

# Evaluation Analysis on Influences of AHP-TOPSIS-Model-Based Artificial Intelligence on College Students Learning

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**Abstract.** In recent years, the field of artificial intelligence has witnessed rapid development and continuous technological advancements. It has found widespread application in various domains, exerting profound influences on all aspects of human social life. This article focuses on evaluating the impact of artificial intelligence on college students' learning. Based on a survey of 4605 participants, the collected data was transformed into numerical values and underwent preliminary data processing. An indicator evaluation system was established, encompassing priority, scientificity, and feasibility, in order to construct a comprehensive evaluation framework. By conducting both objective and subjective analyses of the survey questions, the obtained weight values were subjected to consistency tests, which confirmed their reliability. Through the application of the Analytic Hierarchy Process (AHP), the final weights were determined, and the top eight indicators were selected for evaluation. An AHP-TOPSIS combined evaluation model was developed, which concludes that artificial intelligence has significantly influenced college students' learning and yielded positive effects. The novelty of this article lies in the utilization of the AHP-TOPSIS combined evaluation model, which incorporates the advantages of both models and avoids the limitations associated with a single model, such as biased perspectives and low reliability.

**Keywords:** Artificial Intelligence, College Student Learning, Evaluation Analysis, AHP-TOPSIS Model.

## 1. Introduction

With the rapid development and widespread application of artificial intelligence technology[1], its potential in the field of education has also attracted increasing attention. Especially in higher education, artificial intelligence is widely used in learning assistance, personalized education, and learning assessment, which has a profound impact on students' learning. Therefore, evaluating and analyzing the impact of artificial intelligence on students' learning can provide scientific evidence for educational decision-makers to further improve the quality and effectiveness of higher education.

This paper aims to evaluate and analyze the impact of artificial intelligence on students' learning based on the AHP-TOPSIS model[2]. AHP (Analytic Hierarchy Process) is a commonly used multi-criteria decision-making method that helps decision-makers decompose complex problems into hierarchical structures and determine the weights of different factors. The TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) method can comprehensively consider the advantages and disadvantages of various factors and provide a scientific basis for ranking evaluation results[3].

In the background analysis, we will explore the current status and trends of artificial intelligence in higher education, including intelligent tutoring systems, personalized learning platforms, and intelligent assessment tools. We will focus on the impact of artificial intelligence on improving students' learning outcomes, personalizing the learning process, and optimizing teaching resources. At the same time, we will also discuss the challenges that artificial intelligence may face in higher education, such as privacy protection, technical feasibility, and human-computer interaction.

In the literature review, we will review the research achievements and methods in related fields at home and abroad, including application cases of artificial intelligence in the field of education, the theoretical basis and practical applications of the AHP method and the TOPSIS method. Through the summary and analysis of existing research, we can understand the application status, advantages, and limitations of existing methods in evaluating the impact of artificial intelligence on students' learning.

The purpose of this paper is to construct an evaluation and analysis model of the impact of artificial intelligence on students' learning based on the AHP-TOPSIS model[4], providing educational decision-makers with scientific and objective evaluation results. Through the application of this model, we can comprehensively understand the role and effectiveness of artificial intelligence in higher education, providing strong support for educational decision-making and teaching improvement[5].

Through the research of this paper, we hope to provide new methods and ideas for evaluating the impact of artificial intelligence in higher education and guiding teaching practices. It is hoped that this research can provide useful references and insights for improving and developing higher education, promoting the integration of artificial intelligence and education[6], and enhancing the quality and effectiveness of students' learning.

## 2. Materials and methods

### 2.1. The structure of BP neural network

Taking the evaluation of the impact of artificial intelligence on college students' learning as the research direction, this paper obtains the results of a questionnaire survey by investigating the personal information such as majors, grades and personalities of the respondents, the usage information such as the time and purpose of surfing the Internet, and the prospect of the future development of artificial intelligence.

Firstly, the survey questions are classified, and different numerical transformation methods are used according to the classification results. The 0-1 assignment method is adopted for single-choice double-choice problems, the unified double-negative 0-1 assignment method is adopted for single-choice three-choice double-negative problems, the categorical variable processing method is adopted for single-choice multiple-choice problems, the simple function transformation method is adopted for multiple-choice problems, and the binary coding method is adopted for multiple-choice problems[7].

For the results obtained by solving the above problems, this paper carried out numerical transformation and obtained the encoded data, but the importance of the results could not be reflected. Then this paper carried out standardization processing of the encoded data. The purpose of standardization is to convert measurements into dimensionless values, which can allow indicators of different dimensions to be compared on the same level. For example, some of the questions have three options. If each option is standardized, the results are shown in Table 1 below:

**Table 1.** Standardized treatment

What do you think is the most significant advantage of learning software compared to classroom teaching?		
standardization	binary coding	options
1/3	100	Abundance of real exam questions
1	111	Abundance of real exam questions   Ability for repetitive learning   The comprehensiveness of the study materials
2/3	110	Abundance of real exam questions   Ability for repetitive learning
2/3	011	Ability for repetitive learning   The comprehensiveness of the study materials
1/3	010	Ability for repetitive learning
1/3	001	The comprehensiveness of the study materials
2/3	101	Abundance of real exam questions   The comprehensiveness of the study materials

## 2.2. Research methods

First of all, this paper takes the survey report as the research basis, analyzes and processes the results according to the results of the survey report, and transforms the obtained results numerically. Then the results of the numerical survey report are analyzed, evaluation indicators are selected, and the rationality of the evaluation indicators is discussed from the aspects of priority, scientificity and operability. On this basis, the evaluation index system is constructed. Finally, on the basis of the established evaluation index system, TOPSIS evaluation mathematical model is established, and the impact of artificial intelligence on college students' learning is evaluated according to the results of the model, and a clear and convincing conclusion is given.

## 3. Model establishment and solution

### 3.1. The establishment of AHP-TOPSIS combination model

#### 3.1.1 Model introduction

Analytic hierarchy Process (AHP) is a method to analyze complex problems with many factors. It is mainly to decompose the problem from large to small into multiple levels, and find the weight and comparison rule at each level to determine the relative importance of factors. It is a decision-making technique based on many assumptions. It is often used for decision-making, evaluation, analysis and other problems. Analytic hierarchy process (AHP) is often used in many fields such as planning, investment, equipment selection and performance evaluation[8].

Entropy weight method is a method to assign weight to various indexes by applying the principle of information entropy. In the entropy weight method, by calculating the entropy value of each indicator, the contribution degree of each indicator is obtained, and then the weight of each indicator is calculated, so as to realize the ranking of indicators and the allocation of weights. In general, entropy weight method is a relatively objective and scientific multi-indicator decision-making method, which can better reflect the relationship between various indicators and comprehensive indicators, so as to achieve the standardization and scientific evaluation process of multi-indicator.

#### 3.1.2 Specific steps of model building

The specific steps of entropy weight method are as follows:

Using the raw data, build the data matrix  $A$ , Assume the proportion of scheme  $i$  index value of item  $j$  index  $p_{ij}(i=1,2,3,\dots,n;j=1,2,3,\dots,m)$ .

(1) Determine indicators and indicator data: according to the research objects and evaluation objectives, determine the indicators that need to be evaluated, and collect indicator data.

(2) Calculate the entropy value of each indicator: for the data of each indicator, carry out normalization processing, that is, divide all the data by the maximum value of the indicator, so that the data range is 0-1. Then, according to the information entropy theory, the entropy value of each index is calculated as follows:

$$H = -\sum_{i=1}^n q_i \times \log_2 q_i \quad (1)$$

Where,  $q_i$  is the probability distribution of the index within the normalized value range.

(3) Calculate the weight value of each indicator: According to the principle of information entropy, the indicator with smaller information entropy has a greater impact on the decision result. Therefore, the weight value of each indicator can be calculated by entropy value. The formula is:

$$w_i = \frac{(1 - H_i)}{\left(k - \sum_{j=1}^m H_j\right)} \quad (2)$$

Where,  $H_i$  is the entropy of the  $i$  th index, and  $k$  is the number of indicators.

(4) Comprehensive evaluation: For each data sample, its score in each index is multiplied with the weight value of each index, and weighted and summed to obtain the comprehensive evaluation result. The formula is:

$$Z_i = \sum_{i=1}^n q_i w_i \tag{3}$$

(5) Comprehensive sorting: all data samples are sorted according to the comprehensive evaluation score from high to low, and the final evaluation result is obtained.

It should be noted that the entropy weight method is applicable when the indicators are independent of each other. If there is correlation or duplication among indicators, it is necessary to conduct data preprocessing and indicator screening to ensure the accuracy and reliability of evaluation results.

### 3.2. Selection of evaluation index

#### 3.2.1 Objective level

Based on the evaluation model of entropy weight method established in 3.1, based on the results of the survey report, the validity of the survey questions is judged, and the valid retention is eliminated.

#### 3.2.2 Subjective level

After consulting the relevant data, according to the correlation between the survey report questions and the influence of artificial intelligence on college students' learning, the artificial grade weight is assigned to the survey report questions.

#### 3.2.3 comprehensive weight

Combined with the objective level weight and subjective level weight and the specific problems in this paper, the comprehensive weight is obtained according to the rule of objective weight  $\times 30\%$ + subjective weight  $\times 70\%$ , and the hierarchical analysis method is used to re-normalize. The eight questions with the greatest weight are selected and the results are shown in Table 2 below:

**Table 2.** Comprehensive weight and AHP weight table

survey questions	comprehensive weight	AHP weight normalization
21. Do you think it's possible for artificial intelligence tools to replace teachers in the future?	0.053223	0.133342
15. Have you ever thought about using artificial intelligence learning tools to help you complete research papers?	0.053145	0.133145
14. Have you ever thought about using artificial intelligence learning tools to assist you in completing quizzes?	0.052443	0.131387
24. What do you think is the most significant advantage of learning software compared with classroom teaching?	0.050304	0.126029
30. In which phase of learning do you think artificial intelligence learning tools are integrating with?	0.05001	0.125293
13. Have you ever thought about using artificial intelligence learning tools to help with assignments?	0.048255	0.120894
26. What concerns you the most about using learning software for learning?	0.045996	0.115236
28. In your opinion, which aspects are crucial for artificial intelligence learning tools?	0.045771	0.114673

The obtained results will be tested for consistency to further judge the scientificity of the selection of evaluation indicators:

Consistency test in analytic hierarchy process (AHP) is an important step to ensure the rationality and reliability of decision results. The conditions for consistency are:

(1). The judgment matrix should be consistent, that is, the diagonal elements are 1 and the symmetric elements are consistent.

(2). If there are multiple judgment matrices, consistency normalization should be performed to ensure that they have the same consistency weight.

(3). Check the consistency of the judgment matrix by calculating the consistency index CR. If CR is less than or equal to 0.1, the judgment matrix is considered consistent.

The purpose of consistency test is to avoid the bad effect of deviation from the real situation, and to ensure the accuracy and reliability of the decision result.

The test matrix is shown in Figure 1:

$$\begin{pmatrix} 1 & 1.001 & 1.015 & 1.058 & 1.064 & 1.103 & 1.157 & 1.163 \\ 0.999 & 1 & 1.013 & 1.056 & 1.063 & 1.101 & 1.155 & 1.161 \\ 0.985 & 0.987 & 1 & 1.043 & 1.049 & 1.087 & 1.14 & 1.146 \\ 0.945 & 0.947 & 0.959 & 1 & 1.006 & 1.042 & 1.094 & 1.099 \\ 0.94 & 0.941 & 0.954 & 0.994 & 1 & 1.036 & 1.087 & 1.093 \\ 0.907 & 0.908 & 0.92 & 0.959 & 0.965 & 1 & 1.049 & 1.054 \\ 0.864 & 0.865 & 0.877 & 0.914 & 0.92 & 0.953 & 1 & 1.005 \\ 0.86 & 0.861 & 0.873 & 0.91 & 0.915 & 0.949 & 0.995 & 1 \end{pmatrix}$$

**Figure 1.** Test matrix

Consistency test results are shown in Table 3:

**Table 3.** Consistency test results

The largest eigenvalue	CI ratios	RI ratios	CR ratios	Consistency test result
8	0	1.404	0	pass

The calculation result of analytic hierarchy process shows that the maximum feature root is 8.0, and the corresponding RI value is 1.404 according to the RI table, so  $CR=CI/RI=0.0 < 0.1$ , Pass a one-time inspection.

### 3.3. Construction of evaluation index system

According to the results of comprehensive evaluation weights in 3.2.3, this paper selects the top eight weights as evaluation indicators after sorting, as shown in Table 4:

**Table 4.** Evaluation indicator system

Indicator 1	21. Do you think it's possible for artificial intelligence tools to replace teachers in the future?
Indicator 2	15. Have you ever thought about using artificial intelligence learning tools to help you complete research papers?
Indicator 3	14. Have you ever thought about using artificial intelligence learning tools to assist you in completing quizzes?
Indicator 4	24. What do you think is the most significant advantage of learning software compared with classroom teaching?
Indicator 5	30. In which phase of learning do you think artificial intelligence learning tools are integrating with?
Indicator 6	13. Have you ever thought about using artificial intelligence learning tools to help with assignments?
Indicator 7	26. What concerns you the most about using learning software for learning?
Indicator 8	28. In your opinion, which aspects are crucial for artificial intelligence learning tools?

As for the selected evaluation index, this paper will explain its rationality from three aspects: priority, scientificity and operability.

(1) Priority

In the selection of evaluation indicators, we assign artificial grade weights to survey report questions at the subjective level. After consulting the data, indicators 1, 4, 5, 7 and 8 were assigned the highest grade 5, and indicators 2, 3 and 6 were assigned the second-highest grade 4. It can be concluded that the evaluation indicators selected in this paper meet the priority level.

(2) Scientific

At the objective level, the weight order obtained by using the entropy weight model to analyze the validity of the survey results is index 2, 3, 6, 1, 4, 5, 7, 8; It can be seen that the selected survey questions are highly effective for artificial intelligence, that is, the selected evaluation indicators are highly scientific.

(3) Operability

In the previous numerical transformation, the simple function transformation method is adopted for indicator 1, the unified double negative 0-1 assignment method is adopted for indicators 2, 3 and 6, and the binary coding method is adopted for indicators 4, 5, 7 and 8, so that the non-quantifiable literal indicators are transformed into numerically quantifiable indicators, and it is concluded that the evaluation indicators selected in this paper are operable.

### 3.4. Evaluation impact

Through the analysis of the eight evaluation indicators selected, the degree of influence of the indicator on college students' learning is judged to be large or small, and the index is judged to be positive or negative from the degree of influence on college students' learning. The specific analysis is as follows[9,10]:

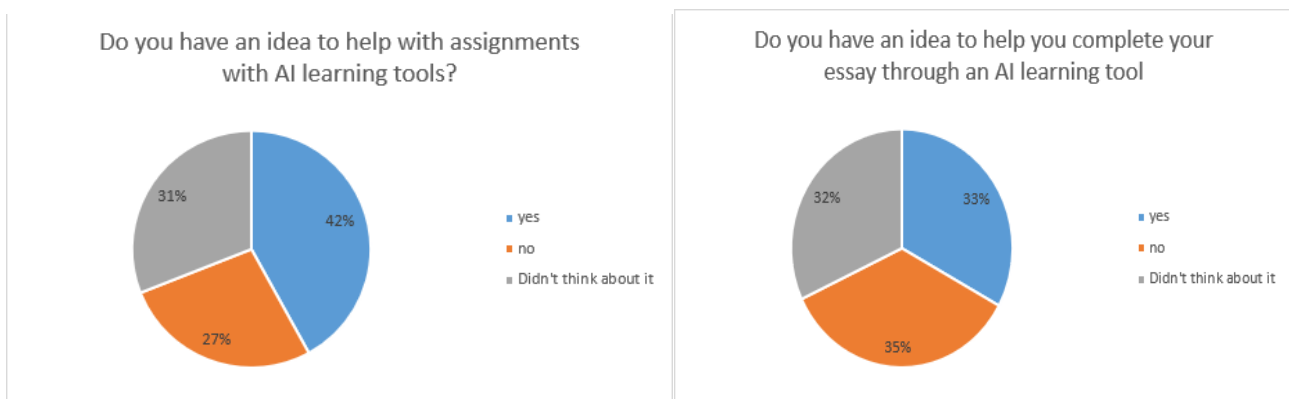
(1) Through analysis, indicators 6, 3 and 2 are of the same type and can be evaluated at the same time.

Indicator 6: Do you have the idea of using AI learning tools to help you complete your homework?

Indicator 3: Do you have the idea of using AI learning tools to help you complete quizzes?

Indicator 2: Do you have any idea of using AI learning tools to help you complete your thesis?

According to the results of these three indicators, most college students have no or no idea of using artificial intelligence learning tools to assist themselves in completing learning tasks, which can indicate that most people are not dependent on artificial intelligence and can complete learning tasks independently. It can be seen that the convenience of artificial intelligence has not damaged the innovative thinking of college students, but there are still some people to complete their learning tasks through artificial intelligence. It is undeniable that there are also favorable aspects, which may affect the generation of innovative thinking and the improvement of practical ability of college students. According to the analysis results of the above three indicators, the impact of artificial intelligence on college students' learning is mainly reflected in the positive impact, and the negative impact is not very big. The result is shown in Figure 2.



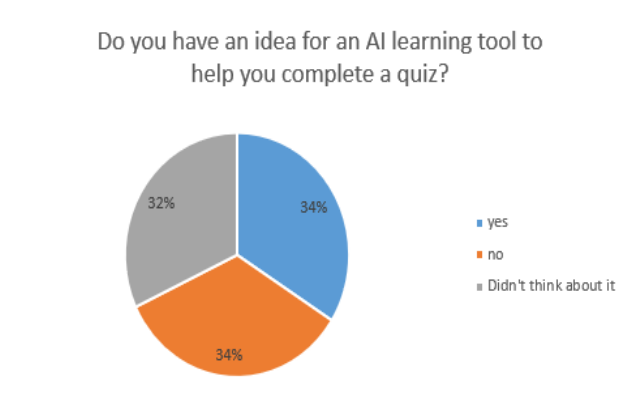


Figure 2. Indicator 2、3、6

(2) Analyze indicator 1.

Do you think artificial intelligence tools can replace teachers in the future?

According to the results of indicator 1, the vast majority of college students have a clear understanding of this problem, and most students think that artificial intelligence tools will not replace teachers in the future, only 13% of students have no clear understanding of this and 15% of students think that artificial intelligence may replace teachers in the future. The question of whether artificial intelligence tools can replace teachers in the future is essentially an evaluation of the impact of artificial intelligence on college students' learning. Most people clearly believe that artificial intelligence will not replace teachers, which indicates that artificial intelligence has a positive impact on college students' learning. The result is shown in Figure 3.

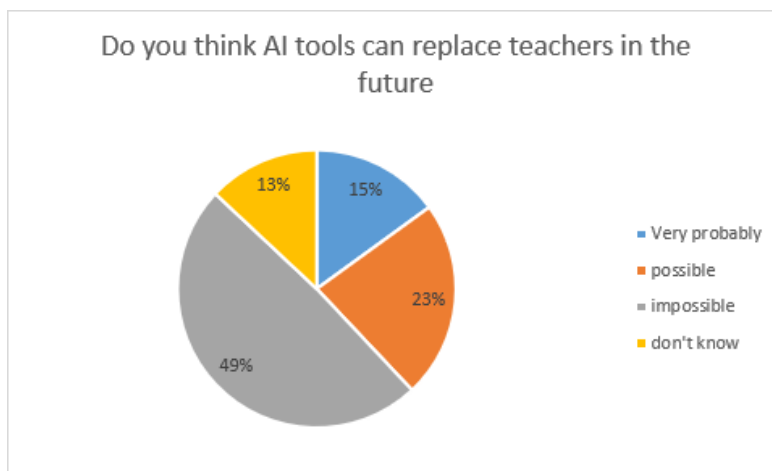


Figure 3. Indicator 1

## 4. Conclusions

This paper constructs an AHP-TOPSIS comprehensive evaluation model based on the results of questionnaires to evaluate the impact of artificial intelligence on college students' learning. Based on the results of the questionnaire and our analysis, it is concluded that there are many comprehensive factors that affect the learning of college students by artificial intelligence, which are affected by multiple factors such as gender, major, grade, personality and Internet access. And some students are already considering using artificial intelligence tools to complete learning tasks. Students should actively use artificial intelligence technology, but also avoid blindly pursuing the appearance of fast and efficient, but should look for the best learning methods through reasonable assessment.

Artificial intelligence has a positive impact on network activities, the application of college students in learning and the impact of software on learning. In the future, educators can use personalized education, smart education and other ways to improve teaching quality and efficiency,

and the development of artificial intelligence learning software will also pay more attention to personalized learning and interactive learning to improve learning efficiency and effect.

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