

# Research on Information Literacy Evaluation System of University Teachers

Lei Ye, Yuqing Hu, Wanli Zhang

Business Administration School of Wuhan Business University, Hubei Wuhan, 430056, China

**Abstract:** With the development of educational informatization, the information literacy of college teachers is becoming more and more important, so it is necessary to evaluate the information literacy of college teachers quantitatively. Fuzzy comprehensive evaluation method is a method that synthesizes various influencing factors and transforms qualitative evaluation into quantitative evaluation, which is very suitable for the evaluation of information literacy of teachers in colleges and universities. Based on this, this paper uses fuzzy comprehensive evaluation method to conduct a comprehensive evaluation and analysis of college teachers' information literacy, in order to provide reference for colleges and universities to improve teachers' information literacy and promote the construction of education informatization.

**Key words:** universities teacher; information literacy; fuzzy comprehensive evaluation.

## 1. Introduction

In April 2018, the Ministry of Education issued the "Education Informatization 2.0 Action Plan", which requires the transformation from improving teachers' application ability of information technology to comprehensively improving their information literacy [1][2]. In 2021, the Ministry of Education and other six departments issued the Guidance on Promoting the Construction of New Education Infrastructure and Building a High-quality Education Support System, pointing out that Internet + Education should be actively promoted and the concept of deep integration of information technology and education and teaching should be adhered to [3]. It can be seen that China is entering the era of education informationization 2.0. Education informationization not only optimizes the traditional education system, but also puts forward higher requirements for the information ability and literacy of teachers in the new era.

In recent years, universities all over the country have accelerated the construction of education information infrastructure systems such as platform system, digital resources and smart campus, which has promoted the development of higher education modernization. At the same time, in order to continue to deepen the development of educational informatization, the improvement of teachers' information literacy has become an urgent demand of colleges and universities. Therefore, how to evaluate the information literacy of college teachers is particularly important. In order to accurately evaluate the information literacy level of college teachers, promote the improvement of their information literacy, and promote

the construction of college education informatization, it is necessary to conduct a comprehensive evaluation of teachers' information literacy. Based on this, this paper establishes the evaluation index system of college teachers' information literacy, and constructs a comprehensive evaluation model by using analytic hierarchy process and fuzzy comprehensive evaluation method.

## 2. Literature Review

By searching the keyword teacher information literacy in the web of science, the time interval is set from 2013.01.01 to 2023.01.01, the document type is Article and Review, and the index is SSCI. A total of 829 records were retrieved. Setting the language category to English and excluding meeting minutes, news, books and other unrelated documents, the author got 796 records. In this paper, Citespace was used to conduct keyword co-occurrence analysis on 796 pieces of data retrieved. The time slice was set as 1 and the node type was selected as the keyword to obtain the keyword co-occurrence graph, as shown in Figure 1. Figure 1 shows a total of 282 keyword nodes and 545 keyword co-occurrence lines, and the keyword co-occurrence network density is 0.0138. Keywords with high frequency include literacy (190 times), teacher (137 times), education (126 times), student (125 times) and information literacy (117), knowledge (90), information (81) and technology (70). Keywords with high keyword centrality in the research field are children (0.26), childhood (0.26) and instructional strategy (0.23), conception (0.22), knowledge (0.19),

framework (0.18), cognitive development (0.18), school (0.17), etc. Keywords are a high generalization of the theme and content of literature research, and the keywords with high frequency are the reflection of the research hotspot and research direction of the research field. Centrality reflects the importance of nodes in the network structure, and the greater the centrality, the key word has a core status [4]. From the point of view of the frequency of keywords, the research on teacher information literacy mainly focuses on information literacy education, information literacy knowledge and information technology. From the point of view of the centrality of keywords, children (0.26), instructional strategy (0.23) and cognitive development (0.18) reflect that the research field of teacher information literacy has begun to deeply study how primary school teachers adopt effective teaching strategies to enrich students' basic information knowledge. Improve students' knowledge of information. It can be seen that although the research in the field of teachers' information literacy has a certain foundation, the research on the evaluation of college teachers' information literacy is relatively weak. Therefore, it is necessary to evaluate the information literacy of college teachers scientifically and put forward specific suggestions.

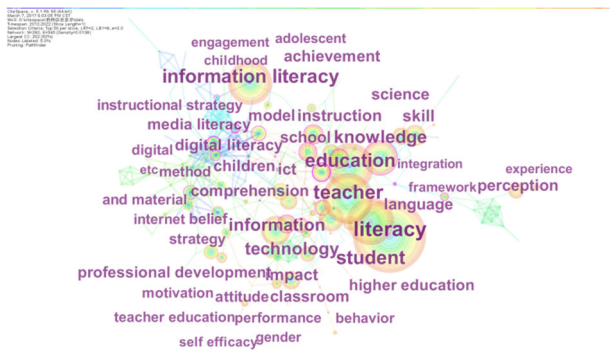


Figure1: Keyword co-occurrence diagram

### 3. Construction of Information Literacy Evaluation System of College Teachers

Analytic hierarchy process (AHP) is a model of decision analysis for different solution problems, which was established by American operations research expert Saaty.T.L. in the 1970s [5]. In this paper, the analytic hierarchy process is adopted to establish the information literacy evaluation system of college teachers. The concrete steps are as follows. Firstly, select indicators. Secondly, the discriminant matrix of the index system is constructed and the index weight is calculated. Finally, the weight results are sorted.

#### 3.1 Index Selection

Through literature review, the new requirements of education informatization on teachers' information literacy are summarized, and the research content of Yu Fengyuan [6], Peng Ruixia [7] and Wu Di [8] is referred

to. Finally, the construction of information literacy evaluation system for teachers in colleges and universities is constructed. Among them, the target layer is the evaluation system of college teachers' information literacy, and the first level indicators are information awareness, information knowledge, information ability and information ethics. Secondary indexes include information initiative (C1), information importance (C2), information insight (C3), basic information knowledge (C4), information retrieval knowledge (C5), information processing knowledge (C6), information acquisition (C7), screening information (C8), application information (C9), information security (C10), information dissemination (C11), and information integrity (C12). The details are shown in Table 1.

Table 1: Evaluation index of information literacy of college teachers

Destination	First-order index	Secondary index	Indicator description
A	B1	C1	Ability to actively acquire information
		C2	Recognize the importance of information
		C3	Be able to see the potential value of information
	B2	C4	Be able to master the basic knowledge of network information technology
		C5	Be able to master the method of retrieving information
		C6	The ability to process information
	B3	C7	Able to use the method of information retrieval, skilled access to their own needs of information
		C8	Ability to analyze, identify and evaluate a large amount of information
		C9	Ability to use the information obtained to solve problems
	B4	C10	Be able to obtain, use and disseminate information in accordance with the law
		C11	Can detect false information and do not spread false information
		C12	Respect others' intellectual property rights and resist academic fraud

### 3.2 Construction of Discrimination Matrix and Weight Calculation

Referring to the thinking of American operations research scientist Saaty.T.L. based on hierarchical analysis, the 1-9 scientific scale method is adopted. "1" indicates that two factors have the same importance when compared with each other. "3" indicates that the former is slightly more important than the latter. "5" indicates that the former is significantly more important than the latter. "7" means that the former is more important than the latter. "9" indicates that the former is more important than the latter. "2", "4", "6" and "8" represent the intermediate values of the above adjacent judgments [9]. Based on this, the discriminant matrix of the information literacy evaluation system of college teachers is constructed and the data is tested scientifically. Finally, the weight of each layer index is calculated. Based on the hierarchical model of the information literacy evaluation system of college teachers and the above methods, relevant questionnaires were prepared and sent to relevant authoritative experts. The questionnaire data were collected and imported into Yaahp software to calculate the discrimination matrix and weight of the information literacy evaluation system of college teachers, as shown in Table 2-6.

Table 2: The discriminant matrix of A

	B1	B2	B3	B4	Weight (Wi)	Consistency ratio(CR)
B1	1	0.3333	0.25	3	0.142	0.0891
B2	3	1	0.3333	3	0.26	
B3	4	3	1	4	0.5167	
B4	0.3333	0.3333	0.25	1	0.0813	

Table 3: The discriminant matrix of B1

	C1	C2	C3	Weight (Wi)	Consistency ratio(CR)
C1	1	4	3	0.625	0.0176
C2	0.25	1	0.5	0.1365	
C3	0.3333	2	1	0.2385	

Table 4: The discriminant matrix of B2

	C4	C5	C6	Weight (Wi)	Consistency ratio(CR)
C4	1	2	0.3333	0.2385	0.0176
C5	0.5	1	0.25	0.1365	
C6	3	4	1	0.625	

Table 5: The discriminant matrix of B3

	C7	C8	C9	Weight (Wi)	Consistency ratio(CR)
C7	1	3	0.25	0.2255	0.0825
C8	0.3333	1	0.2	0.1007	
C9	4	5	1	0.6738	

Table 6: The discriminant matrix of B4

	C10	C11	C12	Weight (Wi)	Consistency ratio(CR)
C10	1	4	5	0.6833	0.0236
C11	0.25	1	2	0.1998	
C12	0.2	0.5	1	0.1168	

The results showed that all the consistency ratios  $CR < 0.1$ , and all the judgment matrices passed the consistency test. Further analysis of the tables is as follows. Table 2 shows that the four main indicators of the information literacy evaluation system of college teachers are information awareness, information knowledge, information ability and information ethics, and the weight of the evaluation from high to low is information ability, information knowledge, information awareness and information ethics. Among them, the weight score of information ability is the highest (0.5167), and that of information ethics is the lowest (0.0813). Table 3 shows that the indicators at the level of information consciousness include three parts which contain information initiative, information importance, and information insight. The weights of the evaluation from high to low are as follows. The weight of the evaluation indicator of information initiative is 0.625. The weight of the evaluation indicator of information insight is 0.2385. The weight of the evaluation indicator of information importance is 0.1365. It can be seen that from the level of information consciousness, information initiative is an important factor to judge the information literacy of college teachers. Table 4 shows that the indicators at the level of information knowledge include information basic knowledge, information retrieval knowledge, and information processing knowledge. The weights of the evaluation from high to low are as follows. The weight of the evaluation indicator of information processing knowledge is 0.625. The weight of the evaluation indicator of information basic knowledge is 0.2385. The weight of the evaluation indicator of information retrieval knowledge is 0.1365. It can be seen that at the level of information knowledge, the influence of information processing knowledge is relatively large, while the influence of information basic knowledge and information retrieval knowledge is relatively small. Table 5 shows that the indicators at the level of information ability include three parts which contain access to information, screening information and application

information. The weights of evaluation from high to low are as follows. The weight of the evaluation indicator of application information is 0.6738. The weight of the evaluation indicator of access information is 0.2255. The weight of the evaluation indicator of screening information is 0.1007. It can be seen that in the level of information ability, application is an important factor to judge the information literacy of college teachers. Table 6 shows that the indicators in the level of information ethics include information security, information communication, and information integrity. The weights of evaluation from high to low are as follows. The weight of the evaluation indicator of information security is 0.6833. The weight of the evaluation indicator of information communication is 0.1998. The weight of the evaluation indicator of information integrity is 0.1168. It can be seen that at the level of information ethics, the impact of information security is relatively large, while the impact of information transmission and information integrity is relatively small.

### 3.3 Weight Sorting

Based on the weight vector of all levels of information literacy evaluation indicators of teachers in colleges and universities, the influence degree of the secondary indicators relative to the target level can be calculated. The weight and ranking of information literacy evaluation indicators of college teachers are shown in the following table.

Table7: Ranking table of information literacy evaluation index weight of university teachers

Destination layer	Primary index layer	Secondary index layer	Weight	Comprehensive weight	Sort
A	B1	C1	0.625	0.0887	4
		C2	0.135	0.0194	10
		C3	0.235	0.0339	9
	B2	C4	0.235	0.062	5
		C5	0.135	0.0355	8
		C6	0.625	0.1625	2
	B3	C7	0.225	0.1165	3
		C8	0.107	0.052	7
		C9	0.673	0.3482	1

			8		
	B4	C10	0.683	0.0555	6
		C11	0.199	0.0162	11
		C12	0.116	0.0095	12

As can be seen from Table 7, the first level indicators are information ability (0.5167), information knowledge (0.26), information awareness (0.142) and information ethics (0.0813) according to their weights. In the secondary index, the weight of information application (0.3482), information processing knowledge (0.1039), information acquisition (0.1008) and information initiative (0.0887) is relatively high.

Among the indicators to evaluate the information literacy of college teachers, the overall evaluation of information literacy is higher, with a weight of 0.5167, which supports the conclusions of previous studies on the information literacy of college teachers, and confirms that the information technology application ability of most college teachers is in the middle level. In teaching, subject teaching resources can be integrated and information teaching mode can be used to carry out teaching [10]. Among the indicators to evaluate the information literacy of college teachers, the overall evaluation of information awareness and information knowledge is also relatively high, with the weight reaching 0.142 and 0.26 respectively. The related conclusion is that most college teachers have a high level of information awareness and information knowledge, and are willing to use information technology in teaching activities [10].

Among the indicators to evaluate the information literacy of college teachers, the overall evaluation of information ethics is not high, with the weight only reaching 0.0813. Among the secondary indicators of information ethics, the evaluation of teachers' information security, information communication and information integrity behavior is not high, and the corresponding weights of the secondary indicators only reach 0.055, 0.0162 and 0.0095. The results show that information security, information communication and information integrity should be the key indicators to improve the information literacy of college teachers.

### 4. Fuzzy Comprehensive Evaluation Analysis

Fuzzy comprehensive evaluation method is based on the membership principle of fuzzy mathematics, which changes from qualitative evaluation to quantitative evaluation, that is, using fuzzy mathematics method to comprehensively evaluate events and objects affected by different parameters [11]. In this paper, the fuzzy comprehensive evaluation method is used to evaluate the information literacy of college teachers, which can be divided into the following steps. Firstly, the fuzzy

evaluation set of college teachers' information literacy is established. Secondly, the fuzzy comprehensive evaluation of college teachers' information literacy is carried out. Finally, the fuzzy comprehensive evaluation results of information literacy of college teachers are analyzed.

#### 4.1 Establishment of Fuzzy Evaluation Set

In this paper, the evaluation set is divided into five levels, and the corresponding comments are respectively excellent, good, average, poor and poor, namely, the evaluation set is  $V\{V1,V2,V3,V4,V5\}$ , to represent the quality of information literacy of college teachers. In order to obtain the evaluation value of each index, 142 questionnaires were sent out, and 142 valid questionnaires were collected to conduct questionnaire survey on teachers in colleges and universities. Through statistical and calculated data, the evaluation results of various indicators related to information literacy of college teachers are obtained, as shown in Table 8.

Table 8: Evaluation results of information literacy index of college teachers

Destination	Layer	Excellent	Good	Generally	Poor	Very poor	
A	B1	C1	0.3169	0.5141	0.1549	0.0141	0
		C2	0.4155	0.4366	0.1268	0.0211	0
		C3	0.2394	0.3944	0.2958	0.0704	0
	B2	C4	0.2394	0.3592	0.2958	0.0986	0.007
		C5	0.2113	0.4225	0.2887	0.0775	0
		C6	0.1549	0.3521	0.3803	0.0915	0.0211
	B3	C7	0.1831	0.4648	0.2676	0.0775	0.0211
		C8	0.1549	0.3803	0.338	0.1197	0.007
		C9	0.1761	0.3873	0.3592	0.0775	0.007
	B4	C10	0.3169	0.5141	0.2465	0.0915	0
		C11	0.1761	0.3521	0.3662	0.1056	0
		C12	0.3521	0.4014	0.2113	0.0352	0

#### 4.2 Fuzzy Comprehensive Evaluation

The fuzzy judgment matrix of each level index can be calculated through the above evaluation value of information literacy of university teachers.

The fuzzy judgment matrix of information consciousness is as follows.

$$R_1 = \begin{bmatrix} 0.3169 & 0.5141 & 0.1549 & 0.0141 & 0 \\ 0.4155 & 0.4366 & 0.1268 & 0.0211 & 0 \\ 0.2394 & 0.3944 & 0.2958 & 0.0704 & 0 \end{bmatrix}$$

The fuzzy judgment matrix of information knowledge is as follows.

$$R_2 = \begin{bmatrix} 0.2394 & 0.3592 & 0.2958 & 0.0986 & 0 \\ 0.2113 & 0.4225 & 0.2887 & 0.0775 & 0.007 \\ 0.1549 & 0.3521 & 0.3803 & 0.0915 & 0 \end{bmatrix}$$

The fuzzy judgment matrix of information capability is as follows.

$$R_3 = \begin{bmatrix} 0.1831 & 0.4648 & 0.2676 & 0.0775 & 0.0211 \\ 0.1549 & 0.3803 & 0.338 & 0.1197 & 0.007 \\ 0.1761 & 0.3873 & 0.3592 & 0.0775 & 0.007 \end{bmatrix}$$

The fuzzy judgment Matrix of information ethics is as follows.

$$R_4 = \begin{bmatrix} 0.3169 & 0.3451 & 0.2465 & 0.0915 & 0 \\ 0.1761 & 0.3521 & 0.3662 & 0.1056 & 0 \\ 0.3521 & 0.4014 & 0.2113 & 0.0352 & 0 \end{bmatrix}$$

According to the formula  $B=WR$ , the judgment vectors  $B_1, B_2, B_3$  and  $B_4$  can be obtained. The calculated results are as follows.

$$B_1 = W_1 R_1 = \begin{bmatrix} 0.0887 & 0.0194 & 0.0339 \\ 0.312 & 0.475 & 0.185 & 0.028 & 0 \end{bmatrix} \begin{bmatrix} 0.3169 & 0.5141 & 0.1549 & 0.0141 & 0 \\ 0.4155 & 0.4366 & 0.1268 & 0.0211 & 0 \\ 0.2394 & 0.3944 & 0.2958 & 0.0704 & 0 \end{bmatrix}$$

$$B_2 = W_2 R_2 = \begin{bmatrix} 0.062 & 0.0355 & 0.1625 \\ 0.183 & 0.363 & 0.348 & 0.015 & 0.091 \end{bmatrix} \begin{bmatrix} 0.2394 & 0.3592 & 0.2958 & 0.0986 & 0 \\ 0.2113 & 0.4225 & 0.2887 & 0.0775 & 0.007 \\ 0.1549 & 0.3521 & 0.3803 & 0.0915 & 0 \end{bmatrix}$$

$$B_3 = W_3 R_3 = \begin{bmatrix} 0.1165 & 0.052 & 0.3482 \\ 0.176 & 0.404 & 0.336 & 0.082 & 0.002 \end{bmatrix} \begin{bmatrix} 0.1831 & 0.4648 & 0.2676 & 0.0775 & 0.0211 \\ 0.1549 & 0.3803 & 0.338 & 0.1197 & 0.007 \\ 0.1761 & 0.3873 & 0.3592 & 0.0775 & 0.007 \end{bmatrix}$$

$$B_4 = W_4 R_4 = \begin{bmatrix} 0.0555 & 0.0162 & 0.0095 \\ 0.293 & 0.353 & 0.266 & 0.088 & 0 \end{bmatrix} \begin{bmatrix} 0.3169 & 0.3451 & 0.2465 & 0.0915 & 0 \\ 0.1761 & 0.3521 & 0.3662 & 0.1056 & 0 \\ 0.3521 & 0.4014 & 0.2113 & 0.0352 & 0 \end{bmatrix}$$

The overall evaluation matrix  $R$  is a fuzzy judgment matrix with  $B_1, B_2, B_3$  and  $B_4$  as rows. According to the weight vector  $W$  of first-level indicators, the overall evaluation result is as follows.

$$B = WR = \begin{bmatrix} 0.142 & 0.26 & 0.5167 & 0.0813 \\ 0.207 & 0.399 & 0.312 & 0.057 & 0.025 \end{bmatrix} \begin{bmatrix} 0.312 & 0.475 & 0.185 & 0.028 & 0 \\ 0.183 & 0.363 & 0.348 & 0.015 & 0.091 \\ 0.176 & 0.404 & 0.336 & 0.082 & 0.002 \\ 0.293 & 0.353 & 0.266 & 0.088 & 0 \end{bmatrix}$$

#### 4.3 Result Analysis

To sum up, each item in Matrix  $B$  is the information literacy evaluation of college teachers based on fuzzy comprehensive evaluation method, which occupies the centralized evaluation power, representing the membership degree of excellent evaluation is 20.7%. The membership degree with good evaluation is 39.9%. The average membership was 31.2%. The membership degree with poor evaluation was 5.7%. The poorly rated membership was 2.5%. It can be seen that good conditions occupy the largest proportion. According to the principle of maximum membership degree,  $0.399 > 0.312 > 0.207 > 0.057 > 0.025$ , and the maximum membership degree of matrix  $B$  is 39.9%, it can be concluded that the evaluation of information literacy of college teachers at the present stage is good.

#### 5. Conclusion

In order to evaluate the information literacy of college teachers scientifically and accurately, this paper constructs the hierarchical structure model of the information literacy of college teachers. The hierarchical

structure model includes four first-level indicators, namely, information awareness, information knowledge and information ability, and 15 second-level indicators, namely, information initiative, information importance, information insight, information basic knowledge, information retrieval knowledge, information processing knowledge, access to information, discrimination of information, application of information, information security, information dissemination and information integrity. Based on this, this paper uses analytic hierarchy process to calculate the corresponding weights of indicators, and combines with the fuzzy comprehensive evaluation method to calculate the evaluation set of indicators, and finally comes to the conclusion that the evaluation result of college teachers' information literacy is good. The evaluation results show that college teachers' information literacy needs to be improved from the aspects of information security, information communication, information ethics, so as to promote the development of college teachers' information literacy and make greater contributions to deepening education informatization.

## Acknowledgments

This paper is supported by the general project of educational science planning in Wuhan (Grant No. 2021C166), and the guiding project of scientific research plan of the Department of Education of Hubei Province (Grant No. B2020234), the philosophy and social science research project of the Department of Education of Hubei Province (Grant No. 20G064), and the research project of national business education training of the 14th Five-Year Plan (Grant No. SKKT-22060).

## References

1. Chen Zheng. Research on the Evaluation System of College Teachers' Information Literacy in the Era of Education Informatization 2.0 [J]. Journal of Xingtai University, 201,36(01):91-94+109.
2. Zheng Xudong. Smart Education 2.0: The New Ecology of Education from the Perspective of Education Informationization 2.0 -- The Second Interpretation of the Action Plan of Education Informationization 2.0 [J]. Journal of Distance Education,2018,36(04):11-19.
3. Jin Yule, Zhang Maocong, Luo Shengquan, Yu Wensen, Zhang Mingkai. Study and Implement the Party's Twenty Great Spirits: A Written Discussion of "Thinking and Acting on the Modernization of Chinese Basic Education" [J/OL]. Journal of Educational Science of Hunan Normal University :1-15[2023-03-20].
4. Chen Biao, Zhang Qianqian, Zhu Qing. Current situation, Hotspot and Trend of Resource and Environmental Economy Research in China: A Visual Analysis Based on CiteSpace [J]. China Land and Resources Economics, 2019,36(02):55-64.
5. Song Caiping, Jin Wenwen. Research on Comprehensive Benefit Evaluation of Forest Product Logistics Enterprises Based on AHP-Fuzzy Comprehensive Evaluation Method: A Case Study of Heilongjiang Province [J]. Forestry Economics,2016,38(05):80-83.
6. Yu Fengyuan. Research on Information Literacy Evaluation of University Teachers Based on Fuzzy Synthesis Method [J]. Journal of University of Electronic Science and Technology of China (Social Sciences Edition),2011,13(03):108-112.
7. Peng Ruixia, Zhao Qinggang. Construction of Teacher Information Literacy Evaluation System by Regression Analysis [J]. Education Research of Tsinghua University,2006(03):114-118.
8. Wu Di, Zhou Chi, Chen Min. Evaluation of Teachers' Information Literacy in the Era of "Internet Plus" [J]. China Audio-Visual Education,2020(01):56-63+108.
9. Luo Yuejun, Qi Xiaoling, Wang Peng, Zhao Daiqing. Research and Judgment of Energy Technology Affecting Power Structure: Based on Hierarchical Analysis and Fuzzy Comprehensive Evaluation [J]. Science and Technology Management Research,20,40(20):50-57.
10. Song Quanhua, Yu Yong. Information Technology Literacy of University Teachers: Current Situation, Dilemma and Path -- Taking Some Universities in Western China as an Example [J]. Modern Educational Technology,2020,30(10):78-84.
11. Liang Haifeng, Liu Ziyan. Comprehensive Benefit Evaluation of Intelligent Distribution Network Based on AHP Entropy Weight Method Fuzzy Comprehensive Analysis [J]. Journal of North China Electric Power University (Natural Science Edition),2023,50(01):48-55.