

Analysis and Evaluation of Factors Affecting College Students' Learning Enthusiasm

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Abstract: This study takes undergraduate and postgraduate students from Southwest Petroleum University (SWPU) as the research subjects. Based on the framework of social cognitive theory, it adopts questionnaire surveys, Interpretive Structural Modeling (ISM), Analytic Hierarchy Process (AHP) and fuzzy comprehensive evaluation method to construct an evaluation system for learning enthusiasm, which includes 4 first-level indicators (personal factors, school factors, family factors and social factors) and 15 second-level indicators. The results show that the comprehensive score of students' learning enthusiasm is 70.88 points, which is above the medium level. Personal factors (81.35 points) and social factors (73.11 points) are the main driving forces, among which internal driving force (C3) and employment pressure (C14) play significant roles. Among school factors (67.78 points), insufficient teaching interaction (C6) and the rationality of the curriculum system (C5) need to be improved. Family factors (66.89 points) have deviations in support methods (C9-C11). The system structure model reveals that personal factors and social factors indirectly affect learning enthusiasm through teaching effectiveness (C6) and peer effect (C7), and cultural environment (C12) has a negative effect on professional identity (C2). This study provides a quantitative basis and decision-making reference for the practice of educational management in colleges and universities, helps to further improve educational and teaching methods and management measures, so as to effectively enhance college students' learning enthusiasm and promote their all-round development.

Keywords: College Students' Learning Enthusiasm, System Structure Modeling, Analytic Hierarchy Process, Fuzzy Comprehensive Evaluation.

1. Introduction

The report to the 20th National Congress of the Communist Party of China clearly states: "We must continue to prioritize the development of education, pursue self-reliance and strength in science and technology, and rely on talent to lead and drive development. We will speed up efforts to build China into a strong country in education, science and technology, and talent, and remain committed to nurturing talent for the Party and the country." As a key link in talent cultivation, higher education shoulders the important mission of supplying high-quality professional personnel to society^[1]. As the main body of higher education, college students' learning initiative not only directly affects their academic achievements and future development, but also bears on the enhancement of national innovation capacity and core competitiveness. A positive learning attitude can motivate students to explore actively, think deeply, fully tap their potential, and achieve all-round development. On the contrary, insufficient learning initiative may lead students to cope with their studies perfunctorily, making it difficult for them to master solid professional knowledge and skills, thereby affecting their competitiveness in the job market and social adaptability^[2].

Numerous scholars at home and abroad have conducted extensive research on the factors influencing college students' learning initiative^[3]. Foreign scholars have mainly carried out studies from the perspectives of teaching methods, teacher quality, and learning environment, holding that diversified teaching methods^[10], high-quality teaching teams^[11] and a favorable learning environment^[12] can effectively stimulate students' learning initiative. Domestic scholars have conducted in-depth discussions from the angles of students' personal factors, family background, and school management,

finding that students' interests and hobbies^[13], family economic conditions^[14], school management systems^[15], and other factors exert a significant impact on learning initiative. However, existing studies are mostly theoretical discussions, and empirical studies targeting specific universities are relatively scarce.

This article takes college students from a university in Sichuan as the research object and collects data through questionnaires, aiming to comprehensively analyze various factors that affect college students' learning enthusiasm. This not only enriches the existing research, but also provides an objective basis for the university to further improve education and teaching methods and improve management measures, and also provides a reference for the educational practice of other universities. This study hopes to make a meaningful contribution to stimulating the learning enthusiasm of college students and improving the quality of talent training in colleges and universities.

2. Research Design

2.1. Construction of Indicator System

In this study, considering that relatively mature reference materials had been obtained during the data collection stage, it was decided to adopt the target analysis method to construct an evaluation index system for college students' enthusiasm^[16]. With college students' enthusiasm as the target layer, their overall enthusiasm is comprehensively evaluated from three dimensions: individual factors, family factors, school factors, and social factors. The evaluation index systems at all levels are then constructed by refining the target system, as detailed in Table 1.

Table 1. Evaluation Indicators of College Students' Enthusiasm

Target layer	Criterion Layer	Scheme layer
A: Evaluation of Influencing Factors on College Students' Learning Motivation	B1: internal factors	C1: Learn the ability of goal management
		C2: Professional identity
		C3: internal drive
		C4: Stability of learning status
	B2: School factors	C5: Curriculum system
		C6: teaching effectiveness ^[17]
		C7: Peer effect ^[18]
	B3: Family factors	C8: Transmission of parental expectations
		C9: Family education strategies
		C10: Frequency of academic communication ^[19]
		C11: Forms of family support
	B4: social factors	C12: The impact of the network environment ^[20]
		C13: The Impact of AI Technology ^[21]
		C14: Driven by employment pressure
		C15: Conflict of social concepts

2.2. Evaluation Methods and Procedures

(1) Construct the judgment matrix

Table 2. Relative Importance Scale Levels and Their Meanings

scale	meaning
1	Qi is equally important as Qj
3	Qi is slightly more important than Qj
5	Qi is more important than Qj
7	Qi is much more important than Qj.
9	Qi is absolutely more important than Qj
2,4,6,8	respectively between the median values of the above pairwise comparisons

In this study, a research team consisting of 10 senior experts in relevant fields was formed, and a decision-making matrix was constructed based on the analytic hierarchy process^[22,23]. The 1–9 ratio scaling method was used to quantify the relative importance among indicators. Experts conducted back-to-back scoring to form an nth-order judgment matrix $S = [r_{ij}]$, where $r_{ij} \in \{1, 3, 5, 7, 9\}$ and their reciprocals, representing the importance level of indicator i relative to indicator j . When establishing the hierarchical weight system, relevant matrix operations were first performed to accurately solve the maximum eigenvalue λ_{max} of the matrix and determine the corresponding eigenvector, which was then normalized to obtain the hierarchical single sort weight vector. To ensure scientific decision-making, a consistency check was carried out simultaneously, with a threshold of 0.1 set for the consistency ratio (CR) to guarantee the rationality of the weight vector. Considering potential divergences among expert opinions, the fuzzy comprehensive evaluation (FCE) method was adopted to integrate expert views, convert qualitative opinions into quantitative data, and

comprehensively balance perspectives from various parties. Through a series of rigorous procedures, a statistically significant hierarchical weight system was successfully established^[19].

First-level index judgment matrix

$$B = \begin{bmatrix} 1 & \frac{1}{2} & \frac{1}{3} & 1 \\ 2 & 1 & \frac{1}{2} & 2 \\ 3 & 2 & 1 & 3 \\ 1 & \frac{1}{2} & \frac{1}{3} & 1 \end{bmatrix} \quad (1)$$

(2) Consistency check

Based on the theoretical framework of Analytic Hierarchy Process (AHP)^[23], this study establishes a consistency evaluation system for the hierarchical structure model. The Consistency Index (CI) is defined as a quantitative representation of the logical consistency of the judgment matrix, and its mathematical expression is as follows:

$$CI = \frac{\lambda_{max} - n}{n - 1} \quad (2)$$

In the formula, λ_{max} is the maximum eigenvalue of the judgment matrix, and n is the order of the matrix. When $CI = 0$, it indicates complete consistency, and the value range of CI is negatively correlated with the strength of logical consistency. To enhance the reliability of the test, the average random consistency index (Random Index, RI) proposed by Saaty is introduced, whose values have been verified through large-scale Monte Carlo simulation experiments (see Table 3 for details).

Table 3. Values of the Average Random Consistency Index RI

1	2	3	4	5	6	7	8	9	10
0.00	0.00	0.58	0.90	1.12	1.24	1.32	1.41	1.49	1.51

By constructing a calculation model for the Consistency Ratio (CR): $CR = RI/CI$, and setting a threshold standard ($CR < 0.1$), an objective quantitative evaluation of the consistency degree of the decision matrix is realized. This method effectively solves the problem of cognitive bias that may exist in traditional subjective judgment matrices and meets the certification requirements of the ISO14000 environmental management system.

The weight vector $WB = [0.2832, 0.1072, 0.4445, 0.1651]$ is calculated from the judgment matrix B using the eigenvalue method. At this time, $CR = 0.0038 < 0.1$, and the matrix passes the consistency test. Similarly, the judgment matrices of the scheme layer (C) and the criterion layer (B) are as follows:

Internal factors:

$$C_{B1} = \begin{bmatrix} 1 & 2 & \frac{1}{2} & 2 \\ \frac{1}{2} & 1 & \frac{1}{3} & 1 \\ 2 & 3 & 1 & 3 \\ \frac{1}{2} & 1 & \frac{1}{3} & 1 \end{bmatrix} \quad (3)$$

Family factors:

$$C_{B2} = \begin{bmatrix} 1 & 2 & 1 \\ \frac{1}{2} & 1 & \frac{1}{2} \\ 1 & 2 & 1 \end{bmatrix} \quad (4)$$

School factors:

$$C_{B3} = \begin{bmatrix} 1 & 3 & 3 & 3 \\ \frac{1}{3} & 1 & 1 & 1 \\ \frac{1}{3} & 1 & 1 & 1 \\ \frac{1}{3} & 1 & 1 & 1 \end{bmatrix} \quad (5)$$

Social factors:

$$C_{B4} = \begin{bmatrix} 1 & \frac{1}{3} & \frac{1}{4} & \frac{1}{3} \\ 3 & 1 & \frac{1}{3} & 1 \\ 4 & 3 & 1 & 3 \\ 3 & 1 & \frac{1}{3} & 1 \end{bmatrix} \quad (6)$$

From the above formula, the weight vectors of each matrix are obtained as follows: $W1=[0.2727, 0.1364, 0.5455, 0.1364]$; $W2=[0.4000, 0.2000, 0.4000]$; $W3=[0.6000, 0.1333, 0.1333, 0.1333]$; $W4=[0.0968, 0.2581, 0.4839, 0.2581]$. After consistency check, the weight vectors of all matrices satisfy $RI < 0.1$, so the judgment matrices constructed above are all within a reasonable range. Therefore, the weights of the evaluation indicators for the factors affecting the economic nature of college students' learning are shown in Table 4.

Table 4. Weight of Each Indicator

First-level indicator	First-level weight	Secondary indicators	secondary weight	Comprehensive weight
B1 internal factors	0.1337	C1 Learning objectives	0.2727	0.0365
		C2 Professional identity	0.1364	0.0182
		C3 intrinsic motivation	0.5455	0.0729
		C4 learning state	0.1364	0.0182
B2 School factors	0.2616	C5Curriculum system	0.4000	0.1046
		C6 teaching effectiveness	0.2000	0.0523
		C7 Peer effect	0.4000	0.1046
B3 Family factors	0.4709	C8 Parental expectations	0.6000	0.2825
		C9 Educational strategies	0.1333	0.0628
		C10 Communication frequency	0.1333	0.0628
		C11 Supported forms	0.1333	0.0628
B4 social factors	0.1337	C12network impact	0.0968	0.0129
		C13AI technology	0.2581	0.0345
		C14 employment pressure	0.4839	0.0647
		C15 Conflict of ideas	0.2581	0.0345

According to the table, family factors (0.4709) > school factors (0.2616) > personal factors (0.1337) = social factors (0.1337), indicating that family support is the most core

external factor influencing college students' learning enthusiasm, followed by school education, while personal and social factors exert a similar degree of influence. Parental

expectation transmission (0.2825), curriculum system (0.1046), and peer effect (0.1046) are the three secondary indicators with the highest weights. The three together account for 49.17%, nearly half of the evaluation system, serving as key starting points affecting learning enthusiasm.

3. Fuzzy Comprehensive Evaluation

(1) Determination of fuzzy evaluation grades.

In this study, the corresponding scoring relationship is as follows: excellent 100 points, very good 90 points, good 70 points, average 50 points, poor 30 points, very poor 10 points, extremely poor 0 points. Based on this scoring, the final score of college students' enthusiasm can be calculated to evaluate

their enthusiasm, with the assigned value $V = \{100, 90, 70, 50, 30, 10, 0\}$.

(2) Construction of fuzzy evaluation matrix.

In the factor set (U) , (U_{ij}) is used to represent the membership degree of the (i) -th element in the evaluation set (Q) . Thus, the single-factor evaluation result of the (i) -th factor can be represented by the fuzzy set $([U_{i1}, U_{i2}, U_{i3}, U_{i4}, U_{i5}, U_{i6}, U_{i7}])$. The matrix composed of (m) single-factor evaluations is the fuzzy evaluation matrix (R) (as shown in Table 5). Constructing this matrix facilitates the systematic analysis of the comprehensive influence of various factors on the evaluation set.

Table 5. Fuzzy Evaluation Matrix

	Q1	Q2	Q3	Q4	Q5	Q6	Q7
U_i	U_{i1}	U_{i2}	U_{i3}	U_{i4}	U_{i5}	U_{i6}	U_{i7}
...
U_m	U_{m1}	U_{m2}	U_{m3}	U_{m4}	U_{m5}	U_{m6}	U_{m7}

The comprehensive evaluation vector is denoted as H , which is obtained by multiplying the feature vector W of each

element in the element set with the fuzzy evaluation matrix R . The calculation formula is as follows:

$$H = W \times R = [W_1, W_2, \dots, W_m] \times \begin{bmatrix} U_{i1} & \dots & U_{i7} \\ \dots & \dots & \dots \\ U_{m1} & \dots & U_{m7} \end{bmatrix} = [h_1, h_2, \dots, h_7] \quad (7)$$

4. Comprehensive Evaluation Results

Based on the weight results obtained by the Analytic Hierarchy Process, the fuzzy comprehensive evaluation method is used to quantitatively assess the factors influencing college students' learning enthusiasm. Questionnaires were distributed to 256 college students, followed by data statistics,

$$R1 = \begin{bmatrix} 0.20 & 0.30 & 0.35 & 0.10 & 0.05 & 0.00 & 0.00 \\ 0.15 & 0.25 & 0.30 & 0.20 & 0.10 & 0.00 & 0.00 \\ 0.30 & 0.40 & 0.25 & 0.05 & 0.00 & 0.00 & 0.00 \\ 0.15 & 0.20 & 0.35 & 0.20 & 0.10 & 0.00 & 0.00 \end{bmatrix} \quad (8)$$

$$R2 = \begin{bmatrix} 0.10 & 0.20 & 0.35 & 0.25 & 0.10 & 0.00 & 0.00 \\ 0.12 & 0.22 & 0.38 & 0.20 & 0.08 & 0.00 & 0.00 \\ 0.18 & 0.32 & 0.30 & 0.15 & 0.05 & 0.00 & 0.00 \end{bmatrix} \quad (9)$$

$$R2 = \begin{bmatrix} 0.10 & 0.20 & 0.35 & 0.25 & 0.10 & 0.00 & 0.00 \\ 0.12 & 0.22 & 0.38 & 0.20 & 0.08 & 0.00 & 0.00 \\ 0.18 & 0.32 & 0.30 & 0.15 & 0.05 & 0.00 & 0.00 \end{bmatrix} \quad (10)$$

$$R4 = \begin{bmatrix} 0.05 & 0.10 & 0.20 & 0.35 & 0.20 & 0.10 & 0.00 \\ 0.10 & 0.20 & 0.30 & 0.25 & 0.15 & 0.00 & 0.00 \\ 0.20 & 0.30 & 0.30 & 0.15 & 0.05 & 0.00 & 0.00 \\ 0.08 & 0.15 & 0.25 & 0.30 & 0.20 & 0.02 & 0.00 \end{bmatrix} \quad (11)$$

$$H3 = W3 \times R3 = [0.1900, 0.2633, 0.2333, 0.1133, 0.0733, 0, 0]$$

$$H4 = W4 \times R4 =$$

$$[0.1481, 0.2581, 0.3039, 0.2081, 0.1081, 0.0148, 0]$$

The comprehensive weight evaluation vector is:

$$C = W \times H = [0.1787, 0.2641, 0.2727, 0.1385, 0.0735, 0.0020, 0] \quad (12)$$

The obtained results are processed into percentages using the formula $(N = C \cdot V = 70.88)$. The final evaluation score for the factors influencing college students' learning

motivation is 70.88 points, and Table 6 shows the scoring results.

Table 6. Scores of Each Indicator

level	Indicator symbol	Indicator Name	Overall score
Target layer	—	Comprehensive Evaluation of College Students' Learning Enthusiasm	70.88
First-level indicator	B1	internal factors	81.35
	B2	School factors	67.78
	B3	Family factors	66.89
	B4	social factors	73.11
Secondary indicators	C1	Learn goal management skills	79.55
	C2	Professional identity	65.45
	C3	internal drive	85.91
	C4	Stability of learning status	65.45
	C5	Curriculum system	68.18
	C6	teaching effectiveness	66.36
	C7	Peer effect	78.41
	C8	Transmission of parental expectations	72.73
	C9	Family Education Strategies	63.64
	C10	Frequency of academic communication	63.64
	C11	Forms of family support	63.64
	C12	The impact of the network environment	59.09
	C13	The Impact of AI Technology	70
	C14	Driven by employment pressure	76.36
	C15	Conflict of social concepts	70

5. Result Analysis

5.1. Overall Score Overview

Total Score (A): 70.88 points, which falls exactly between the two grades of "Good (70 points)" and "Excellent (90 points)". Specifically, this score clearly reflects that the overall learning motivation of university students across the campus is at an above-average level. Nevertheless, it is not difficult to observe from the detailed scores that the current learning motivation of college students has not yet reached an ideal state. This indicates that there is still considerable room for improvement in future educational guidance and incentive measures, which urgently require further attention and effort.

Regarding the score ranking of the first-level indicators, we can clearly observe the specific performance of each influencing factor as follows: first, internal factors (B1), with a high score of 81.35, significantly leading other indicators, highlighting the key role of college students' internal motivation in their learning enthusiasm; second, social factors (B4), with a score of 73.11, indicating that the social environment and external atmosphere also exert a non-negligible influence on college students' learning attitudes; third, school factors (B2), with a score of 67.78, reflecting that the school's educational resources, teaching methods, peer effects and other aspects have promoted students' learning enthusiasm to a certain extent, but the effect still needs to be strengthened; finally, family factors (B3), with a score of 66.89, showing that although family background and support have a certain impact on students' learning enthusiasm, their effect is relatively weak compared with other factors and requires more attention and improvement.

5.2. In-depth Analysis of First-level Indicator Scores

(1) Personal Factors (B1: 81.35 points, highest score)

Core driving factors: The comprehensive weight of internal driving force (C3) is 0.0729, and its total membership degree at the "excellent" and "good" levels reaches 70% ("excellent" 0.30, "good" 0.40), indicating that students have a strong subjective willingness for self-improvement, which is the main reason for the high score of indicator B1. On the other hand, the membership degree of learning goal management (C1) at the "fair" level and above reaches 85% ("fair" 0.20, "fairly good" 0.30, "good" 0.35), reflecting that most students have clear learning goals and can effectively plan and manage their studies, laying a foundation for academic improvement.

Potential shortcoming analysis shows that the membership degree of professional identity (C2) at the "average" level is 20%, indicating that some students have weak interest and recognition in their major and fail to fully stimulate learning motivation; 20% of students also have a learning state stability (C4) at the "average" level, showing that these students are prone to learning fluctuations and difficult to maintain stable efficiency and effectiveness. Overall, the membership degree of both indicators at the "average" level is 20%, pointing out that some students have significant deficiencies in cultivating professional interest and maintaining learning status, which require joint attention and improvement from educators and students.

(2) Social Factors (B4: 73.11 points, second-highest score)

Positive driving factors: Employment pressure drive (C14): with a comprehensive weight of 0.0647, the total membership degree of the "Excellent" and "Good" levels is 60% (0.30 each), indicating that intense employment competition

significantly motivates students' learning enthusiasm and encourages them to devote greater effort to their studies. Impact of AI technology (C13): the membership degree of the "Good" level reaches 30%, showing that the application of artificial intelligence technology has gradually demonstrated its auxiliary effect on learning, improving learning efficiency and stimulating learning interest and motivation.

Negative constraining factors: Network environment impact (C12): the total membership degree of the "Average" and "Poor" levels is 55% (0.35 and 0.20 respectively), indicating that the network environment has a significant negative impact on the system or project. A large amount of fragmented information distracts people's attention and affects work efficiency and decision-making quality.

(3) School Factors (B2: 67.78 points, the second lowest score)

Weakness Analysis: The membership degree of teaching effectiveness (C6) at the "average" level accounts for 20%, indicating that teaching outcomes have not reached the ideal state. Specifically, the low frequency of teacher-student interaction and insufficient timely feedback and communication hinder the improvement of teaching effectiveness; the effectiveness of the feedback mechanism needs to be strengthened to promote the improvement of teaching quality. The membership degree of the curriculum system (C5) at the "average" level is as high as 25%, reflecting problems in curriculum design. Specifically, the adaptability of curriculum difficulty is unsatisfactory, failing to fully consider students' learning abilities and needs, resulting in inappropriate learning pressure for some students; the rationality of the assessment mechanism needs to be optimized to ensure that assessment results truly reflect learning performance.

Strengths: Peer effect (C7) performs prominently, with the total membership degree of "excellent" and "good" levels reaching 80%, showing that the school's learning atmosphere has a significant positive impact on students' motivation. A positive peer effect promotes mutual assistance and cooperation among students, stimulates learning motivation, forms a positive learning environment, and plays an important role in improving overall learning effectiveness.

(4) Family Factors (B3: 66.89 points, the lowest score)

Parental Expectation Transmission (C8): This indicator has a relatively high comprehensive weight among all secondary indicators, reaching 0.2825, indicating its significant impact on students' academic achievement. However, in terms of membership degree, only 35% of families can reach the "Excellent" level, while the membership degree of the "Good" level is 25%, which shows that the actual incentive effect of parental expectations has not been fully transformed into students' academic performance.

Family Education Strategies (C9), Academic Communication Frequency (C10), and Family Support Patterns (C11): The membership degrees of these three indicators at the "Average" level all exceed 20%, reflecting that the methods and frequency of family support may deviate to a certain extent from students' actual needs.

6. Conclusion and Improvement Suggestions

6.1. Conclusion

This study takes undergraduate and postgraduate students

at SWPU as the research subjects. Based on the framework of social cognitive theory, it systematically explores the influencing factors and evaluation system of college students' learning enthusiasm. By means of questionnaire surveys, systems engineering methods, analytic hierarchy process and fuzzy comprehensive evaluation, an evaluation system including 4 first-level indicators (personal factors, school factors, family factors, social factors) and 15 second-level indicators is constructed to conduct a quantitative assessment of college students' learning enthusiasm.

The results show that the overall score of students' learning enthusiasm across the university is 70.88 points, which is at an above-average level. Among them, personal factors (81.35 points) and social factors (73.11 points) play a significant role in driving learning enthusiasm, while school factors (67.78 points) and family factors (66.89 points) have room for optimization. Specifically, students' internal motivation, namely their interest and pursuit in learning itself, and social employment pressure, that is, the competition in the job market and the demand for career development after graduation, together constitute the main driving forces of their enthusiasm. However, the quality of school teaching, including curriculum design, teaching methods, faculty strength and other aspects, as well as the actual effect of family support, such as parents' educational concepts and family learning atmosphere, still have many problems in practical operation and are in urgent need of further optimization and improvement.

6.2. Suggestions

School level: To comprehensively improve the quality of education, schools need to focus on optimizing curriculum design (C5). This includes not only updating and adjusting existing curriculum content but also emphasizing the rationality and forward-looking nature of the curriculum structure. In addition, schools should strengthen the interactive feedback mechanism between teachers and students (C6). Specific measures may include increasing the proportion of seminars to promote active thinking and communication among students; meanwhile, establishing a personalized learning guidance system to provide customized teaching support according to the characteristics and needs of different students.

Family level: In family education, the role of parents is crucial. Therefore, schools and society should work together to guide parents to adopt more scientific educational strategies (C9). Specifically, parents should reduce utilitarian expectations for their children, avoid excessive pursuit of academic performance and rankings, and instead pay more attention to their children's all-round development. At the same time, parents need to increase emotional support and communication frequency for their children (C10). Through daily communication and companionship, a warm and harmonious family atmosphere can be created to help children grow up healthily.

Society level: Faced with the challenges of the information age, society needs to strengthen education on the ability to screen online information (C12), cultivate the public, especially teenagers, to distinguish true from false information, and avoid the infringement of harmful information. Meanwhile, make full use of artificial intelligence technology (C13) to develop intelligent learning tools, and transform advanced technological advantages into students' learning motivation. These intelligent tools can not

only improve learning efficiency but also provide personalized learning suggestions according to students' learning conditions, thereby comprehensively enhancing learning effectiveness.

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