

The Application of Analytic Hierarchy Process Method in the Evaluation of Educational Quality in Colleges and Universities

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Abstract: Talent quality is the lifeline of colleges and universities. Based on employment guidance, this paper establishes a student quality evaluation and control system including knowledge, moral character, and ability, and uses the Analytic Hierarchy Process (AHP) method to analyze the factors affecting the quality of education in colleges and universities. In addition, some suggestions are provided to improve the quality of students.

Keywords: Student quality; Knowledge; Ability; Literacy

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1. Introduction

Colleges and universities are an important part of China's higher education. They shoulder the task of cultivating senior application-oriented professionals who support the basic line of the Party and meet the needs of production, construction, management, and service in the aspects of morality, intelligence, sports, and beauty. All the teaching and administrative staff of colleges and universities have the important responsibility of conducting ideological education for college students. How to integrate education work into all aspects of school work is an important topic to be constantly explored by the majority of educators. This paper surveys administrators, teachers, and students and then employs the Analytic Hierarchy Process (AHP) to analyze factors affecting the quality of college education. By identifying the primary factors influencing educational quality from various indicators, the study aims to guide staff in focusing on these key factors, thereby enhancing the effectiveness of education.

2. Literature review

Alumni surveys began in the 1920s. In the 1970s, a large number of complete survey services appeared. In the

late 1980s, many states issued orders to prove the achievements of kilometer universities, and alumni surveys became more popular and rigorous. With the continuous upgrading of educational reforms in colleges and universities, there are increasingly more studies on the evaluation methods of talent cultivation quality, which have played a pivotal role in specific periods and fields. Foreign countries began to conduct research on the issue of talent cultivation quality evaluation as early as the end of the last century ^[1-3]. The focus of foreign studies mainly concentrates on aspects such as the standards for measuring talent cultivation quality, the evaluation system, and the quality of teaching work. They suggest that a talent cultivation quality evaluation system that satisfies both qualitative and quantitative analysis should be established by taking advantage of the multi-disciplinary intersection from multiple dimensions and aspects. Appropriate comprehensive assessments can be made from the perspectives of stakeholders, teaching staff, and university infrastructure. Domestic-related studies mainly analyze the talent cultivation quality evaluation system of scientific research-oriented public colleges and universities ^[4-10]. They have explored how to improve the talent cultivation quality evaluation system in Chinese colleges and universities and how the evaluation indicators are established. They have also conducted certain evaluation cases on talent cultivation quality using some qualitative analysis methods, and have researched the talent cultivation model of private colleges and universities and the construction and monitoring system of undergraduate talent cultivation quality.

2.1. Overview of the hierarchical analysis method

The Analytic Hierarchy Process (AHP) was proposed by American operations researcher Professor Sartre at The University of Pittsburgh in the early 1970s to decompose the elements always related to decision-making into goals, guidelines, programs, and other levels, based on qualitative and quantitative analysis. Tomographic analysis is a standardized and quantitative method of making people's thinking processes and subjective judgments. It can reduce many uncertain factors greatly, which not only simplifies the system analysis and calculation work but also helps the decision-makers to maintain the consistency of their principles in the thinking process and decision-making process. For those complex management problems that are difficult to fully quantify, relatively satisfactory decision results can be obtained, so it is a scientific method to determine the weight ^[11]. Hierarchical analysis is mainly used to analyze the relative importance weight or relative quality order of the highest-level total goal in the multi-level structure model. The method is suitable for decision-making on multi-criterion, multi-objective complexity problems.

2.2. Basic principles

The AHP method mathematically systemizes the thinking process, so that the decision-making basis is easily accepted. This method has little demand for quantitative information, but decision-makers must thoroughly master the nature of decision-making problems, the included system elements, and their logical relationship. Meanwhile, the AHP method is more applicable to unstructured system evaluation and multi-objective decision-making problems. In practical application, the most important factors can be compared according to the established evaluation factors, establish the evaluation matrix, and find the eigenvector value to determine the most important factors.

2.3. Main steps

The AHP method leverages human analytical judgment and comprehensive skills to break down complex problems into multiple factors and construct a multi-level model. It involves comparing the relative importance of these factors to assess their significance and determine their relative weight through a comprehensive evaluation process ^[12]. When using AHP method, it can be divided into the following four steps:

- (1) Establishing a hierarchical structure model: The correlation and subordination of the factors involved in the target system are analyzed and divided into different levels to build an orderly ladder hierarchical structure model.
- (2) Constructing the judgment matrix: According to the hierarchical structure model, the judgment matrix is constructed layer by layer from top to bottom, and the judgment matrix is constructed by pairwise comparison of the 1–9 scale method. According to the ratio between adjacent factors, 1, 3, 5, 7, 9 respectively represent the ratio of factors i and j , that is, generally important, slightly important, strong, and especially important, while 2, 4, 6, 8 respectively represent the judgment value of factors between different levels.
- (3) Level of single ranking and consistency inspection: To solve the maximum eigenvalue and the corresponding eigenvector of the judgment matrix, the hierarchical single-ranking weight vector is obtained after normalization. As the results of the judgment matrix have a certain objectivity, the consistency test analysis is needed.
- (4) Overall ranking of the levels: The composite weight of the total target of the system is calculated from top to bottom, and the ranking results of the factors on the overall target are obtained.

3. Construction of the student quality evaluation index system

3.1. The principle of determining the index system

The scientificity and rationality of the student quality index system are directly related to the reliability of the student's quality evaluation, so the selection of indicators must be carried out under the guidance of relevant principles, which are as follows:

- (1) Purpose requirements: The purpose of quality evaluation is to investigate the degree of college students and individuals on the scale of talent quality, and to test the success or failure of the content, means, and curriculum system of university education, so as to promote the healthy development of higher education.
- (2) Adaptability requirements: The quality of talent quality is finally tested by society. Whether it can adapt to the characteristics and development trends of the times is certainly an important standard to measure the quality of talent.
- (3) Structural requirements: The quality of talents can be reflected in the three levels of moral character, ability, and knowledge. The index system must reflect the inevitable connection between moral character, ability, and knowledge, and reflect the differences of different structures.
- (4) Operability requirements: The indicators in the index system can be actually observed, measured, or tested, summarize all aspects of the evaluated individuals, and draw clear conclusions or get in line with the actual index score.

3.2. The hierarchical structure of college student quality

According to the principle of index system determination, after in-depth analysis and demonstration of the different composition levels of student quality from the micro level, hierarchical analysis methods are decomposed, according to the interconnection and membership of various factors, and aggregated into an orderly hierarchical structure. This is the general system of college student quality assessment, as shown in layers A–D in **Figure 1**. From **Figure 1**, in this hierarchical analysis model, layer A is the ultimate target layer, that is, achieving the best quality of students is taken as the ultimate goal. Level B is the middle target layer, respectively for moral character, ability, and knowledge. Layers C and D are the student quality element layer

and the basic element layer respectively, while Layer E is the influencing factor layer. The AHP method is used to analyze and evaluate the quality of students, which involves five levels and contains complicated data. At the same time, because the calculation methods of different levels are inconsistent, we use computer programs, while the total ranking weight and the total consistency test are calculated by Excel. The calculation results of the total ranking weight of the final target layer are presented in **Table 1**. Factors influencing student quality are faculty, educational resources, educational environment, teaching management, curriculum, practical activities, and school status management. The total ranking of the weight to the final target layer is 0.202081 for teaching staff, 0.369936 for curriculum provision, 0.190775 for teaching management, 0.111748 for educational environment, 0.054326 for practical activity, 0.044409 for educational resources, and 0.023168 for student status management.

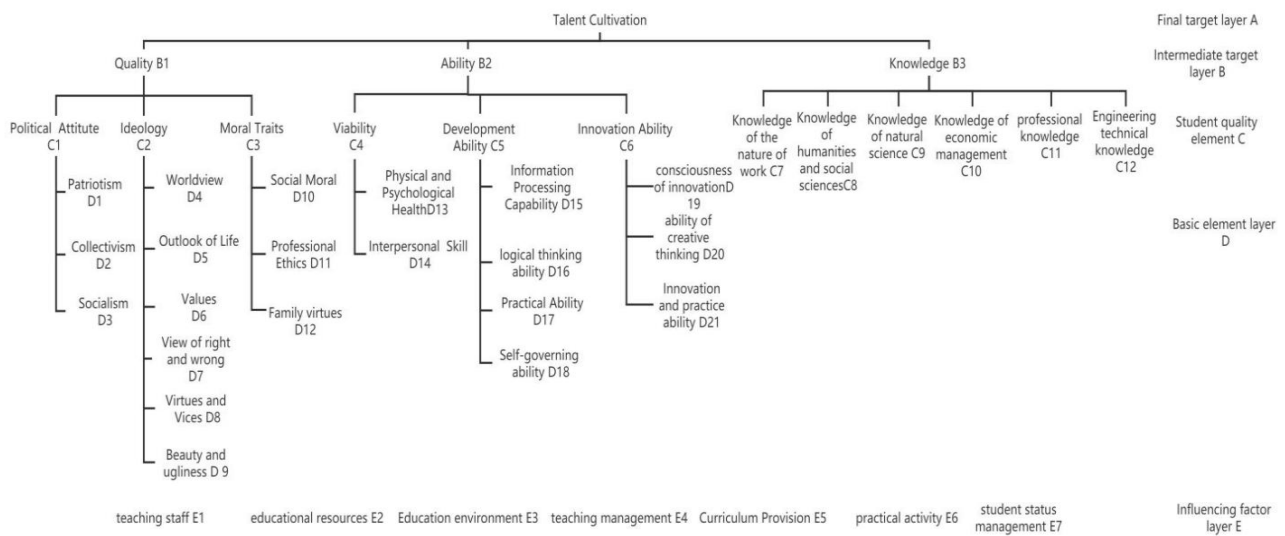


Figure 1. Student quality hierarchical structure

Table 1. Total sort weight of layer D

Layer D	Total sort weight	Layer D	Total sort weight
D1	0.2451	D12	0.00324
D2	0.029582	D13	0.029
D3	0.14791	D14	0.0051
D4	0.02268	D15	0.0198
D5	0.02268	D16	0.0198
D6	0.02268	D17	0.0198
D7	0.004455	D18	0.0396
D8	0.004455	D19	0.05985
D9	0.004455	D20	0.01197
D10	0.020736	D21	0.0198
D11	0.008424		

4. Countermeasures to improve students' quality

4.1. Building high-level teaching staff

Among the many influencing factors, teachers are undoubtedly one of the key factors affecting the quality of education and students. This requires colleges and universities to establish a set of effective measures and methods from the introduction of talents, teacher training, teaching supervision, and rules and regulations construction, so as to meet the requirements of building a high-level teacher team. In order to ensure the overall quality of teachers, on the one hand, we must ensure the level of introduced teachers. Colleges and universities must strictly enforce the appointment system, and further improve and strengthen the university teacher qualification certificate system. For example, we can take the lead in implementing the system of applying for college teacher qualification certificates in some key disciplines and traditional disciplines. In addition, scientific and feasible conditions for the evaluation and employment of university teachers should be formulated to attract outstanding talents to join the faculty of universities. On the other hand, the development of society and the economy puts forward higher and higher requirements for talent, and the requirements for the level of college teachers are also improved. Therefore, the importance of on-the-job training and education for college teachers is becoming increasingly prominent. The 2003–2007 Action Plan for Education Revitalization issued by the Ministry of Education in 2004 stipulates that six key projects will be carried out in the next five years. In fact, improving the teacher education and lifelong learning system is also an important part of the “high-quality teachers and management team construction project” in the “six major projects” proposed by the Ministry of Education. Education decision-making departments and leaders of colleges and universities must attach great importance to teacher training from a strategic height to ensure that the funds for teacher training are in place. They need to strive to be scientific and reasonable in the use of funds and adopt different types of fund input methods in different training categories. In order to ensure the quality of training, it is necessary to establish a teacher education quality assurance system. It includes the formulation of an on-the-job training plan, the selection of teaching content, the evaluation of training effect, the examination and approval of relevant training qualifications and the issuance of certificates, and the monitoring system of teacher education quality composed of the society.

4.2. Meeting the social needs and improving the curriculum

A scientific curriculum setting is conducive to meeting the needs of the all-round development of talents, adjusting the students' knowledge structure, and promoting the coordinated development of students' scientific and humanistic quality. For a long time, the undergraduate curriculum system in Chinese colleges and universities has been rigid, focusing predominantly on subject-specific knowledge. This approach emphasizes specialization, depth, and the intricacies of individual majors while often neglecting the breadth of disciplines and interdisciplinary integration. As a result, graduates tend to have a narrow range of knowledge and limited social adaptability. In the market economy era, the demand for talent has fundamentally shifted towards a more diverse, multi-specification, multi-type, and multi-level landscape. This evolution necessitates a broader knowledge base and stronger adaptability and development skills in professionals. Consequently, the curriculum system needs to evolve from a rigid “subject-based” model to a “quality-based” framework that emphasizes the integration and imparting of knowledge, the cultivation of skills, and the enhancement of overall quality.

4.3. Strict teaching management and enhancing teaching quality

Institutions of higher learning undertake the social, economic, and cultural development of senior specialized personnel, carry out scientific research, and engage in social services and other functions; but the basic function and fundamental task of all types of higher learning is to cultivate talents, and the cultivation of talents cannot

be separated from teaching, so the teaching work is the center of school work. Teaching work is a complex process of multi-series, multi-link, and multi-factor synthesis. In order to ensure the implementation of teaching work according to the plan and complete various teaching tasks with high quality and efficiency, the school must implement strict and effective management of teaching work. In the management of the entire school, teaching management plays a particularly important position in the management of institutions of higher learning, which is in the core position. Effective management of teaching work ensures the establishment of a structured teaching environment, orderly work processes, and a well-organized daily routine. This enhances teaching quality and fosters students' good behavioral habits, contributing to their overall development and healthy growth. High-level teaching management is helpful to realize scientific and standardized teaching in institutions of higher learning, improve the teaching quality and educational efficiency, and ensure the realization of the goal of talent training in institutions of higher learning. Scientific teaching management is reflected in several key aspects: assessing the current situation, understanding the professional setting, and making timely adjustments to non-urgent majors; defining the teaching content based on actual needs and possibilities; revising and improving teaching management rules and regulations; enhancing teaching evaluation processes; and advancing the modernization of management methods.

4.4. Beautifying the campus environment and playing the function of education

Strengthening the construction of campus culture and optimizing the education environment is an important way to implement moral education and improve the moral cultivation of college students. The rich cultural atmosphere and beautiful educational environment reflect the cultural accumulation and heritage of a school, which not only plays a good role in regulating students' study, life, and psychology but also plays a subtle role in regulating their behavior habits and promoting the improvement of their overall quality. Therefore, it is essential to cultivate a positive campus spirit, foster harmonious interpersonal relationships, enhance the campus environment, and fully realize the educational function.

4.5. Carrying out practical activities to improve students' ability

The teaching process of higher education is the organic combination of theoretical and practical teaching systems. Theoretical teaching is the main source for students to acquire basic knowledge and theories, and it is the basic support point for cultivating students' thinking, analytical skills, and problem-solving skills. Practical teaching is the primary means to learn to obtain practical operation skills, which is conducive to cultivating students' innovative spirit and practical skills. Therefore, to improve the quality of students, we must strengthen the experiment, practical teaching, curriculum design (thesis), graduation design (thesis), and other teaching links.

4.6. Increasing investment in education and making full use of existing resources

The fundamental condition for running schools effectively is ensuring that educational resources—particularly the hardware—are adequate, which is crucial for maintaining high-quality higher education. At present, in addition to the national key institutions of higher learning, the running conditions of the provincial, local, and municipal level institutions of higher learning are generally insufficient under the pressure of enrollment expansion. Therefore, expanding financing channels to strengthen hardware infrastructure and optimizing resource allocation are key focuses for improving student quality. First of all, it is the responsibility of governments at all levels and educational administrative departments to strengthen macro-regulation and control by formulating policies and give full play to the overall benefits of educational resources. Secondly, it is necessary to effectively transform the mechanism, improve the schools' management efficiency, improve the

comprehensive utilization rate of school educational resources, and provide resource guarantees for improving the quality of students. Thirdly, education should cross the boundaries between different units to achieve interaction and communication.

4.7. Establishing a new school management system

Gradually improving the credit system allows students to select courses based on their interests and hobbies. This approach encourages students to take charge of their learning, fostering self-directed goal-setting, personal development, self-realization, and self-discipline. It enhances student engagement and creativity, helping them showcase their talents and stand out.

5. Conclusion

The scientific nature of the evaluation system for students' academic quality is directly linked to the overall quality of higher education. The diversified and open evaluation system of students' academic quality reflects the comprehensiveness, objectivity, fairness, development, and professionalism of the evaluation process. It can reflect the quality of students in colleges and universities scientifically, truly, and comprehensively, which is conducive to the close connection between teaching and social needs, the development of students' individual professional quality, and the strengthening of students' autonomy and initiative in learning.

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