Research on the Evaluation Model and Application of University Teachers' Information Awareness in the Information Age

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Abstract. As a transporter of talents to the society, college teachers directly influence their ability to acquire, judge and use information, which affects the effect of information-based teaching and affects the quality of talents delivered to a certain extent. In view of this, the article builds a set of scientific and systematic informationization evaluation index system of college teachers in the information age, uses principal component analysis method to construct the evaluation model of college teachers' information consciousness in the information age, and the information of college teachers. The sample survey of consciousness is carried out, and the evaluation model is used to comprehensively evaluate the application of college teachers' information awareness. Finally, the evaluation results are briefly analyzed.

1. Introduction

Information technology has an increasing influence on all walks of life in all fields of society. With the rapid development of information technology, information technology is leading the society to change. Since the "Internet +" action plan was put forward, the degree of integration of Internet + industry and industry The bigger the more popular, the education community naturally set off a wave of information technology integration education, the era of education informationization and change is inevitable, Internet + education is also an important component of the national Internet of Things + strategy. In today's information age, how to use colleges and universities to transform educational methods and means with information technology, how to improve the teaching effect by means of information technology is a question for teachers to think about.

2. The significance of the evaluation of college teachers' information awareness

Outline of the National Medium- and Long-Term Education Reform and Development Plan (2010-2020)[1] pointed out that it is necessary to strengthen the application of information technology, improve the level of teachers' application of information technology, update teaching concepts, improve teaching methods, and improve teaching effects. The strength of college teachers' information awareness directly affects the speed and ability of acquiring, judging and using information, which in turn affects the effect of informatization teaching. It also indirectly affects students' learning and the ability of students to acquire, judge, use information and the quality of students.
In the information age, the evaluation of college teachers' information awareness is the need to adapt to the new requirements of teachers in today's informationization, adapt to the needs of educational informationization, and conform to the trend of the times. From the perspective of academic research, this research can further enrich teachers. The theoretical results of information consciousness research, to a certain extent, make up for the lack of quantitative research on information consciousness.

In the information age, the evaluation of college teachers' information awareness can provide teachers with a better understanding of self-information awareness, find out the inadequacies of their information consciousness, and promote teachers' benchmarking to improve individual's information awareness, information ability and information literacy. At the same time, it provides teachers with a better understanding of the status of information awareness in information teaching, and stimulates teachers' subconscious information behavior to provide assistance.

3. Information awareness evaluation index system for college teachers

A set of scientific and systematic information age evaluation index system for college teachers is an basis for objective evaluation of teachers' information awareness.

3.1 Principles for evaluating the index system

The concept of information consciousness is not clearly defined at present, but the literature research related to combing can find that information consciousness belongs to the psychological and behavioral tendency of people's objective information and information activities, and it has difficulty in quantifying complexity. Therefore, in the design of the evaluation index system, we should try to be scientific, comprehensive and comprehensive, consider the systemicity and connection between indicators, try to choose indicators that are easy to quantify, and follow the simplicity, availability, and combination of quantitative and qualitative. The dean selects indicators, and the principles must be considered comprehensively and treated differently.

3.2 Construction of evaluation index system

On the basis of reading a large number of relevant literatures and deeply comprehending the connotation of information consciousness, we draw on the evaluation and evaluation of information literacy evaluation and information awareness at home and abroad. Considering the process of generating information needs, forming psychological motives for detailed information, cognitive information, consciously acquiring, absorbing, utilizing information, and forming information capabilities, and constructing five primary indicators and 39 secondary indicators based on consulting experts' opinions. University teacher information awareness evaluation index system (as shown in Table 1). The 10 experts were invited to rank the importance of each level of indicators, and the weights of each level of indicators were calculated as shown in Table 1. Since the number of secondary indicators is large, it is assumed that the weights of the secondary indicators are the same.
### Table 1: Evaluation Index System of College Teachers' Information Awareness in the Information Age

| Primary indicator | W(%) | Secondary indicators |
|-------------------|------|----------------------|
| Information cognition and demand awareness | 0.26 | Have a correct understanding and understanding of information and information activities in the information society X11 |
| | | Correct understanding of information education, active attention to education informationization and maintaining high enthusiasm X12 |
| | | Recognizing the importance of information technology to education and teaching and willing to learn information technology knowledge X13 |
| | | Actively face the rapid and massive information technology challenges in the information age, not afraid of information technology X14 |
| | | Have a strong desire for knowledge X15 |
| | | Strong sensitivity, judgment, and insight into information, enabling rapid and keen capture of information X16 |
| | | Willing and consciously improve their level of informatization and maintain a high enthusiasm for new information X17 |
| | | Awareness of lifelong learning X18 |
| | | Innovative X19 |
| Information acquisition and communication awareness | 0.26 | Willing to learn and use information tools frequently X21 |
| | | Skilled use of information acquisition methods X22 |
| | | Willing to use information technology as a basic means of work X23 |
| | | Ability to screen and judge information in a variety of information X24 |
| | | Skilled in obtaining valid information X25 |
| | | Frequently discuss with peers, exchange methods for capturing information, accessing information, and using tools X26 |
| | | Ability to pass on the value, function, access, and use of information to students X27 |
| | | Information technology can be used to provide students with information on pre-class exploration and after-school development X28 |
| | | Can use the information technology such as network platform to communicate with students and discuss X29 |
| | | Pay Attention to the Cultivation of Students' Information Consciousness X30 |
| Information exchange and application awareness | 0.24 | Can apply information reasonably to education and teaching X31 |
| | | Can use information means to improve the effect of education and teaching X32 |
| | | Ability to effectively integrate information with the courses taught X33 |
| | | Ability to integrate information with personal knowledge systems X34 |
| | | Effectively exchange information and cooperation with colleagues and subject experts in teaching and research, and actively influence others to enhance information awareness X35 |
| | | The information resources collected can be processed and integrated into the information resources that they need. X36 |
| Information Economy and Value Consciousness | 0.13 | Can recognize and tap the value of the information itself X41 |
| | | Ability to process and deliver correct, timely information X42 |
| | | Ability to integrate existing information and generate new information X43 |
| | | Have the habit of inducing, classifying, and storing information X44 |
| | | Can use information to solve problems in education and teaching, let information play its greatest value X45 |
| | | Can effectively use information to solve problems in scientific research and let information maximize economic and social benefits X46 |
| | | Can effectively use information to solve problems in life and let information play the most economic and social campus X47 |
| Information ethics and security awareness | 0.11 | Understand information laws and comply with information laws and regulations X51 |
| | | In the process of obtaining, using, and exchanging information, you can abide by the various ethics in information activities. X52 |
| | | Can consciously resist interference from harmful information X53 |
| | | Can shield and clean up unwanted spam interference X54 |
| | | Being able to maintain the security of social information by yourself X55 |
| | | Deliver information that is good for students X56 |
| | | Have a strong sense of confidentiality X57 |

### 4. The Principal Component Analysis Evaluation Model and Steps

Principal component analysis [5] is a statistical analysis method that reduces the plurality of indicators into a few unrelated comprehensive indicators through dimensionality reduction technology. The basic idea is to try to recombine many of the previously relevant indicators (such as p indicators) into a new set of mutually independent comprehensive indicators instead of the original indicators.
The mathematical model of principal component analysis is essentially a transformation. There are \( n \) samples, and each sample observes \( P \) indicators (variables): \( X_1, X_2, X_3, \ldots, X_p \), get the raw data matrix \( X = (X_1, X_2, X_3, \ldots, X_p) \), using the \( p \) vectors of the data matrix \( X \) as a linear combination, is:

\[
F_i = a_{i1}X_1 + a_{i2}X_2 + \cdots + a_{ip}X_p \quad i = 1, \ldots, k
\]  

(1)

\( F_i \) is the \( i \)-th principal component, \( a_{ij} \) is the \( j \)-th component of the eigenvector corresponding to the \( i \)-th eigenvalue of the covariance matrix of \( X \), and \( k \) is the number of main components. Specific steps are as follows:

1) Raw data data matrix composed of \( P \) indicators (variables) of \( n \) samples \( X = (X_1, X_2, X_3, \ldots, X_p) \) standardized processing.

2) According to the correlation coefficient matrix \( r \) of the standardized data array calculation index, the correlation coefficient matrix is used to obtain the eigenvalue and the feature vector.

3) Find the eigenvalues of the correlation coefficient matrix \( r \) \( \lambda_i \) \( (i = 1, \ldots, k) \), \( \lambda_i \) reflecting the original information content represented by the \( i \)-th principal component, ie \( F_i \), the variance of the original indicator data is explained, then the principal component \( F_i \) contribution rate \( \lambda_i / \sum_{i=1}^{n} \lambda_i \). That is to say, the contribution rate of the \( i \)-th principal component is the variance of the \( i \)-th principal component. \( \lambda_i \) Full variance \( \sum_{i=1}^{n} \lambda_i \) The proportion.

4) Sort the eigenvalues obtained from the correlation coefficient matrix from large to small, and extract the corresponding eigenvectors according to the principle that the cumulative contribution rate of the eigenvalues reaches 85% or more, and the cumulative contribution rate of the current \( k \) principal components. \( \sum_{i=1}^{k} \lambda_i / \sum_{i=1}^{n} \lambda_i \) When 85% is reached, the first \( k \) principal components are selected.

5) Extract the first \( k \) principal components whose cumulative contribution rate reaches 85%, and find the eigenvector \( a_{ij} \).

\[
a_{ij} = b_{ij} / \sqrt{\lambda_i}
\]  

(2)

\( b_{ij} \) is the factor load of the \( j \)-th principal component on the \( i \)-th indicator.

6) Write each principal component according to the feature vector

\[
F_i = a_{i1}X_1 + a_{i2}X_2 + \cdots + a_{ip}X_p \quad i = 1, \ldots, k
\]  

(3)

7) Calculate the principal component score for comprehensive evaluation

The calculation formula of the principal component score is that the factor score \( fac \) is multiplied by the square root of the corresponding variance, and then the principal component score is weighted by the variance contribution rate of each principal component, the comprehensive score of the sample is calculated, and the samples are sorted.

5. Application of principal component analysis and evaluation model in the evaluation of college teachers' information consciousness in the information age

Ten college teachers from Changsha City were randomly selected to conduct information awareness surveys. 10 teachers were scored for 10 points, and 10 teachers scored slightly.
5.1 Principal component analysis of the secondary indicators under each primary indicator

Since the indicators are of the same dimension, the standardization process is omitted here. Principal component analysis was performed with nine indicators in information cognition and demand consciousness.

Table 2 Explains the total variance

| Ingredients | Initial eigenvalue | % of variance | Accumulation% | Extract square sum loading | % of variance | Accumulation% | Rotation square sum loading | % of variance | Accumulation% |
|-------------|-------------------|---------------|---------------|--------------------------|---------------|---------------|---------------------------|---------------|---------------|
| 1           | 5.171             | 57.456        | 57.456        | 5.171                    | 57.456        | 57.456        | 3.754                     | 41.706        | 41.706        |
| 2           | 1.471             | 16.344        | 73.800        | 1.471                    | 16.344        | 73.800        | 2.363                     | 26.253        | 67.959        |
| 3           | 1.245             | 13.832        | 87.631        | 1.245                    | 13.832        | 87.631        | 1.771                     | 19.672        | 87.631        |
| 4           | .456              | 5.066         | 92.697        | .456                     | 5.066         | 92.697        | .363                     | 39.379        | 131.076       |
| 5           | .387              | 4.301         | 96.998        | .387                     | 4.301         | 96.998        | .315                     | 28.361        | 124.359       |
| 6           | .156              | 1.729         | 98.727        | .156                     | 1.729         | 98.727        | .125                     | 10.875        | 119.596       |
| 7           | .088              | .981          | 99.708        | .088                     | .981          | 99.708        | .075                     | 6.630         | 126.336       |
| 8           | .026              | .292          | 100.000       | .026                     | .292          | 100.000       | .020                     | 1.760         | 101.760       |
| 9           | 3.929E-5          | .000          | 100.000       | 3.929E-5                 | .000          | 100.000       | .000                     | .000          | .000          |

Extraction method: principal component analysis.

Based on the principle that the principal component cumulative variance contribution rate is greater than or equal to 85%, the cumulative variance contribution rate of the first three principal components of the information cognition and demand consciousness index is 87.63%, corresponding to the first three eigenvalues. They are 5.171, 1.471, and 1.245 respectively. Using formula $a_{ij} = b_j / \sqrt{\lambda_i}$, the feature vector of the principal component analysis (i.e., the coefficient of the principal component) is calculated, wherein the component matrix is as shown in Table 3.

Table 3 Component Matrix

| Ingredients | 1     | 2     | 3     |
|-------------|-------|-------|-------|
| X11         | .583  | -.537 | .443  |
| X12         | .899  | -.096 | -.058 |
| X13         | .840  | .002  | -.379 |
| X14         | .795  | .371  | -.349 |
| X15         | .913  | .203  | -.276 |
| X16         | .447  | .736  | .474  |
| X17         | .855  | -.068 | -.076 |
| X18         | .686  | -.655 | .052  |
| X19         | .670  | .144  | .686  |

The first three main components extracted are as follows:

$F_{11} = 0.256X11 + 0.395X12 + 0.369X13 + 0.35X14 + 0.4013X15 + 0.0197X16 + 0.376X17 + 0.302X18 + 0.295X19$

$F_{12} = -0.501X11 - 0.09X12 + 0.002X13 + 0.346X14 + 0.19X15 + 0.687X16 - 0.063X17 - 0.612X18 + 0.134X19$

$F_{13} = 0.397X11 - 0.052X12 - 0.34X13 - 0.313X14 - 0.247X15 + 0.425X16 - 0.068X17 + 0.047X18 + 0.615X19$

The principal component score $f$ is calculated from the factor score, where the principal component score = factor score * the square root of the corresponding feature value.

According to $F1 = 0.575/0.8763 \times F11 + 0.163/0.8763 \times F12 + 0.138/0.8763 \times F13$ Calculate the comprehensive scores of information cognition and demand awareness of 10 teachers:

$B1 = (0.98, -1.126, -1.643, 1.619, 1.346, 0.637, -0.594, 0.938, 0.069, -2.225)$
In the same way, the main component scores b2, b3, b4, and b5 are calculated by principal component analysis for four first-level indicators of information acquisition and communication awareness, information exchange and application awareness, information economy and value awareness, and information ethics and safety awareness.

For the information acquisition and communication awareness index, the first three main components are extracted, and the second level index comprehensive score of 10 teachers is calculated:

\[
B2 = (0.411, 0.049, -2.243, 0.806, 2.066, 0.942, -3.314, -0.903, -0.052, 2.099)
\]

For the information exchange and application awareness indicators, the first two principal components are extracted, and the third level index comprehensive score of 10 teachers is calculated:

\[
B3 = (1.186, -1.619, -2.665, 0.986, 2.471, 1.042, -1.014, -0.027, -1.535, 1.173)
\]

For the information economy and value consciousness indicators, the first principal component is extracted, and the fourth level index comprehensive score of 10 teachers is calculated:

\[
B4 = (0.374, -1.019, -1.587, 0.917, 3.777, 2.098, -4.838, 1.992, -1.749, 0.034)
\]

For the information ethics and safety awareness indicators, the first principal component is extracted, and the fourth level index comprehensive score of 10 teachers is calculated:

\[
B5 = (-0.14, 0.229, 0.85, 0.567, 0.692, -1.493, 1.045, -1.189, 1.164, -1.726)
\]

5.2 Weighted comprehensive evaluation of the first-level indicators of college teachers' information consciousness

Weights determined by experts for each level of indicators \(W = (0.26, 0.26, 0.24, 0.13, 0.11)\). For the right, the principal component analysis comprehensive scores of each level of indicators are weighted, and the information-aware comprehensive scores of 10 teachers are calculated.

\[
B = W \begin{bmatrix} B1 \\ B2 \\ B3 \\ B4 \\ B5 \end{bmatrix} = \begin{bmatrix} 0.680, -0.776, -1.763, 1.049, 2.084, 0.769, -1.774, 0.131, -0.463, 0.063 \end{bmatrix}
\]

6. Brief analysis of comprehensive evaluation

(1) According to the weighted score of principal component analysis, it can be found that: the maximum score of the principal component analysis of 10 teachers' information consciousness is 2.084, followed by 1.049, the minimum value is -1.774, and the information consciousness of 10 teachers has certain differences. It can be speculated that teachers' informatization consciousness is different in college teachers, and they are strong and weak. Through comprehensive evaluation, teachers can be motivated to improve their information awareness.

(2) According to the principal component score, the information consciousness of 10 teachers can be sorted: the fifth teacher has the strongest information consciousness, the fourth teacher has the second information consciousness, and the seventh teacher has the weakest information consciousness. Further observations show that the fifth teacher with the strongest information consciousness scores higher in information cognition and demand consciousness, information acquisition and communication awareness, information exchange and application awareness, information economy and value consciousness. Teachers can The fifth teacher inspires its information-aware behavior, and the fifth teacher can positively influence other teachers in these four aspects.
7. Conclusions

On the basis of constructing a set of scientific and systematic information orientation evaluation index system for college teachers, this paper invites 10 experts in the field of education informatization to score the first-level indicators in the evaluation index system and determine the weight of the first-level indicators. Then, a sample survey of college teachers' information awareness is conducted in Changsha City. The principal component analysis method is used to comprehensively evaluate the information awareness of college teachers. Firstly, the second-level indicators under the first-level indicators are comprehensively evaluated, and the comprehensive scores of the first-level indicators are calculated. Then, we use the first-level indicator as the weight to calculate the comprehensive score of 10 teachers' information consciousness, and finally analyze the calculation result briefly.

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