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Evaluation Method of Ideological and Political Classroom Teaching Quality Based on Analytic Hierarchy Process

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Abstract: Political and theoretical education forms the core of socialist development, with Graduate medical education serving as vital arenas for talent cultivation and educational advancement. As practical skills gain prominence in educational curricula, it's imperative to enhance the quality of ideological and political instruction. Presently, there's a lack of standardized evaluation criteria for such courses. This study addresses key issues in ideological and political education at the university level and proposes a systematic evaluation framework. Through the analytic hierarchy process, we established an assessment system tailored to the root causes of teaching deficiencies. Survey results indicate that 78% of students appreciate teaching methods that foster active engagement, while 57% feel encouraged to think critically and pursue autonomous learning. These findings underscore the effectiveness of ideological and political instruction.

1. Introduction

In today's competitive landscape, a nation's strength relies heavily on nurturing talent and fostering ideological education within academic institutions. Crucially, a fair evaluation system with relevant metrics is imperative for effective ideological education, not only serving as a benchmark for research but also promoting interdisciplinary connections. Assessing teacher effectiveness entails measuring instructional outcomes, including meeting educational objectives and students' acquisition of knowledge, skills, and values, while considering their readiness for societal integration and employment post-graduation. Refinement of evaluation criteria for ideology and political theory courses in higher education is essential, guiding moral education activities within institutions. However, the current evaluation system lacks a scientifically sound model, which could be rectified through the implementation of the Analytic Hierarchy Process (AHP), thereby establishing a robust sociological quality control rating system. Such measures would not only advance intellectual and political education but also support college students' engagement in ideological and political discourse.

2. Related Work

Cultural and political education is crucial for achieving educational objectives. Wu X discussed the relationship between blended learning and ideology using the "Campus English" school as an example [1]. Chen integrated ideology into degree program curricula [2]. Pan H introduced teaching strategies for Chemical Engineering Principles alongside ideologies and politics courses [3]. Zhu G explored virtual technology in teaching ideologies and developed a software model [4]. Hou Y developed an AI algorithm for sentiment analysis in philosophical and political classes [5]. However, research on the effectiveness of political instruction remains limited.

Assessing the effectiveness of ideological instruction lacks a thorough evaluation index system. Ls A devised a simulations teaching indicator system using AHP and the Delphi approach [6]. Wan H combined AI guidance with data mining and machine learning to enhance emotional analysis efficiency, proposing an AHP-based quantification method [7]. Jiang L introduced a teaching quality evaluation method based on AHP and neural networks, establishing risk values for safety regulations [8]. Huizhen J optimized an English teaching system using Rough Set Theory and AHP, incorporating diverse examination topics and assessment methods [9]. Zhang J improved teaching effectiveness through smartphone-based analysis [10]. However, there is limited research on the effectiveness of ideologies and politics education using AHP.

3. Teaching Quality Evaluation Method

3.1 Analytic Hierarchy Process (AHP)

AHP, or Analytic Hierarchy Process, is a robust method for determining weights in decision-making [11]. It breaks down complex objects into hierarchical layers, facilitating systematic evaluation. Through sorting at each level, AHP refines decision factors [11]. Decision-making in AHP involves identifying influential factors and assessing their impact on the final choice [12]. The process starts with defining the target goal, followed by criteria, bases, and essential decision factors. Alternatives, factors, and indicators constitute the solution layer. This hierarchical structure guides analysis and computation, as depicted in Figure 1 [13].

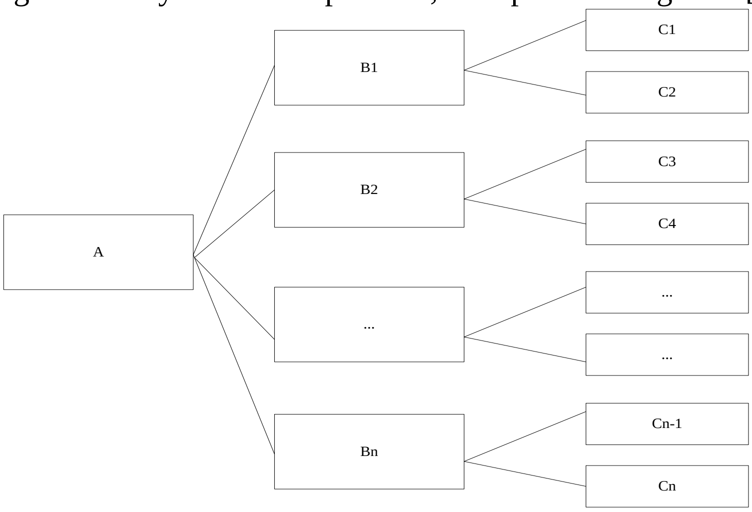

Figure 1: Hierarchy diagram

The selection process of the evaluation index is shown in Figure 2.

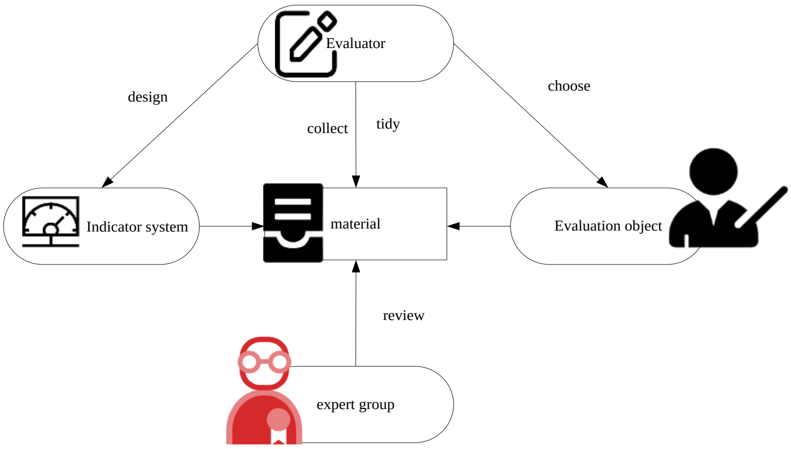

Figure 2: Flow chart of evaluation indicators selection

The researchers used the importance as a metric to quantify it using the comparison results of the hierarchical proportions, as shown in Table 1.

Table 1: Schematic representation of importance

importance	definition	introduce
1	equally important	Indicates that two factors are compared and have equal importance
3	slightly important	Indicates a comparison of two factors, one being slightly more important than the other
5	obviously important	Indicates a comparison of two factors, one being significantly more important than the other
7	Very important	Indicates a comparison of two factors, one being much more important than the other
8	extremely important	Indicates a comparison of two factors, one being extremely important than the other
2, 3, 6, 8	in between	between the above two adjacent judgments

After assigning values according to the scale table, it forms a matrix form. It is the judgment matrix shown in Table 2, that is, the positive and negative matrix.

Table 2: Judgment matrix

M_k	X_1	X_2	...	X_m
X_1	x_{11}	x_{21}	...	X_{m1}
X_2	x_{21}	x_{22}	...	X_{m2}
...	...	...	...	...
X_n	X_{n1}	X_{n2}	...	X_{nm}

That is to say, according to a certain standard, the weight of each factor is judged and tested. It is assumed that there is a condition, and the weight vector of each element is:

$$M = (M_1, M_2, ..., M_m)^R \tag{1}$$

M can be obtained by solving the equation shown in Formula (2):

$$XM = \lambda_{max} M \tag{2}$$

In Formula (2), λ_{max} is the largest eigenvalue of the matrix.

$$W_a = \prod_{b=1}^{m} x_{ab}(a,b=1,2,...,m) \tag{3}$$

The m-th root of W_a is computed: $\tilde{M}_a = \sqrt[m]{W_a}$.

Vector $\tilde{M} = \left(\tilde{M}_1, \tilde{M}_2, ..., \tilde{M}_m\right)^R$ is normalized.

$$M_a = \tilde{M}_a / \sum_{b=1}^{m} \tilde{M}_b (a,b=1,2,...,m) \tag{4}$$

Vector $M = (M_1, M_2, ..., M_m)^R$ is the obtained vector weight. According to the largest eigenvalue of the judgment matrix, the calculation of λ_{max} is:

$$\lambda_{max} = \frac{1}{m} \sum_{a=1}^{m} (XM)_a / M_a \tag{5}$$

Among them, *a* represents the *a*-th element of the vector *XM*.

$$CI = \frac{\lambda_{max} - m}{m-1} \tag{6}$$

$$CR = \frac{CI}{RI} \tag{7}$$

If CR falls below 0.1, reassessment is needed, as it indicates the reliability of the evaluation vector. Lower CR values signify greater correctness in the decision matrix [14]. AHP method quantifies qualitative issues, where eigenvectors play a key role. Therefore, exact precision isn't always necessary, and slight deviations are acceptable. The geometric mean method is commonly used for approximation. By analyzing the comprehensive weight of each element and overall index based on individual rankings, consistency in overall evaluation is achieved, resulting in a comprehensive ranking at one level [15].

In general, in a hierarchy of *m*-level, the combined weight of each factor of *m*-level and exponential level is:

$$M = M_m \bullet M_{m-1} ... M_3 \bullet M_2 M_1 \tag{8}$$

At the same time, a consistency check is also carried out. If it passes, a decision can be made based on its weights, otherwise the model must be reconsidered, or a contrast matrix reconstituted with a considerable proportion of agreement. It is calculated as follows:

It is assumed that the consistency index $CI_1^m, ..., CI_a^m$ of the *m* layer is: *a* is the number of units in the *m*-1 layer, and the random index is $RI_1^m, ..., RI_a^m$, then there are:

$$CI^m = \left[CI_1^m, ..., CI_a^m\right] M^{m-1} \tag{9}$$

$$RI^m = \left[RI_1^m, ..., RI_a^m\right] M^{m-1} \tag{10}$$

In the case where the joint consistency ratio of the scheme layer is $CR^{m} < 0.1$, the overall consistency is verified. In this way, a guideline or scheme can be empowered through the outcome of the classification, and ultimately decisions and choices can be made.

3.2 Fuzzy Comprehensive Evaluation

Fuzzy comprehensive evaluation is a method that evaluates anything from a variety of criteria (indicators) utilizing fuzzy correlation degree [16]. The factor universe V and the rank universe U of the object being judged are determined:

$$V = \{v_1, v_2, \ldots, v_m\} \tag{11}$$

$$U = \{u_1, u_2, \ldots, u_m\} \tag{12}$$

One-factor judgment is made, and the fuzzy relation matrix T is constructed:

$$T = \begin{bmatrix} t_{11} & t_{12} & \cdots & t_{1n} \\ t_{21} & t_{22} & \cdots & t_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ t_{m1} & t_{m2} & \cdots & t_{mn} \end{bmatrix}, 0 \le t_{ab} \le 1 \tag{13}$$

Among them, t_{ab} is the affiliation of factor v_a in V to level u_a in V. The evaluation factor weight vector X is determined. X is the dependence of each element in V on the evaluation object, and it depends on the focus that people pay attention to when conducting fuzzy comprehensive evaluation, that is, the weight distribution of each element during evaluation. After synthesizing X and T, there are:

$$Y = \{y_1, y_2, \ldots, y_m\} \tag{14}$$

$$Y = X \bullet T = (x_1, x_2, \ldots, x_m) \bullet \begin{bmatrix} t_{11} & t_{11} & \cdots & t_{1n} \\ t_{21} & t_{22} & \cdots & t_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ t_{m1} & t_{m2} & \cdots & t_{mn} \end{bmatrix} \tag{15}$$

$$y_b = (x_1 \bullet t_{1b}) \dot{+} (x_2 \bullet t_{2b}) \dot{+} \cdots \dot{+} (x_m \bullet t_{mb}), b = 1,2,\ldots, n \tag{16}$$

Finally, Y is subjected to the mushy exhaustive assessment. The phase with the highest total attribute values is typically utilized as the systematic analysis of the review in following the rule of optimum class labels.

3.3 Comprehensive Evaluation of Levels

AHP, derived from the Analytic Hierarchy Process (AHP), effectively handles complex evaluation tasks by dividing them into hierarchical levels and determining weights for factors. It resolves challenges such as managing numerous factors and determining their importance. By stratifying decision problems and using a comprehensive fuzzy appraisal approach, it evaluates lower-level factors and integrates them with upper-level assessments to derive overall results.

The factor universe V that determines the determined target is divided into e sub-sets according to specific properties:

$$V = \{V_1, V_2, ..., V_e\} \tag{17}$$

Among them, there are:

$$V_a = \{V_1^{(a)}, V_2^{(a)}, ..., V_{n_a}^{(a)}\},\ a = 1,2,...,e \tag{18}$$

The weight vector is calculated and checked for consistency, and the distribution of the weights of each factor in V_a is set to $X_a = \{X_1^{(a)}, X_2^{(a)}, ..., X_{n_a}^{(a)}\}$. Among them, $\sum_{a=1}^{n_a} x_r^{(a)} = 1$; the comment level domain U is determined, and $U = \{U_1, U_2, ..., U_m\}$.

From the factor set T_a, comprehensive decisions are made respectively, and the fuzzy relationship matrix is obtained:

$$T_a = \begin{Bmatrix} t_{11}^{(a)} & t_{12}^{(a)} & \cdots & t_{1n}^{(a)} \\ t_{21}^{(a)} & t_{22}^{(a)} & \cdots & t_{2n}^{(a)} \\ \cdots & \cdots & \cdots & \cdots \\ t_{m1}^{(a)} & t_{m2}^{(a)} & \cdots & t_{mn}^{(a)} \end{Bmatrix} \tag{19}$$

For each X_a, a comprehensive judgment is performed separately to obtain the first evaluation vector.

$$Y_a = X_a \bullet T_a = (y_{a1}, y_{a2}, ..., y_{am}), a = 1,2,...,e \tag{20}$$

$$T = \begin{bmatrix} Y_1 \\ Y_2 \\ \cdots \\ Y_e \end{bmatrix} = \begin{bmatrix} y_{11} & y_{12} & \cdots & y_{1m} \\ y_{21} & y_{22} & \cdots & y_{2m} \\ \cdots & \cdots & \cdots & \cdots \\ y_{e1} & y_{e2} & \cdots & y_{em} \end{bmatrix} \tag{21}$$

Each X_a as part of V responds to some X characteristic. Its weight can be determined according to its importance:

$$X = \{x_1, x_2, ..., x_m\} \tag{22}$$

The quality assessment database serves as the foundation for the assessment scheme, overseeing the management of comment sets and indicators. Tasks include adding, deleting, modifying, and verifying indicators. The evaluation plan, derived from project database evaluation, involves a hierarchical process of selecting indicators from a library, as illustrated in Figure 3. The weighting method is the 1-9 scale method. First, the indicators at each level are compared and judged for their importance, and a 1-9 scale method is used to construct a judgment matrix. If it passes the test, the feature vector (normalized) is a weight vector; if it fails, the two comparison matrices need to be reconstructed to form a decision matrix. The weighting assistance flow chart is shown in Figure 4.

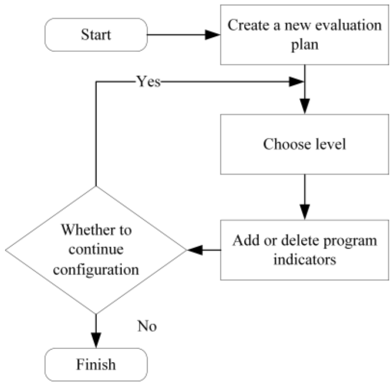

Figure 3: Flow chart of developing an evaluation plan

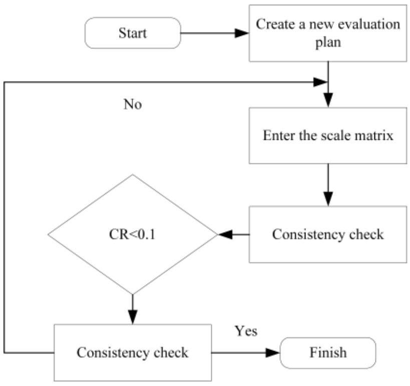

Figure 4: Weight assist flowchart

The thorough grading of tertiary indications C1–C6 is calculated and a holistic analysis model evaluating quality of instruction is built by creating the excellent reviews testing system depicted in Figure 5.

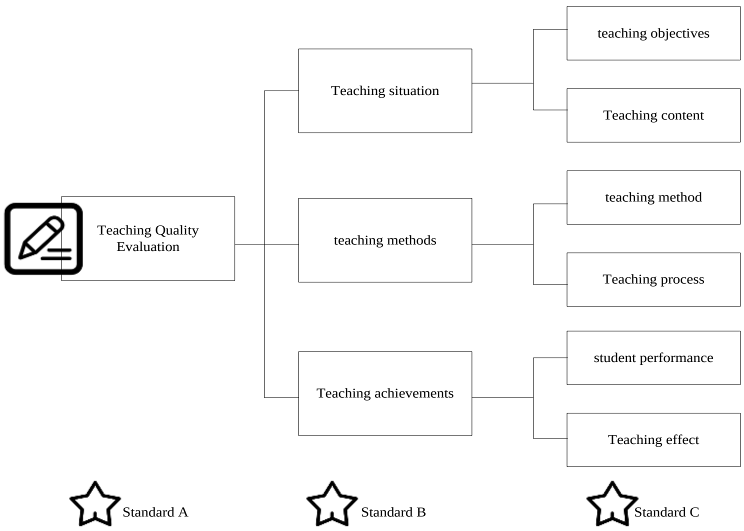

Figure 5: Evaluation indicators of ideological and political classroom teaching

4. Evaluation of the Teaching Quality of Ideological and Political Teaching

4.1 Data Preparation before Experiment

Teaching evaluation encompasses internal and external assessments, including teacher performance, student proficiency, and oversight. External evaluation, crucial for educational management, stems from societal and familial scrutiny. By consolidating internal and external monitoring data, schools can promptly identify teaching management issues and implement corrective measures. To engage parents, regular seminars can be held to gather feedback and share teaching insights. The activity was conducted by asking for surveys and issuing them to school students in a random way. 250 questions were distributed, 200 of which were valid. In the valid questionnaires, the proportions of boys and girls were 55% and 45%, respectively.

4.2 Evaluation of the Teaching Situation of Ideological and Political Classroom Teaching

Teaching goals in thought and policy courses aim to enhance students' understanding and application of concepts, guided by Marxist principles to meet modern societal needs. Evaluation criteria inform student assessments, with results displayed in Figure 6.

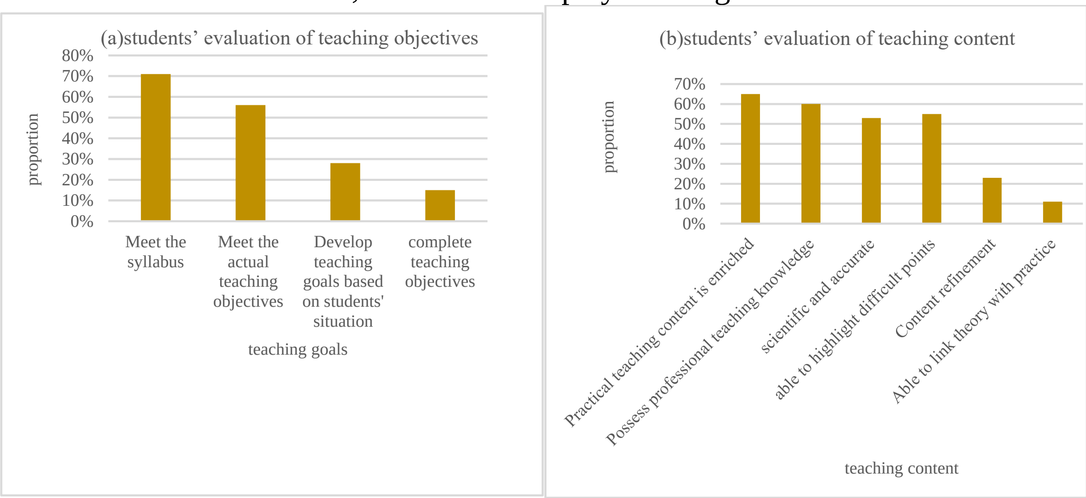

Figure 6: Students' evaluation of teaching objectives and teaching content

In Figure 6(a), 71% of students believe that the course objectives are consistent with the curriculum, while 56% of students think they align with the actual teaching objectives. 28% of teachers feel capable of tailoring objectives for individual students, and 15% of teachers view ideological and political education merely as a means to achieve teaching objectives. Regarding the teaching content in Figure 6(b), 65% of respondents find it rich in practicality, and 60% consider it professionally strong. 53% believe the content is scientifically accurate, and 55% think the key points are effectively highlighted. Only 23% find the content concise, and 11% perceive a strong connection between theory and practice. Improving the quality of ideological and political education requires aligning content with student needs. Proficiency in teaching specialized knowledge is divided into primary and advanced levels, as illustrated in Figure 7.

Figure 7(a) displays students' assessment of teachers' teaching methods. 57% found the methods inspiring and skill-building, 54% considered them aligned with teaching theory, and 50% felt they catered to students' abilities. In Figure 7(b), 78% felt their subjectivity was encouraged, and 73% noted a harmonious teaching atmosphere.

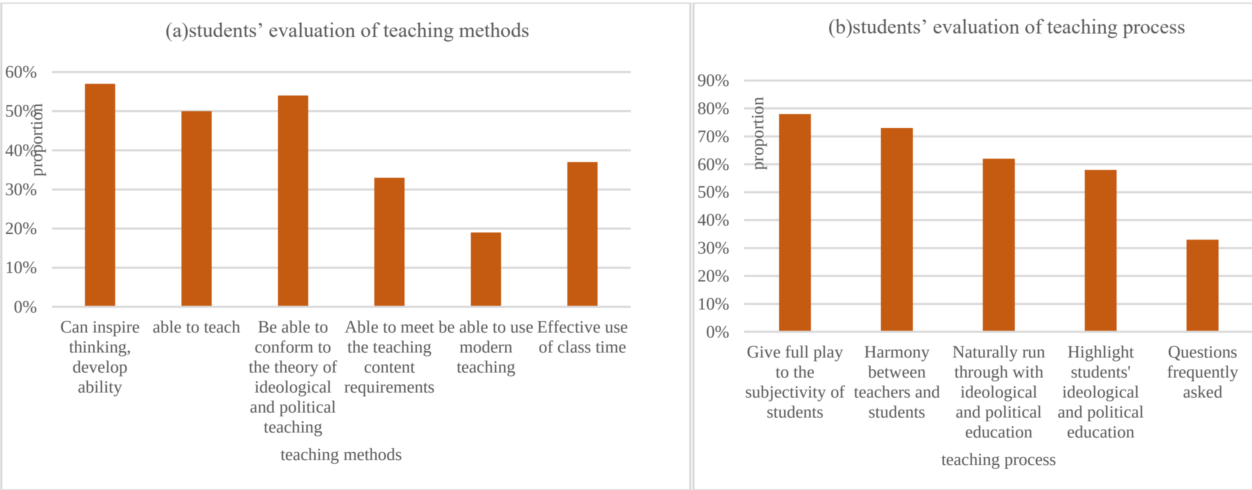

Figure 7: Students' evaluations of teachers' teaching methods and teaching process

4.3 Evaluation of the Teaching Effect of Ideological and Political Classrooms

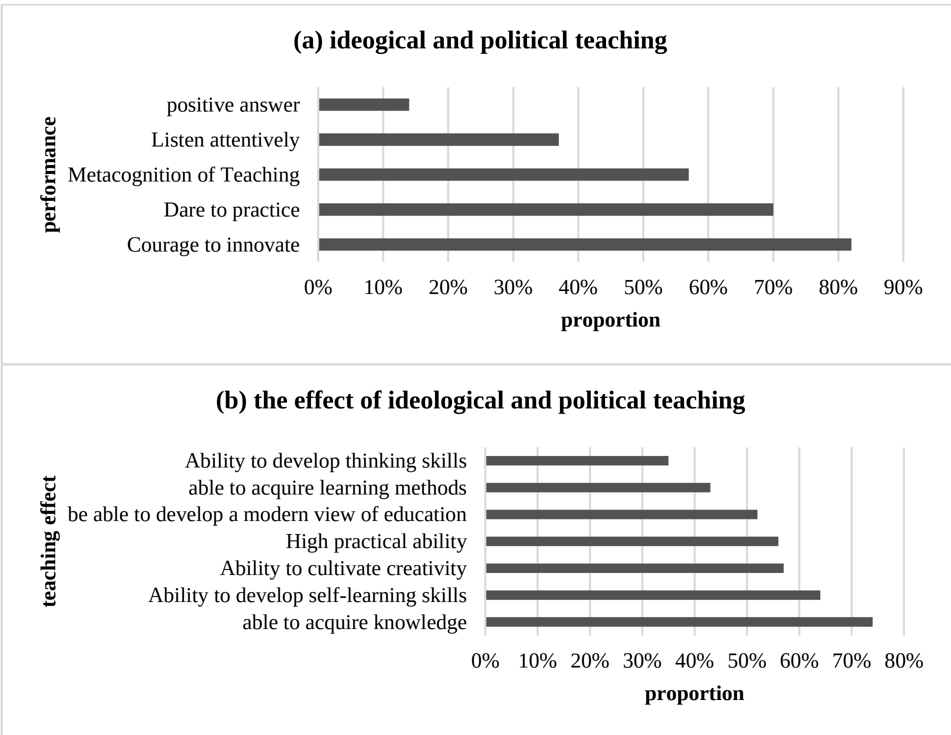

Figure 8: Analysis of teaching effectiveness through student performance

Figure 8(a) displays students' academic performance in ideological and political courses. 82% exhibited innovation courage, with 70% demonstrating practical boldness. In Figure 8(b), 74% mastered knowledge, 64% engaged in autonomous learning, and 57% enhanced creative abilities. The efficacy of ideological and political education hinges on addressing key challenges in socialist development, guiding individuals positively on a spiritual level.

5. Conclusions

In the modern era, establishing an education analysis indicator system for ideology and political theory classes is vital for improving moral education. This paper introduces a streamlined assessment index system aimed at evaluating teaching quality in these courses. It considers classroom and practical teaching, combining subjective and objective factors to ensure comprehensive assessment. Each indicator is clearly defined for practical use, based on scientific data and calculations to enhance operability.

Acknowledgement

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