Research on Young Teachers’ Planning and Teaching Ability Improvement in Independent Colleges

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Abstract. Frequent flow of young teachers in independent colleges is a key factor restricting their rapid development. Moreover, the teaching ability of teachers in independent colleges is related to teaching quality and personnel training. Scientific and reasonable evaluation index of teaching ability is the key to guarantee teaching quality, and is also an effective way to train and build young teachers. The development of independent colleges is unique, and young teachers also have their own characteristics of the times. This paper will put forward guiding suggestions from the perspective of young teachers’ planning and the improvement of young teachers’ teaching ability to help the new development of independent colleges.

1. INTRODUCTION
Chinese government puts forward new and higher requirements for the strategic orientation, historical mission and objective tasks of education, and promotes the continuous improvement of higher education through various measures taken by governments at all levels. Therefore, it is urgent to give priority to the development of education, to strengthen education first, to support national modernization with educational modernization, and to support socialist modernization with educational power. More practical methods should be explored in the aspects of teachers’ morality, qualifications, recruitment system, assessment and evaluation, career development, salary guarantee and honor system, and classified management should be carried out according to the characteristics of different teachers’ posts. Independent colleges are an important part of Chinese education, and young teachers are the main force and subject of development in Chinese education. Effective young teachers’ planning and improvement of young teachers’ teaching ability are the keys to improve the quality of running schools and achieve sustainable development.

2. LITERATURE REVIEW
Markov chain, named after Markov, a Russian mathematician, is a mathematical model based on stochastic processes. It is a mathematical model for predicting the future motion of random variables by analyzing their actual motion. The model has the characteristics of randomness, no aftereffect and stability. Chinese scholars often use Markov chain in the field of education, such as the evaluation of teaching quality, long-term prediction of teaching process, human resources planning of universities and so on. Peng S.M. and Wei S.G. (2019) constructed a multi-level fuzzy comprehensive evaluation model through questionnaires, and put forward measures to effectively and continuously improve students’ mathematical reading ability. Yu G.F. and Zhao X.M. (2018) set up an evaluation index system of high-efficiency classroom teaching quality on the basis of discussing the principle of multi-level fuzzy comprehensive evaluation. They define the fuzziness of teaching quality at a better
level and evaluate the quality of teaching objectively and impartially. Liu H.M. and Yang Y.D. (2016) constructed a multi-level fuzzy comprehensive evaluation model combining AHP and FCE models. The empirical results show that the FCE model combined quantitatively and qualitatively can better evaluate the teaching performance of University seminars.

3. Methodology

3.1. Markov Model

When the state of a system at a given time is known, the conditional probability distribution of the state at time \( t > t_1 \) is not related to the state before time \( t_1 \), but only to time \( t_1 \). The probability distribution function is described as: let the state space of the stochastic process \( \{ X(t), \ t \in T \} \) be \( S \). If for any time of time \( t \) \((t_1 < t_2 < \ldots < t_n, \ n \geq 3, \ t_i \in T) \), under condition \( X(t_i)=x_i \) \((x_i \in S, \ i=1, 2, \ldots, n-1) \), if the conditional probability distribution function of \( X(t_n) \) is exactly equal to that of \( X(t_{n-1})=x_{n-1} \), the conditional probability distribution function of \( X(t_n) \) is \( P \{ X(t_n)=x_n | X(t_1)=x_1, X(t_2)=x_2, \ldots, X(t_{n-1})=x_{n-1} \} = P \{ X(t_n) \leq x_n | X(t_{n-1})=x_{n-1} \}, x_n \in R \). In this case, the stochastic process \( \{ X(t), \ t \in T \} \) has Markov property or has no aftereffect. This process is called Markov process. Suppose that the stochastic process \( \{ X(t), \ t \in T \} \), \( T = 0, 1, 2, \ldots \) The state space \( S=\{0, 1, 2, \ldots \} \) For positive integers \( m \), \( n \), \( P \) and any non-negative integers \( j_m > j_{m-1} > \ldots > j_2 > j_1 \), and \( l_{n+p}, l_n, i_m, \ldots, i_2, i_1 \) has \( P \{ X(n+p)=l_{n+p} | X(n)=i_n, X(j_m)=i_m, \ldots, X(j_2)=i_2, X(j_1)=i_1 \} \) has \( P \{ X(n+p)=l_{n+p} | X(n)=i_n \} = P \{ X(n+p)=l_{n+p} | X(n)=i_n \} \) holds, and \( X_T \) is the Markov chain.

When \( p(h) \) is a matrix consisting of transition probability \( p_{ij}^{(h)}(n) \), and the state space \( S=\{1, 2, 3, \ldots \} \), \( p(h)=\begin{bmatrix} P_{11}^{(h)}(n) & P_{12}^{(h)}(n) & \ldots & P_{1m}^{(h)}(n) \\ P_{21}^{(h)}(n) & P_{22}^{(h)}(n) & \ldots & P_{2m}^{(h)}(n) \\ \vdots & \vdots & \ddots & \vdots \\ P_{m1}^{(h)}(n) & P_{m2}^{(h)}(n) & \ldots & P_{mm}^{(h)}(n) \end{bmatrix} \) is called the \( h \)-Step transition matrix of Markov chain.

3.2. AHP and Fuzzy Comprehensive Evaluation Method

AHP is a direct and effective combination of expert’s opinions and the objective results of scholar’s analysis. By comparing two factors at a certain level, it determines the importance from a quantitative point of view. Then it calculates the weight value of each factor’s importance order by mathematical method. Finally, it ranks the comparative weights of all levels and all factors. Fuzzy comprehensive evaluation method is to transform qualitative evaluation into quantitative evaluation according to the membership degree theory of fuzzy mathematics, that is, to make an overall evaluation of things or objects constrained by various factors with fuzzy mathematics. It has the characteristics of clear results and strong systematicness. It can better solve vague and difficult to quantify problems. It is suitable for solving various uncertain problems.

4. Research Design and Empirical Analysis

4.1. Using Markov to Plan Young Teachers in G College

Through the investigation, we can understand the post grade setting of teachers in G College, the distribution of young teachers with professional titles at all levels, and the flow of young teachers with professional titles at all levels. The professional titles of full-time young teachers in G College are senior, intermediate and junior respectively. The number of senior, intermediate and junior teachers in 2018 was 53, 56 and 128, 69, 78 and 83 respectively in 2019, and 21 teachers were lost. According to the flow of young teachers from 2015 to 2017, we take the average: (see Table 1)
Table 1. Flow of young teachers with professional titles in G College.

| classification       | senior title | intermediate title | primary technical job title | quit |
|----------------------|--------------|--------------------|----------------------------|------|
| senior title         | 0.89         | 0                  | 0                          | 0.11 |
| intermediate title   | 0.24         | 0.65               | 0                          | 0.11 |
| primary technical job title | 0.03 | 0.29               | 0.62                      | 0.06 |
| quit                 | 0            | 0                  | 0                          | 1    |

Data Source: personal survey

According to the flow of full-time young teachers in G College over the years, the transfer probability matrix of young teachers is calculated by taking the average value, and then the supply and demand of young teachers in 2019 are predicted by Markov. As can be seen from table 1, 89% of young teachers with senior professional titles in G College are retained and 11% leave their posts every year.

4.2. Planning of Young Teachers in G College

- Initial state vector \( X(0) = (53, 56, 128, 0) \) of full-time young teachers in G College
- From Table 1, the transfer probability matrix \( P = \begin{bmatrix} 0.89 & 0.00 & 0.00 & 0.11 \\ 0.24 & 0.65 & 0.00 & 0.11 \\ 0.03 & 0.29 & 0.62 & 0.06 \\ 0 & 0 & 0 & 1 \end{bmatrix} \) is obtained.
- Forecast the number of full-time young teachers with professional titles at all levels in 2019

\[
\text{State Vector of Young Teachers in 2018 } X(1) = X(0) \times P = \begin{bmatrix} 0.89 & 0.00 & 0.00 & 0.11 \\ 0.24 & 0.65 & 0.00 & 0.11 \\ 0.03 & 0.29 & 0.62 & 0.06 \\ 0 & 0 & 0 & 1 \end{bmatrix} \times (53, 56, 128, 0) = (65, 74, 79, 20)
\]

Markov predicts that in 2019, there will be 65, 74, 79 full-time young teachers with senior, intermediate and junior professional titles in G College, and 20 resigned teachers.

4.3. Determining the Evaluation Index of Young Teachers' Teaching Ability

In order to ensure the scientificness and operability of the research process, this study solicits the opinions of education experts, G college managers and excellent teachers, so as to get the weight of the judgement indicators. Specific process:

- Establishing Hierarchical Structure Model
- Constructing Judgment Matrix
- Calculate the weight vector and get the weight value
- Hierarchical importance ranking to determine the weight of evaluation index (see Table 2)

Table 2. Evaluation index of young teachers’ teaching ability in G College.

| evaluation content of young teachers teaching ability in G College | first-level indicators | weight coefficient | secondary indicators | weight value |
|------------------------------------------------------------------|------------------------|-------------------|----------------------|-------------|
| U_1 teaching attitude                                           | 0.1752                 |                   | C_1-preparing textbooks | 0.3101      |
|                                                                 |                        |                   | C_2-ready for students | 0.3192      |
|                                                                 |                        |                   | C_3-prepare for class  | 0.1898      |
|                                                                 |                        |                   | C_4-instructional design | 0.1809     |
|                                                                 |                        |                   | C_5-relevance to practice | 0.3508     |
|                                                                 |                        |                   | C_6-times and advancement | 0.3505     |
|                                                                 |                        |                   | C_7-analysis of important and difficult points | 0.2987     |
| U_2 content of courses                                          | 0.3301                 |                   | C_8-innovation and applicability | 0.4447      |
| U_3 teaching method                                             | 0.3144                 |                   | C_9-interactive effect | 0.4028      |
|                                                                 |                        |                   | C_10-utilization of resources | 0.1525     |
4.4. Fuzzy Comprehensive Evaluation of the Overall Level of Young Teachers’ Teaching Ability

4.4.1. Determining the Weight Set of Evaluation Indicators

According to table 2: \( W = (0.1752, 0.3301, 0.3144, 0.1803) \)

\( W_1 = (0.3101, 0.3192, 0.1898, 0.1809) \)

\( W_2 = (0.3508, 0.3505, 0.2987) \)

\( W_3 = (0.4447, 0.4028, 0.1525) \)

\( W_4 = (0.2627, 0.2283, 0.2023, 0.1599, 0.1468) \)

4.4.2. Determine the evaluation grade

\( V = (V_1, V_2, V_3, V_4, V_5) = \langle \text{excellent, good, qualified, unqualified, poor} \rangle \)

\( = (90, 80, 65, 50, 30) \)

Table 3. Evaluation table of young teachers’ teaching ability in G College.

| evaluation content | first-level indicators | secondary indicators | excellent | good | qualified | unqualified | poor |
|--------------------|------------------------|----------------------|-----------|------|-----------|------------|------|
| U_4 teaching services | 0.1803 | C_1 | 6 | 2 | 2 | 0 | 0 |
| | | C_2 | 7 | 2 | 1 | 0 | 0 |
| | | C_3 | 6 | 2 | 2 | 0 | 0 |
| | | C_4 | 7 | 1 | 2 | 0 | 0 |
| | | C_5 | 5 | 2 | 2 | 1 | 0 |
| | | C_6 | 3 | 4 | 2 | 1 | 0 |
| | | C_7 | 8 | 1 | 1 | 0 | 0 |
| | | C_8 | 7 | 2 | 1 | 0 | 0 |
| | | C_9 | 8 | 2 | 0 | 0 | 0 |
| | | C_10 | 6 | 2 | 2 | 0 | 0 |
| | | C_11 | 5 | 2 | 2 | 1 | 0 |
| | | C_12 | 7 | 2 | 1 | 0 | 0 |
| | | C_13 | 6 | 2 | 1 | 1 | 0 |
| | | C_14 | 6 | 2 | 2 | 0 | 0 |
| | | C_15 | 4 | 4 | 1 | 1 | 0 |

4.4.3. Computing Fuzzy Relation Submatrix \( R_s \) and Total Matrix \( R \) (Take \( U_3 \) teaching method as an example)

- According to the \( U_3 \) corresponding data in Table 3, the fuzzy evaluation matrix is obtained.

\[
R_3 = \begin{bmatrix}
0.7 & 0.2 & 0.1 & 0 & 0 \\
0.8 & 0.2 & 0 & 0 & 0 \\
0.6 & 0.2 & 0 & 0 & 0
\end{bmatrix}
\]

- Matrix Computation: \( S_3 \cdot W_3 \cdot R_3 = \langle 0.4447, 0.4028, 0.1525 \rangle \cdot \begin{bmatrix}
0.7 & 0.2 & 0.1 & 0 & 0 \\
0.8 & 0.2 & 0 & 0 & 0 \\
0.6 & 0.2 & 0 & 0 & 0
\end{bmatrix} \]

\( = \langle 0.7250, 0.2000, 0.0750, 0.0 \rangle \)

- By calculating \( S_1, S_3 \) and \( S_4 \) in the same way, the conclusion is drawn.

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4
4.4.4. Normalization and Fuzzy Comprehensive Evaluation Vector

\[
R = \begin{bmatrix}
S_1 \\
S_2 \\
S_3 \\
S_4
\end{bmatrix} = \begin{bmatrix}
0.6500 & 0.1819 & 0.1681 & 0 & 0 \\
0.5195 & 0.2402 & 0.1701 & 0.0701 & 0 \\
0.7250 & 0.2000 & 0.0750 & 0 & 0 \\
0.5672 & 0.2294 & 0.1423 & 0.0612 & 0
\end{bmatrix}
\]

\[S = W^T R = (0.1752, 0.3301, 0.3144, 0.1803)^T \cdot \begin{bmatrix}
0.6500 & 0.1819 & 0.1681 & 0 & 0 \\
0.5195 & 0.2402 & 0.1701 & 0.0701 & 0 \\
0.7250 & 0.2000 & 0.0750 & 0 & 0 \\
0.5672 & 0.2294 & 0.1423 & 0.0612 & 0
\end{bmatrix} = (0.6156, 0.2154, 0.1348, 0.0342, 0)
\]

4.4.5. Total score of fuzzy comprehensive evaluation
\[=(90, 80, 65, 50, 30) \cdot (0.6156, 0.2154, 0.1348, 0.0342, 0) = 83.1080\]

5. CONCLUSION

The prediction results in 2019 are 65, 74, 79 and 20. Compared with the actual data 69, 78, 83 and 21, the prediction errors are 5.8%, 5%, 4.8% and 4.8%, respectively. The errors are less than 6%, which can be predicted by this model. However, because there are many and complex factors affecting the flow of young teachers in independent colleges, it is not only based on data results, but also based on the actual situation of independent colleges. The empirical result of 83.1080 shows that young teachers in G College have medium teaching ability, and need to cultivate and improve their comprehensive teaching ability in many aspects. Fuzzy comprehensive evaluation method divides the comprehensive evaluation grade of young teachers' teaching ability from the qualitative point of view. Young teachers themselves and the administrators of G College can have clear goals and take corresponding measures to improve the comprehensive teaching level of young teachers.

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