thead>
<tr>
<th>project</th>
<th>Teacher(%)</th>
<th>Student(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Academic record</td>
<td>52</td>
<td>69</td>
</tr>
<tr>
<td>Learning attitude</td>
<td>55</td>
<td>62</td>
</tr>
<tr>
<td>Ability development</td>
<td>80</td>
<td>57</td>
</tr>
</tbody>
</table>

The results show that the satisfaction degrees towards the students’ academic records, learning attitude and capability development by the teachers are 52%, 55% and 80%, respectively. And those by the students are 69%, 62% and 65%, respectively. This indicates that though the complete credit system provides high-level freedom for students, the academic performance of some students with poor self-discipline ability will be greatly influenced because of the great difference from the education they received before. For the teachers, the complete credit system poses a great challenge for their teaching abilities, although it can effectively improve the overall level of students and cultivate them into high-calibre compound talents. The teachers need to be equipped with a deep understanding of the specialized knowledge and also an extensive coverage of knowledge of other disciplines to enhance their teaching levels (Chang, 2017).

3.4 Teaching quality evaluation

Teaching quality evaluation is to evaluate the teaching effectiveness for analysis of the inadequacies in teaching and targeted settlement. China's colleges and universities generally attach importance to the teaching quality evaluation, and there are still some shortcomings in the teaching quality evaluation.

<table>
<thead>
<tr>
<th>project</th>
<th>Teacher(%)</th>
<th>Student(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project method</td>
<td>80</td>
<td>70</td>
</tr>
<tr>
<td>Project content</td>
<td>52</td>
<td>60</td>
</tr>
<tr>
<td>Project object</td>
<td>65</td>
<td>52</td>
</tr>
<tr>
<td>Project subject</td>
<td>50</td>
<td>41</td>
</tr>
</tbody>
</table>
As is shown by the statistical results, the satisfaction degrees towards the evaluation method, evaluation content, evaluation object and evaluation subject of teaching quality be the teachers are 80%, 52%, 65% and 50%, respectively. And those by the students are 70%, 60%, 52% and 41%, respectively. The teaching quality evaluation is of great significance to the improvement of teaching levels in colleges and universities. However, the investigation results show that colleges and universities in China attach little importance to the teaching quality evaluation, leaving it on the surface and increasing the difficulty in reflecting its importance (ShangGuan, 2005). Meanwhile, with the problems of crossed items and repeated contents, teaching quality evaluation will be further devalued and fail to increase college teaching quality.

4. CONCLUSION

The university education management system under the complete credit system is highly free and flexible for students to choose the learning contents and time according to their own actual situation to achieve more targeted learning. For students with self-control, this teaching management system is of great significance because it can cultivate them into high-calibre compound talents that meet the social demands. But this system may impede the development of those students lacking self-control, as they may turn to entertainment in flexible learning schedules. This kind of teaching management mode has promoted the overall quality development of students, but it also brings some difficulties to the teachers’ work of teaching and management, which requires teachers to learn extensively to better meet the students’ learning demands.

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