

Research on the Impact of Artificial Intelligence on College Students' Learning Based on the Entropy Power Method

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Abstract: With the development of society, artificial intelligence [1] has gradually penetrated into all aspects of our lives, and has had different degrees of impact on different aspects of society. The development of artificial intelligence has a different degree of impact on all aspects of society and also affects the learning life of college students. In order to understand the impact of artificial intelligence on college students' learning at different levels, this paper designs a questionnaire to interview and analyse it, obtains the survey feedback results and analyzes and evaluates the results according to the survey. We first transformed the questionnaire data from textual data to numerical data, and invalid sample exclusion through case analysis. A total of 145 invalid samples were excluded to avoid errors in the post analysis. The data were validated for reliability analysis of this non-scale question based on the Cronbach_alpha coefficient. After that, determining the purpose of their own indicators - the impact of AI on students' learning, based on the purpose of the selected indicators, the questions in the questionnaire were screened, and questions that were considered to be the same indicator were grouped together to create "proficiency in learning software", "Dependence on AI learning tools", "Demand for the use of AI learning tools", "Tolerance for the use of AI learning tools", and "Acceptability of the future direction of educational development of AI" five indicators, and separately homogenise and assign points to the various indicators constituted by the selected questions, and finally form a complete evaluation system. We analysed the validity of all the questions in the questionnaire to derive the weights of the questions within the indicator. Calculate the evaluation value of each indicator, then differentiate the five indicators constructed in the second question into positive and negative indicators. An analysis of the weights of the five indicators based on the entropy weighting method reveals that the weight of the indicator "proficiency in learning software" is as high as 51 per cent. Finally, the five indicators are combined to calculate a composite evaluation value for the sample. Using Origin to make a comprehensive evaluation value line graph of the sample, analysing both the fluctuation of the value of the lines and the degree of intensity, and finally concluding that AI has a wide range of influence and a large degree of influence on college students' learning.

Keywords: Reliability analysis; Cronbach_alpha coefficient; Homogenise; Entropy weighting method.

1. Introduction

With the development and progress of the times, artificial intelligence has become a common tool in our lives, which has a great impact on our lives. The college student group is one of the main groups of AI users, and AI plays an important role in the study of college students and has a great impact on their study life.

2. Modelling Assumptions

(1) Hypothesis one: Assuming that the survey data are true

and reliable

(2) Hypothesis two: Assuming that quantitative results do not affect each other

(3) Hypothesis three: Assuming that the results of the questionnaire are all students' true thoughts

(4) Hypothesis four: It is assumed that the results of the questionnaire are all true and valid data.

3. Description of Symbols

Table 1. Description of symbols

Notation	Hidden Meaning
α	Proficiency in learning software
β	Dependence on AI learning tools
γ	Demandingness for the use of AI learning tools
δ	Tolerance for the use of AI learning tools
ϵ	Acceptance of the future direction of AI in education
N	Comprehensive Evaluation Value
M	Evaluation Value

4. Data Processing and Analysis

4.1. Pre-processing of data

First convert the text-based data in the survey results into

numerical data [2], facilitate subsequent analytical processing;

In order to ensure the authenticity and reliability of the survey results data, it is necessary to eliminate the invalid samples among them. Since there are no missing values in the

data, we only need to eliminate the questionnaires with too many identical numbers, so the questionnaires with the same numbers appearing in 70 per cent and above are eliminated, and a total of 145 invalid questionnaires are eliminated.

4.2. Analysis of data

4.2.1. Analysis of variances

In order to further compare differences between samples, after basic data processing and analysis of all single and

multiple choice questions, the data can be further compared and analysed using the "chi-square" method. The chi-square test is a statistical method that tests whether two categorical variables are related (independent of each other), and the main operation of the method is to compare the composition ratio of two or more samples and analyse the correlation of the categorical variables.[3]

4.2.2. Differences in Internet habits between genders

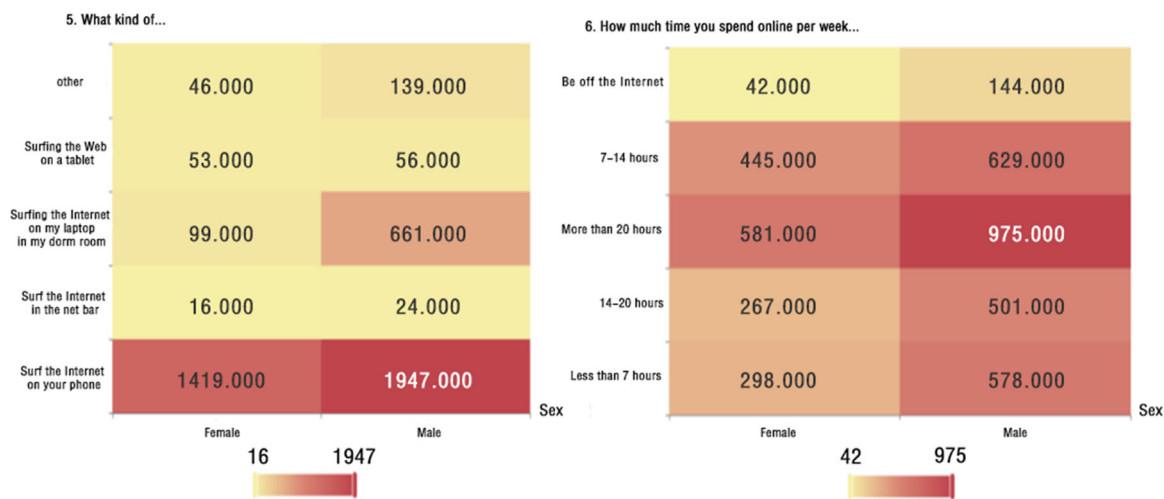


Figure 1. Differences in Internet access habits between genders

The chi-square analysis was conducted between question 1 and questions 5 and 6, and different heat maps were obtained.

The analysis shows that there is a moderate difference between question 1 and question 5, while there is a weak difference between question 1 and question 6, indicating that, due to the difference in gender, which leads to a certain

difference in the way of accessing the Internet among people of different genders, there will not be too much difference in the weekly length of accessing the Internet.

4.2.3. Differences in time spent on learning software in terms of willingness to use it

Table 2. Differences in time spent on learning software in terms of willingness to use it

Field name/Analysis item	Phi	Crammer's V	Number of columnar links	lambda
13、 Do you have ideas for homework help through AI learning tools?	0.119	0.084	0.118	0.023
14、 Have you ever had the idea of an AI learning tool to help you complete a quiz?	0.133	0.094	0.132	0.061
15、 Do you have an idea for an AI learning tool to help you with your dissertation?	0.124	0.088	0.123	0.051

Carrying out the chi-square analysis between question 8 and questions 13, 14 and 15.

The analysis shows that since the Crammer's V corresponding to the three college students' willingness to use AI learning tools is only 0.084, 0.094, and 0.088, respectively, it indicates that there is only a weak variability between question 8 and questions 13, 14, and 15, which suggests that

the college students' different choices of the time to use the learning software will not result in a greater differences in willingness to use it.

4.2.4. Differences in attitudes towards AI learning tools in terms of expectations of them

Table 3. Differences in attitudes towards AI learning tools in terms of expectations of them

Field name/Analysis item	Phi	Crammer's V	Number of columnar links	lambda
20、 If you were to use an AI learning tool, what would you prefer to get out of it?	0.176	0.125	0.174	0.000
21、 Do you think AI tools could replace teachers in the future?	0.34	0.24	0.322	0.000

A chi-square analysis was conducted between question 17 and questions 20 and 21.

The analysis shows that, as the Crammer's V corresponding to the expectation of the effect of the use of AI learning tools

by college students is 0.125 and 0.24, respectively, there is a weak difference between question 17 and question 20 while there is a moderate difference between question 17 and question 21, which indicates that, the people with different attitudes towards the use of AI learning tools do not have a big difference in terms of the effect of using the tool, but there is some difference in terms of the understanding of the question of whether AI can replace the teacher in the future. There is no significant difference in the use of the tool, but there is some difference in the perception of the question of

whether AI can replace teachers in the future.

5. Research on the Impact of Artificial Intelligence on University Students' Learning

5.1. Ideas for establishing indicators in the evaluation system

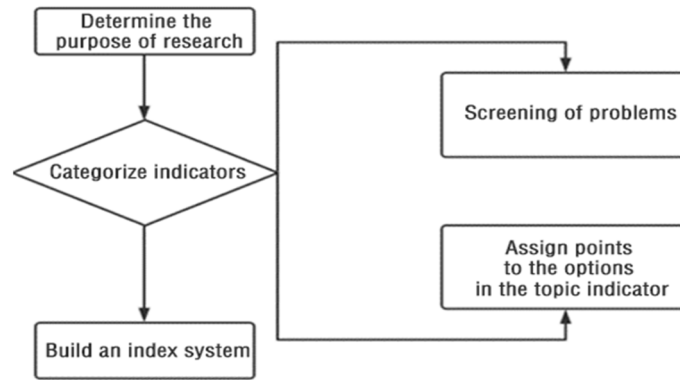


Figure 1. Analysis of the ideas for establishing evaluation indicators

5.2. Construction of indicators in the evaluation system

5.2.1. Analysis of the evaluation system

Priority: we constructed the indicators with the aim of the degree of impact of AI on students' learning, and validated the selected indicators through a later validity.

Scientific: the indicators are homogenised through the validity analysis at a later stage, and the evaluation scores assigned are based on the importance of each topic obtained from the validity analysis.

Operational: the degree of impact can be judged by the assigned score, which is highly operable.

5.2.2. Classification of indicators in the evaluation system

The aim is to homogenise the results of the selection of the different questions in the indicators by grouping the questions

with key characteristics in the questionnaire in Annex I as individual indicators for the construction of the evaluation system and assigning values to each indicator.

5.2.2.1 Proficiency in learning software (α)

Constructing an indicator with questions 6, 7, 10 and 11

We construct an indicator to describe students' proficiency in learning software, which will have a role in evaluating the impact of artificial intelligence on college students' learning.

We judge whether students are enthusiastic about learning software based on whether they want to access the learning resources of colleges and universities across the country, and then judge whether they have used learning software, whether their teachers have recommended learning software, and compare the length of time spent on the Internet to evaluate their proficiency in learning software.

Table 4. Criteria for assigning scores to the topic options in the learning software proficiency indicator

		6			7		10		11		
A		More than 20 hours	7-14 hours	Less than 7 hours	Not on the Internet	Yes	No	Yes	No	Recommended	Not have
5		4	3	2	1	2	1	2	1	2	1

5.2.2.2 Dependence on AI learning tools (β)

Constructing an indicator with questions 12, 13, 14, 15, 17, 19

We constructed an indicator to describe the degree of students' dependence on AI, which will have an impact on AI's evaluation of college students' study habits as well as their academic performance.

Firstly, we evaluate whether students will become dependent on AI learning tools by whether they will choose to use AI learning tools. Then determine whether students want to use AI learning tools to help complete homework, complete quizzes, complete essays, as well as students' attitudes towards AI responses and whether students agree with the use of AI to evaluate students' dependence on AI learning tools.

Table 5. Labelling of the assignment of the topic options in the dependency indicator on the AI learning tool

12		13			14			15			17			19		
Yes	No	Yes	Never thought of that.	No	Yes	Never thought of that.	No	Yes	Never thought of that.	No	Endorsement	Unclear	Clogged	High	Usual	Mistrust
2	1	3	2	1	3	2	1	3	2	1	3	2	1	3	2	1

5.2.2.3 Demand for the use of AI learning tools (γ)

Constructing an indicator with questions 13, 14, 15, and 20

We constructed an indicator to describe students' neediness for AI learning tools, which has some evaluative impact on AI on students.

Firstly, intuitively through whether students will choose to use AI learning tools, and then by determining whether students want to help complete assignments, quizzes, and essays through AI learning tools, to better the construction of the evaluation system for the defined indicator.

Table 6. Criteria for assigning scores to the topic options in the demand indicators for the use of AI learning tools

13			14			15			20			
Yes	Never thought of that.	No	Yes	Never thought of that.	No	Yes	Never thought of that.	No	Comprehensively improve their overall quality	Completion of the thesis	Cope with exams	Help yourself only with questions you don't know
+3	0	-3	+2	0	-2	+1	0	-1	4	3	2	1

5.2.2.4 Tolerance of AI learning tools (δ)

Constructing an indicator with questions 18, 19, and 20

We constructed an indicator to describe students' tolerance of AI learning tools, which will have an impact on the

evaluation of students' learning by AI.

Firstly, we intuitively judge whether we agree with the use of AI learning tools by students, and then we further improve the evaluation system through the attitude towards the credibility of AI learning tools in answering questions.

Table 7. Criteria for assigning scores to topic options in the tolerance indicator for AI learning tools

18			19		
Slow software response	Invalid answer	Incomplete answers to questions	High	Usual	Mistrust
2	3	1	3	2	1

5.2.2.5 Acceptance of AI learning tools (ϵ)

Constructing an indicator with questions 21 and 22

We constructed an indicator to describe students' acceptance of AI learning tools, which has an impact on AI on

students' learning in the future.

The evaluation system of the indicator was constructed directly through whether or not it is recognised that AI tools will replace teachers in the future.

Table 8. Criteria for assigning scores to the topic options in the indicator of acceptance of AI learning tools

21				22			
Extremely possible	It's possible	Currently unknown	Unlikely	Active use of new learning styles and tools	Passive acceptance of new modes of learning	Complete reliance on AI tools	Fixed in tradition and not open to new ways of learning
4	3	2	1	4	3	1	2

5.3. Evaluating the impact of artificial intelligence on university students' learning

5.3.1. Determination of evaluation objectives

The objective of this evaluation is set as the impact of AI on college students' learning, and the evaluation model for evaluating the impact of AI on college students' learning is built on the basis of the evaluation system constructed in question two.

5.3.2. Validity Analysis

The data were analysed for validity and the importance of each question was compared by comparing the variance explained to obtain the weights between different topics within the same indicator.

5.3.3. Establishment of positive and negative indicators

The five indicators that have been established in the evaluation system above include "proficiency in learning software", "dependence on AI learning tools", "demand for the use of AI learning tools", "tolerance for the use of AI

learning tools", and "acceptance of the future direction of AI in education".

Among them, "proficiency in learning software", "demand for the use of AI learning tools", and "acceptance of the future direction of education in AI" are positive indicators of how university students' learning is affected by AI. The "proficiency in learning software", "demand for the use of AI learning tools", and "acceptance of the future direction of AI education" have a positive effect on how university students' learning is affected by AI, so they are taken as positive indicators. On the other hand, "dependence on AI learning tools" and "tolerance of AI learning tools" have a negative effect on the impact of AI on university students' learning, so they are used as negative indicators.

5.3.4. Determination of the significance of the different indicators

In order to further determine the weights of different indicators, the entropy weight method was chosen to analyse the weights of five indicators. The entropy weighting method is based on the amount of information contained in each

indicator to determine the size of the weight of the indicator; the smaller the entropy of an indicator, the greater the degree of variability of the value of the indicator, and the more

information it contains, the greater the weight of the indicator, and the greater the role it plays in the comprehensive assessment.[4]

Table 9. Inter-topic weights within indicators

Ingredient	Total Variance Explained					
	Characteristic Root			Post-rotation Variance Explained		
	Characteristic Root	Variance Explained Rate (%)	Cumulative Percentage (%)	Characteristic Root	Variance Explained Rate (%)	Cumulative Percentage (%)
6	1.123	3.699999999999997	39.7			
7	1.089	3.599999999999996	43.4			
8	1.016	3.400000000000004	46.7			
10	0.968	3.2	53.30000000000004			
11	0.956	3.2	56.49999999999999			
12	0.92	3.1	59.5			
13	0.902	3	62.5			
14	0.858	2.900000000000004	65.4			
15	0.847	2.800000000000003	68.2			
17	0.803	2.7	73.7			
18	0.78	2.6	76.3			
19	0.76	2.5	78.8			
20	0.743	2.5	81.3			
21	0.71	2.4	83.6			
22	0.705	2.3	86			

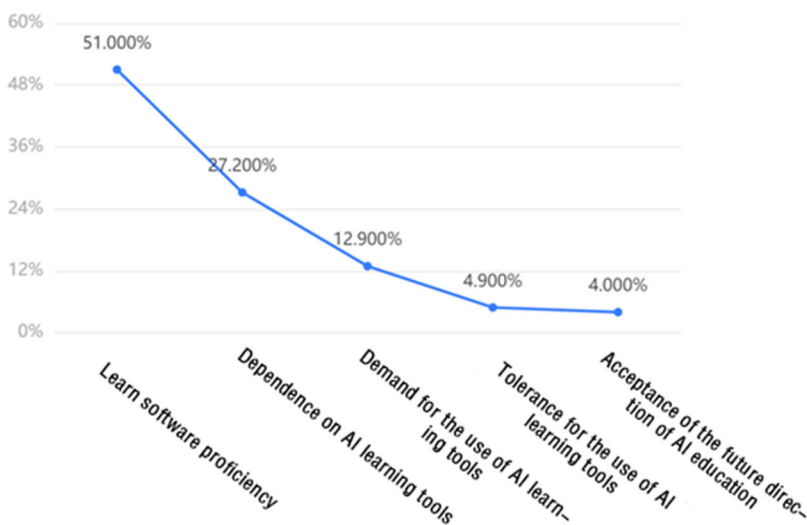


Figure 3. Entropy weighting method for five inter-indicator weights

There is a graphical analysis that shows that the weight of proficiency in learning software is 12.85%, the weight of the need for the use of AI learning tools is 27.179%, the weight of the acceptance of the direction of the future development of education with artificial intelligence is 51.069%, the weight of the dependence on artificial intelligence is 4.921%, and the weight of tolerance for the use of AI learning tools is 3.981%.

The maximum value of 51.069 per cent of the weight of the indicator is the acceptance of the future direction of educational development of artificial intelligence, and the minimum value of 3.981 per cent is the tolerance of the use of artificial intelligence learning tools.

5.3.5. Calculation of the composite assessed value

After obtaining the weights of the different questions between the intra-indicators and the weights between the

indicators, it is possible to weight the calculation of all the university students in the sample regarding the impact of AI on learning.

1. Weighting calculation within indicators:

As different questions answered by college students within each indicator occupy different weights, it is necessary to first perform a weighting calculation within the indicators to obtain the evaluation value of each indicator. Let the evaluation value be M. The evaluation values of the five indicators are set as follows

M_1 、 M_2 、 M_3 、 M_4 、 M_5 , the formula is as follows:

- (1) Proficiency in learning software
 $M_1 = 1.123 \times \text{Assignment of points for question 6} + 1.089 \times \text{Assignment of points for question 7} + 0.968 \times \text{Assignment of points for question 10} + 0.956 \times \text{Assignment of points for question 11}$
- (2) Dependence on AI learning tools

$M_2=0.92 \times \text{Assignment of points for question 12}$
 $+0.902 \times \text{Assignment of points for question 13}$
 $+0.858 \times \text{Assignment of points for question 14}$
 $+0.847 \times \text{Assignment of points for question 15}$
 $+0.803 \times \text{Assignment of points for question 17}$
 $+0.76 \times \text{Assignment of points for question 19}$

(3) Demand for the use of AI learning tools

$M_3=0.902 \times \text{Assignment of points for question 13}$
 $+0.858 \times \text{Assignment of points for question 14}$
 $+0.847 \times \text{Assignment of points for question 15}$
 $+0.743 \times \text{Assignment of points for question 20}$

(4) Tolerance of AI learning tools

$M_4=0.78 \times \text{Assignment of points for question 18}$
 $+0.858 \times \text{Assignment of points for question 19}$
 $+0.847 \times \text{Assignment of points for question 20}$
 $+0.743 \times \text{Assignment of points for question 20}$

(5) Acceptance of AI learning tools

$M_5=0.71 \times \text{Assignment of points for question 21}$
 $+0.705 \times \text{Assignment of points for question 22}$

1. Weighting between indicators:

The weight corresponding to each indicator is multiplied with the evaluation value of each indicator and then summed to get the comprehensive evaluation value about AI on college students' learning, which is calculated as follows:

$$N=0.51M_1+0.272M_2+0.129M_3+0.049M_4+0.04M_5$$

6. Conclusion

6.1. Conclusion

6.1.1. Analysis of the composite assessment value

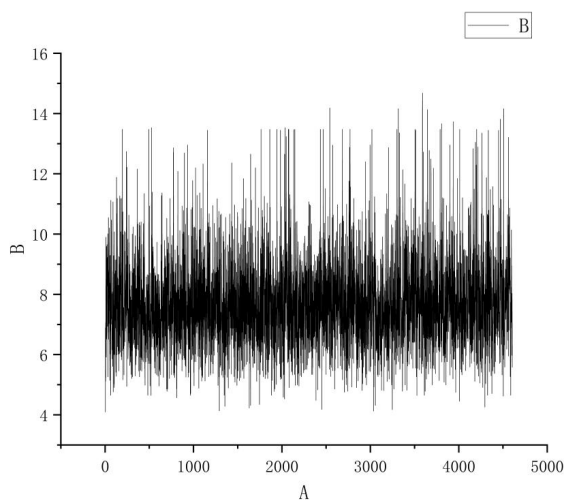


Figure 4. Line graph of the composite evaluation value of the sample

After the comprehensive evaluation value of all the data in the sample was calculated, a line graph was created using Origin.

1. Numerical fluctuation: According to the numerical fluctuation of the lines in the vertical direction, the comprehensive evaluation value of the college students in the image is classified into three situations: the comprehensive evaluation value is below 6, the comprehensive evaluation value is between 6 and 9, and the comprehensive evaluation value is higher than 9. And these three situations correspond to the three situations of AI on college students' learning: AI has a small impact on their learning, AI has a certain impact on their learning, and AI has a large impact on their learning.

2. Intensity: From the dense distribution of the lines, it is

found that the comprehensive evaluation value of college students is centrally distributed between 6 and 9, indicating that AI has a certain influence on the learning of most college students; the distribution of the lines with a comprehensive evaluation value of less than 6 is more dense than that of the lines with a comprehensive evaluation value of more than 9, which indicates that the number of college students with less influence of AI on their learning is larger than the number of college students with greater influence of AI on their learning. The fluctuation of the lines above 9 is more obvious than the fluctuation of the lines below 6, which indicates that for those college students whose learning is more affected by AI, AI will affect their learning to a much higher degree than other college students.

6.1.2. The impact of artificial intelligence on college students' learning

In summary, it can be concluded that the impact of artificial intelligence on college students' learning: artificial intelligence has a wide range of influence on college students' learning and a large degree of influence.

6.2. Knowledge, perception of the impact of artificial intelligence on university students' learning

This paper investigates the impact of AI on college students' learning by constructing an evaluation model and finds that the impact of AI on college students' learning has the following characteristics:

1. To a large extent, it is related to college students' proficiency in learning software.

In this paper, the entropy power method is used to evaluate "proficiency in learning software", "dependence on AI learning tools", "demand for AI learning tools", "Tolerance for the use of AI learning tools" and "Acceptance of the future direction of AI in education" were analysed, and it was found that the weight of the indicator of "proficiency in learning software" was "The weight of this indicator is as high as 51%, which largely determines the degree of influence of artificial intelligence on college students' learning. The entropy weight method determines the weights of the indicators according to the degree of variation of the indicator value of each indicator, and the assignment method is more objective, avoids the bias caused by human factors, and has high precision and objectivity, which can better explain the results obtained. [5]

2. Has a wide range of influence, large degree of influence

Through the line graph established by the comprehensive evaluation value of the sample, it is obvious that the learning situation of the vast majority of college students is affected by artificial intelligence. And by observing the fluctuation range of the lines, it can be intuitively seen that artificial intelligence has a greater degree of influence on the learning situation of college students.

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