



# Construction of information security literacy evaluation model for College students based on Analytic Hierarchy Process

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**Abstract.** In the information age, information security is an important issue faced by contemporary college students, and how to evaluate the information security literacy of college students has become the key to protect the information security of college students. This paper uses the analytic hierarchy process and combines the evaluation principles of college students' information security literacy to establish an evaluation model of college students' information security literacy, in order to provide a scientific reference for the evaluation of college students' information security literacy, so as to provide reference for more colleges and universities to evaluate college students' information security literacy.

**Keywords:** Information Security; Information Security literacy; Analytic Hierarchy Process

## 1 INTRODUCTION

In the 21st century, with the advent of the Internet era, it has brought abundant information resources and diverse forms of information, making people's lives more and more inseparable from the Internet. Especially with the popularization of smartphones, the mobile Internet is increasingly penetrating and changing people's work and lifestyle. By the end of June 2015, the number of Internet users and mobile Internet users in China ranked first in the world, reaching 674 million and 594 million respectively. According to Baidu's monitoring data on mobile Internet users, the proportion of students using mobile Internet increased from 35.1% in 2012 to 49.8% in 2015, of which 41.7% of mobile search users are students aged 15-24. At the same time, information security issues arising from the use of the Internet are also attracting attention. According to the latest research report on the information security status of Chinese netizens, 84.8% of netizens have encountered information security incidents, with an average of 2-4 types of information security incidents per person. According to the 2015 Survey Report on the Protection of the Rights and Interests of Chinese Netizens released online by the

Cyber Security Administration of the Ministry of Industry and Information Technology, 78.2% of netizens have experienced the leakage of personal identity information, including name, education, home address, ID number and work unit.

In the face of increasingly prominent information security problems, college students, as a young group, are one of the main groups in the information society, and their information security literacy has attracted widespread attention. In order to understand the current situation of college students' information security, it is necessary to evaluate the information security quality of college students, and find out the problems existing in the personal information security protection of college students and the weak links in the construction of information security in colleges and universities, so as to provide reference for improving the information security literacy of college students.

## 2 INFORMATION SECURITY LITERACY AND RELATED CONCEPTS

<sup>[1]</sup>About the connotation of information security literacy, domestic scholars starting from the definition of information literacy, that information security literacy refers to the literacy of information security people have, is one of the basic ability of modern society members to adapt to the work under informationized conditions. <sup>[2]</sup>Some scholars also believe that information security literacy refers to people's understanding of information security and various comprehensive capabilities displayed under informationized conditions. <sup>[3]</sup>Some scholars have specially proposed college students' network information security literacy, which has been evaluated from four aspects of network information security prevention ability, network information security awareness, network information security knowledge and network information security law ethics. <sup>[4]</sup>Some scholars have established the evaluation indicators of university safety education system from six aspects: "educational object", "educational content", "way and method", "organizational mechanism", "educational assessment mechanism" and "funding guarantee".

We believe that the connotation of information security literacy can be comprehensively summarized from the definitions of information security and information literacy. <sup>[5]</sup>Information security can be understood from a narrow and broad perspective, the most used is the narrow sense of information security, which refers to the security of the information itself, including information confidentiality, integrity, availability, controllability and reliability of 5 aspects. <sup>[6]</sup>As for information literacy, since 1974, Paul Zurkowski, President of the American Information Industry Association, first proposed that "information literacy is the application of a large number of information tools and main information sources and other technical and skill means to solve problems", the concept of information literacy has been continuously enriched. More authoritative is the 1989 American Library Association proposed that discovering, retrieving, analyzing and using information is the essence of information literacy. <sup>[7]</sup> Some domestic scholars have pointed out that the connotation of information literacy is essentially information consciousness, information knowledge, and information ability and infor-

mation morality. Based on this, we think that information security literacy can be defined as a basic ability to identify information security problems and prevent and protect information security by using information security knowledge.

### 3 EVALUATION OF INFORMATION SECURITY LITERACY

<sup>[8]</sup> As for the evaluation of information security literacy, Velki et al. proposed a general user information security literacy questionnaire, which includes four main parts: common users' dangerous behaviors, users' information security level, users' information security beliefs, password quality and security. <sup>[9]</sup> Ndiege et al. developed an information security literacy evaluation scale for undergraduates, including general security awareness and security ability. <sup>[10]</sup> Lin uses a quasi-experimental method to evaluate information security literacy from four categories of information security knowledge, information security skills, information security application and influence, and information security ethics

Starting from the definition of information security literacy, aiming at the characteristics of college students, combined with the security problems commonly faced by college students, and following the principles of scientificity, operability, quantitative and qualitative combination, an evaluation system of college students' information security literacy can be set up from four perspectives: information security awareness, information security knowledge, information security ability and information ethics.

#### 3.1 Evaluation index analysis

##### 1) Information security awareness

<sup>[11]</sup> Information security awareness is the basis of information security literacy. Information security awareness is rich in connotation, including not only the basic cognition of information security issues, but also the conscious attention and maintenance of information security. Therefore, the degree of emphasis on information security largely determines the level of awareness of information security. However, as college students have few opportunities to contact the society, their awareness of information security mainly comes from the publicity and education of schools. However, the current education on information security in colleges and universities fails to attract college students to pay attention to information security actively, which fails to achieve the due educational effect. As a result, many college students, like most people, believe that information security is a matter for security departments or security personnel and technical personnel, and has nothing to do with themselves. <sup>[12]</sup> At the same time, information security related education is relatively limited mainly in the form of publicity of relevant documents and regulations, which is easy for people to equate the popularization of information security awareness and literacy with the same security education as fire prevention and anti-theft. Therefore, first of all, it is necessary for college students to pay attention to the relevant issues of information security consciously, so as to solve the problems of information security.

## **2) Information security knowledge**

Information security knowledge mainly refers to the concept of information security, information technology and other aspects of basic knowledge. <sup>[13]</sup>According to the survey, most colleges and universities in China offer computer and related majors, but relatively few schools offer information security majors, accounting for only 47.8% of the total number of surveys. Therefore, for most students of other majors, they can only rely on their own active learning and accumulation in order to learn about information security. However, many students only take the initiative to learn about information security when they or their classmates encounter information security problems such as information leakage and network intrusion.

## **3) Information security skills**

Information security skills are the key elements of information security literacy, which means that people use various information security technologies to solve information security problems. Information security threats, in addition to the website or service provider problems without my consent, collection or disclosure of personal information, there is a large part of the reason is due to the network service system security loopholes, criminals through Trojan viruses, phishing websites and other ways to steal personal information caused by information security incidents. <sup>[14]</sup>In May 2015, according to the China Internet Network Security report, the overall situation of China's network security in 2014 was stable, but there were still more vulnerability risks in the basic network, and the problem of personal information leakage was still serious. Therefore, only by understanding basic computer operations and learning to use basic technical means to prevent information security loopholes and eliminate information security risks can we prevent the further spread of information security problems and effectively solve information security problems.

## **4) Information security ethics**

In the aspect of information security ethics, it is mainly evaluated from the perspective of college students' familiarity with relevant laws and policies and whether they consciously resist bad information behaviors. In the network and information age, information security ethics is also a basic moral code, which has a complementary role to the law, especially in the case that the relevant legal system is not perfect, information security ethics can play a good role in guiding people's information behavior. <sup>[15]</sup>In terms of information security legislation, China has not yet a complete and independent Personal Information Protection Law to protect personal information security, the main scope of personal information protection is personal privacy information, and only provides limited and indirect privacy protection. Therefore, the protection of information security depends more on everyone's consciousness, taking the initiative to protect personal information, resisting insecure information, and resolutely not participating in the dissemination of insecure information.

### 3.2 Analytic Hierarchy Process

The Analytic hierarchy Process (AHP) is a semi-quantitative method which combines qualitative and quantitative perfectly, proposed by an American expert and scholar. Analytic hierarchy process (AHP) has clear ideas, can solve many complex problems that have not been uniformly measured at present, and is operable and simple and convenient. Therefore, it is highly reliable to choose AHP to evaluate college students' information security literacy. The basic steps of analytic hierarchy process are as follows:

(1) Divide the problem into a multi-level structure. Generally, it can be divided into three levels, namely target layer, criterion layer and index layer, in which the target layer reflects the final goal of the system; the criterion layer is a series of criteria established to achieve the final goal. The index layer is a variety of factors decomposed on the basis of the criterion layer.

(2) Construct the judgment matrix. The pairs of comparison values between various factors are used as the elements of the judgment matrix to construct the judgment matrix, and the 1-9 scale designed by Satie is used as the comparison standard. As follows table 1:

**Table 1.** Scale 1-9 rating sheet

Scale	Implication
1	Both factors are equally important
3	One factor is slightly more important than the other
5	One factor is significantly more important than the other
7	One factor is strongly more important than the other
9	One factor is more important than the other
2,4,6,8	The median of the two adjacent judgments above
Count back-wards	Factor i is compared with j to obtain the judgment $a_{ij}$ , then factor j is compared with i to obtain the judgment $a_{ji}=1/a_{ij}$

(3) Calculate the weight value and consistency test. The eigenvector  $w$  and the maximum eigenroot  $\lambda_{max}$  of the judgment matrix are calculated, and the eigenvector  $w$  is the weight value of the layer, that is, the influence factors of the layer on the previous layer, which is also called the hierarchical single ranking, and the influence factors of the layer on the target layer are called the hierarchical total ranking. The consistency ratio  $CR=CI/RI$  is calculated using the formula  $CI=(\lambda_{max}-n)/(n-1)$ . When  $CR \leq 0.10$ , the judgment is considered to have satisfactory consistency.

## 4 APPLICATION EXAMPLES

The following is the hierarchical structure of information security literacy of college students in a university, combined with the 1-9 scale rating table designed by Satie. As show in table 2.

**Table 2.** Hierarchical structure of information security literacy of college students in a university

Target layer A	Criterion layer B	Index layer C
Information Security Literacy of College students A	Information Security Awareness B1	Understand the importance of information security in daily life and learning C1
		Able to actively learn the knowledge about information security on the Internet and books B2
		Be able to consciously protect their own sensitive information through password Settings, file encryption and other methods C3
	Information security knowledge B2	Understand the common means of information theft and common virus, Trojan C4
		Understand the relevant concepts C5 of information security, information confidentiality, and information security literacy
		Master the basic information security risks and information security protection knowledge C6
	Information Security Skills B3	Be able to judge and identify information and websites with security risks C7
		Can through the correct Settings to prevent virus, Trojan attack C8
		Master basic computer operations, be able to backup and restore lost information C9
	Information Security Ethics B4	Understand information security related regulatory policies and related rights and obligations C10
		Do not spread Internet rumors and bad information at will C11
		Do not download malware with illegal use of information C12

According to the 1-9 scale score table designed by Satie and the hierarchical structure of college students 'information security literacy, 25 teachers and experts from a university are invited to evaluate and score the influencing factors of college students 'information security literacy on the specific situation of the school. The evaluation results are sorted out and calculated as follows:

$$A = \begin{bmatrix} 1.00 & 0.57 & 0.71 & 1.88 \\ 1.75 & 1.00 & 0.96 & 2.13 \\ 1.44 & 1.04 & 1.00 & 2.77 \\ 0.53 & 0.47 & 0.36 & 1.00 \end{bmatrix} \lambda_{\max}=4.02, \text{ Feature vector } w=(0.22,0.32,0.33,0.13)^T$$

Therefore, the weights of the four first-level indicators are as follows: 0.22, 0.32, 0.33, 0.13.

Calculating consistency metrics  $CR=0.0073<0.1$  It indicates that the calculated results satisfy the consistency check.

$$A1 = \begin{bmatrix} 1.00 & 0.78 & 0.40 \\ 1.28 & 1.00 & 0.96 \\ 2.50 & 1.04 & 1.00 \end{bmatrix} \lambda_{\max}=3.04, \text{ Feature vector } w1=(0.22,0.34,0.44)^T$$

Therefore, the weights of the secondary indicators are:0.22, 0.34, 0.44

Calculating consistency metrics CR=0.0422<0.1 It indicates that the calculated results satisfy the consistency check.

Multiplied by the corresponding first-level indicator weights w= (0.22, 0.32, 0.33, 0.13)<sup>T</sup> The results obtained w11=(0.05,0.07,0.10)<sup>T</sup> It is the weight of each secondary index for the target layer, that is, the total rank of the hierarchy.

Similarly, the weight values of the indicators at all levels can be obtained as follows table 3:

**Table 3.** Table of weights of indicators at all levels

Target layer A	Criterion layer B	Weights	Index layer C	Hierarchical single sort	Total hierarchical sort
Information Security Literacy of College students A	Information Security Awareness B1	0.22	Understand the importance of information security in daily life and learning C1	0.22	0.05
			Able to actively learn the knowledge about information security on the Internet and books B2	0.34	0.07
			Be able to consciously protect their own sensitive information through password Settings, file encryption and other methods C3	0.44	0.10
	Information security knowledge B2	0.32	Understand the common means of information theft and common virus, Trojan C4	0.25	0.08
			Understand the relevant concepts C5 of information security, information confidentiality, and information security literacy	0.46	0.15
			Master the basic information security risks and information security protection knowledge C6	0.29	0.09
	Information Security Skills B3	0.33	Be able to judge and identify information and websites with security risks C7	0.26	0.09

			Can through the correct Settings to prevent virus, Trojan attack C8	0.44	0.14
			Master basic computer operations, be able to backup and restore lost information C9	0.31	0.10
	Information Security Ethics B4	0.13	Understand information security related regulatory policies and related rights and obligations C10	0.29	0.04
			Do not spread Internet rumors and bad information at will C11	0.32	0.04
			Do not download malware with illegal use of information C12	0.39	0.05

The above results calculated by the analytic hierarchy process to a certain extent verify the effectiveness and operability of the evaluation system of college students' security literacy. At the same time, the results can also analyze the importance of the various factors of college students' information security literacy. From the perspective of the standard level, the school still pays more attention to the cultivation of information security skills and the education of information security knowledge, which is related to the current education concept of theory and practice and pays attention to students' practical ability. In terms of indicators, understanding the common means of information theft, common viruses and Trojans, and being able to prevent the attacks of viruses and Trojans through correct Settings are the knowledge and skills that the school believes that college students should focus on.

## 5 CONCLUSION

At present, the evaluation of college students' information security literacy is strong subjectivity and difficult to describe quantitatively. This paper uses the analytic Hierarchy process (AHP) to make a quantitative analysis of each index of college students' information security literacy, which is helpful to fully understand the relative importance of each index of college students' information security literacy, and arounds the attention of colleges and universities to college students' information security literacy. At the same time, starting from the system can also do further questionnaire survey of college students' information security literacy, the current college students' information security literacy evaluation, so as to be able to solve the information security problems faced by college students, improve the information security literacy of contemporary college students.



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