

Research on Information Literacy of Students in Independent Undergraduate Universities: Empirical Analysis Based on G University

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ABSTRACT

University students' information literacy is not only related to their academic achievement, but also affects their lifelong learning ability and future sustainable development. The authors chose undergraduate students at G University as a sample, using questionnaires and statistical analysis to study the current situation of students' information literacy based on information literacy construct, lifelong learning construct, and sustainable development construct. According to the study, information consciousness and information morality performed better, information safety and information skills performed at a medium level, while information knowledge was the weakest one among the five factors. Gender, household registration, grade level, and major have various effects on the abovementioned five different factors. Based on the research, the authors give some suggestions for improving students' information literacy at G University in three aspects: The construction of G University's information environment, the introduction of digital learning resources, and differentiated training.

KEYWORDS:

Independent Undergraduate Universities, Students, Information Literacy, Empirical Analysis, Sustainable Development

INTRODUCTION

The Central Committee of the Communist Party of China and the State Council released the Education Modernization Plan 2035, demonstrating China's active participation in global education governance, fulfillment of its commitment to the United Nations 2030 sustainable development

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agenda, and its contribution of Chinese wisdom, Chinese experience, and Chinese approaches to the world's education development (Xinhua, 2019). Therefore, as an essential part of China's education system, higher education should be continuously improved to cultivate more high-quality talents for sustainable development. The post-epidemic era has promoted changes in the teaching model and tested students' ability to cope with the information explosion even more. Thus, the information literacy level of students has become one of the key concerns of higher education, and exploring the current information literacy level of students in universities can help point out the direction for the reform of university education. Many scholars are interested in studying student information literacy; however, few have chosen one or a few universities to conduct the study. In this paper, we hope to contribute to the improvement of information literacy among students at tail-end universities through actual case studies.

This study combines information-based education and teaching characteristics in the post-epidemic era and proposes G University as an example. The authors adopted questionnaire surveys and statistical analysis to study the current situation of information literacy among students in independent undergraduate universities, and the problems and factors affecting students' information literacy. Based on their findings, in this paper, the authors believe that G University should coordinate multiple departments to improve the construction of the campus information environment, introduce more national information resource platforms, and provide differentiated training according to the current situation of students to enhance the level of information literacy and lifelong learning abilities and reach sustainable development.

The paper is organized as follows: The first section briefly introduces the background of higher education in China; the second section provides the literature review on information literacy from various countries and related constructs; the third, fourth, and fifth sections provide an in-depth analysis of the questionnaire results; the sixth and seventh sections give some comments on the findings and conclude the paper.

LITERATURE REVIEW

Related Studies on Information Literacy

Definition of Information Literacy

With the development of information technology, many scholars have studied "information literacy" since the 1990s. In 1974, Paul Zurkowski, the former president of the Information Industry Association, proposed to the U.S. National Commission on Libraries and Information Science that information literacy refers to a person's ability to master information tools, acquire relevant information, and solve practical problems through training (Wang, 2017). Subsequently, research on the definition of information literacy was concentrated on the relevant conferences and documents of the United Nations Educational, Scientific, and Cultural Organization (UNESCO), national policies of some developed countries, and personal publications. With the popularization of information technology and the Internet, after 2000, research on information literacy began to shift to the practical application level, that is, to equip citizens with the foundational competencies of information literacy through education and training, which means information literacy transformed from the skill level to the competency level. According to the Alexandria Proclamation of 2005, information literacy refers to the ability of people to recognize their information needs, locate and assess the quality of information, store and retrieve information, use information effectively and ethically, and apply information to create and exchange knowledge (Catts & Lau, 2008).

The earliest research on information literacy in China did not appear in the field of education. Xiong's (1989) work focused on the information literacy of business operators and is the earliest retrievable paper on information literacy in China. Wang's (1999) *Information Literacy Construct* is

the first relevant monograph in China, and the writer believed information literacy is a kind of ability to obtain, use, and develop information that can be cultivated through education.

Research on Components and Elements of Information Literacy

The U.S. *Information Literacy Competency Standards for Higher Education* gives six specific competencies that information literacy should develop:

1. Determining the scope of information needed.
2. Accessing the information needed efficiently.
3. Critically evaluating information and its sources.
4. Incorporating selected information into the knowledge base.
5. Using information effectively to achieve a specific purpose.
6. Understanding the relevant economic, legal, and social issues related to information use and ethically and legally obtaining and using information (Library Association, 2000; Suo, 2018).

According to Sang(2000) and Zhong (2013), information literacy allows the following aspects: To acquire information effectively; to evaluate information skillfully and critically; to absorb, store, and extract analyzed information effectively; to express information in a multimedia way and to use information creatively; to transform the ability from dominate information into learning and communicate independently; to learn, train, and improve moral values, emotions, legal consciousness, and social responsibility as citizens in the information age. Liang (2001) pointed out that individuals' information literacy can be divided into three levels: information emotional literacy, information cognitive literacy, and information skill literacy. Xu (2010) indicated that information literacy mainly consists of information-consciousness, -morality, -knowledge, and -competence.

Research on Information Literacy Standard System

Among the information literacy standard systems in different countries, the American Association of College and Research Libraries (ACRL) standard, the British SCONUL standard, and the Australian information literacy assessment standard are the most famous. The Council of Australian University Librarians established ten aspects to examine personal information literacy in 2001 (Andretta, 2005; Johnston & Webber, 2003). In 2005, the Beijing University Library Association released the Information Literacy Competency Index System for Universities in Beijing, regarding the American ACRL standards. It was the first relatively complete and systematic information literacy competency evaluation index system in China, which established a seven-dimension index system by the Delphi method and other methods (ACRL, 2011; Suo, 2018). Subsequently, related research institutions released the index system for evaluating the comprehensive level of information quality of university students, the study on the exemplary framework of information quality ability of colleges and universities in Beijing, and the index system of information quality of university students. Chen and Yang (2000) compiled information literacy competence standards (containing nine items) for students in higher education institutions. Wang (2008) designed information literacy standards for undergraduates in military institutions. Liu (2015) developed a scenario-based experimental test of information literacy and proposed a comprehensive level evaluation of the university student indicator system's information quality. Zeng et al. (2006) and Ma et al. (2009) investigated the current state of information literacy among university students in different regions.

Research on Information Literacy Education for University Students

Many international outline documents, such as the Alexandria Proclamation, have concluded information literacy in systematic educational programs and highlighted the important strategic position of information literacy in human resources training. Lloyd (2010) used a sociocultural lens

to examine the dynamic relationship between students and their surroundings in higher education, and the academic library landscape. Kim (2018) found that the potential role of information, communication, and technology (ICT)-mediated education in narrowing the achievement gap between immigrant and nonimmigrant students could help immigrants better integrate into their destination countries. Gómez-García et al. (2020) pointed out the importance of information literacy promotion among quality students based on contemporary backgrounds. They gave some innovative strategies and methods, such as the flipped classroom, by improving informational teaching from different knowledge disciplines at the university level. Hussain et al. (2022) used the survey method to analyze undergraduate students' information literacy abilities in Pakistan; they indicated that students were in a poor position to identify information sources, and their ability to access and use the information for assignments, tests, and examinations was extremely limited. Chinese experts (Guo, 2019; Huang & Li, 2015; Zhang & Wei, 2016; Zhong & Zheng, 2017) studied the role of massive open online courses (MOOCs) in information literacy education in colleges and universities. Wang (2021) conducted a study on the content of information literacy courses for university students in a mobile network environment, and Luo (2021) analyzed educational support for information literacy. Albitz (2007) exposed disconnects between higher education graduation goals and imparting such knowledge in preparing information literate, critical thinking students. Liao and Tian (2022) indicated that critical information literacy has become the top priority of information literacy education and will be enriched through primary material analysis, reflection, and critical reading.

Lifelong Learning and Sustainable Development

Contemporary society has promoted lifelong learning and implemented lifelong learning policies. Some scholars believe that lifelong learning is a new concept, while others believe it is a series of concepts that follow lifelong education. Lifelong education can be interpreted as the whole process of education during people's lifetimes, from birth to old age, including education in the family, school, and society, which can be formal, nonformal or informal education (Ratanaubol et al., 2015; Wu & Xie, 2004). Lifelong learning focuses on the whole process of how the knowledge, skills, and learning attitudes that people need throughout their lives should be developed and applied, and it focuses on the individual behavior of the learner as a subject in a broader field (Aspin & Chapman, 2000; Sibbald & Troy, 2007; Wu & Xie, 2004).

Early applications of sustainable development were mainly in environmental science and economics. In 2002, the World Summit on Sustainable Development affirmed the importance of education in sustainable development and proposed that students should be motivated to acquire skills, values, and knowledge for sustainable living through multiple forms of education (Cui, 2012). The United Nations and Tkáčová et al. (2021) also demonstrated that education and learning would promote student development, and that social sustainability would be achieved through student empowerment (Cui, 2012). In the impact of lifelong learning reports, information literacy was identified as one of the critical elements of lifelong learning, thus forming the notion that emphasis is placed on developing students' information literacy in higher education (Pei & Liu, 2013). Information literacy education in higher education not only cultivates learners' information skills, but, more importantly, cultivates their ability to use the skills they have learned to develop independent learning and self-learning skills to become lifelong learners. Students in higher education need to improve their literacy at a certain point to meet social development needs (Shi et al., 2016). Hence, information literacy has become an important indicator for the holistic and sustainable development of students in higher education in the information society.

To meet the challenges of a changing future, university teaching practices need to help students generate appropriate thoughts and actions to cultivate lifelong learning ability (Su et al., 2012). Chin and Jacobsson (2016) believed that the development of ICT has provided excellent conditions for digital learning platforms to offer free high-quality education effectively and cost-efficiently, which will help achieve the Sustainable Development Goals (SDGs) worldwide. Louise (2017) figured out the important role of higher education in meeting sustainable development challenges, and this

needs multilateral departments to work together. Webb et al. (2017) and Chankseliani and Mccowan (2020) analyzed SDG 4 to provide equal access to tertiary education and promote lifelong learning opportunities. Franco et al. (2018) used a qualitative strategy with theory-building methodology and various methodological techniques and suggested that a better understanding of existing gaps, target areas, commonalities, and differences would facilitate higher education for sustainable development. According to Anyim (2021), e-learning resources and pedagogy are important in achieving the SDGs.

Research Review

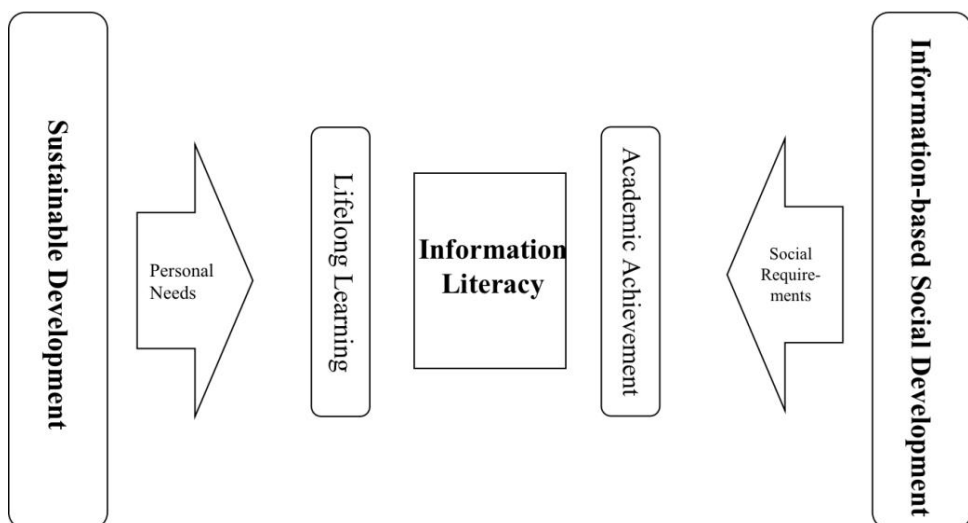
There are relatively abundant research achievements on the concept, components, and standards of information literacy being conducted worldwide. Information literacy may be interpreted as the ability to adapt to the information society under global informatization. The main elements of information literacy can be summarized as information consciousness, information knowledge, information skills, and information morality, and many countries have constructed information literacy systems based on information literacy elements that meet their national conditions. Many scholars have researched information literacy education in universities from the perspectives of library construction, information technology application, and critical thinking; however, they seldom combine the research with the actual situation of universities. From a macro perspective, implementing a sustainable development strategy should consider the popularization of lifelong learning, and one important indicator to measure the ability of lifelong learning is information literacy. In general, there are many research perspectives on information literacy, while fewer studies have been conducted on a particular university or type of university, especially on the information literacy of students in the tail-end universities of the country. The research on the status of information literacy in tail-end universities in China is hoped to promote the development of tail-end universities and help the national macro strategy of lifelong learning and sustainable development (Figure 1).

METHODOLOGY

Research Methods

The main purpose of this paper is to examine what factors influence the information literacy of students in independent undergraduate universities and taking G University as the research sample.

Figure 1. Theoretical framework

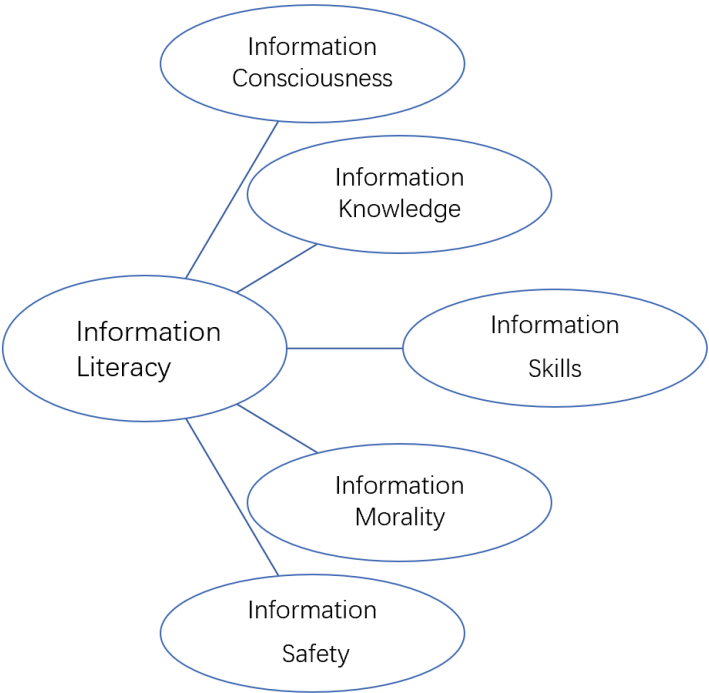


G University was approved by the Ministry of Education to be established in 2005 and transferred to become an independent undergraduate level private general higher education university in February 2021. G University is a multidisciplinary full-time general undergraduate higher education university covering economics, law, education, literature, science, engineering, medicine, management, art, and other subjects; it is open to the whole country of China and has more than 20,000 students.

Drawing on Wang's (2008) and Suo's (2018) research methods, the authors designed an information literacy questionnaire for G University students. They used a five-point Likert scale questionnaire, so they scored all the questions positively on a scale from 1 to 5, with higher scores indicating higher agreement. The questionnaire has two parts: The first part is the basic information of students; the second part concerns the grade of the students' information literacy, including five dimensions, namely, information consciousness, information knowledge, information skills, information morality, and information safety.

Information consciousness refers to individuals' sensitivity and insight toward information; it affects students' abilities to obtain, judge, and use the information and their learning efficiency (Suo, 2018; Xu, 2019). Informational knowledge indicates students' understanding of information theory and information technology and students' acquisition of knowledge about information tools. Information skills are defined as students' competence to use information tools to acquire, analyze, process, and evaluate information, to create new information, as well as to transmit information (Sarango-Lapo et al., 2021). Information morality involves ethical, legal, and social aspects; students are obliged to abide by certain ethical norms in the process of acquiring, using, processing, and disseminating information and must not endanger society or violate the legitimate rights and interests of others (UNESCO, 2022). Information safety includes understanding the basic concept of confidentiality, the proper use of mobile media, the storage and destruction of confidential computer files, and the security of network information transmission and other technologies and methods (Shen et al., 2007; Wang, 2007).

Figure 2. The research model



To ensure that the questionnaire data were valid and reliable, the authors administered the questionnaire twice: A pilot and formal, respectively. They used a random sampling method to create the questionnaire on wjx.cn (i.e., an online platform to assist questionnaire distribution) and sent the link to students in all grades and classes through social networking tools (i.e., WeChat or QQ, instant messaging software produced by Tencent) by class cadres and counselors. During the questionnaire design and pilot survey stages, the authors carefully reviewed the questionnaire, recontacted 11 students who had participated in the pilot survey for suggestions, and accordingly optimized the number of questions. Due to the COVID-19 pandemic, it was impossible to effectively conduct a large-scale face-to-face survey; thus, all the participants completed the questionnaires online.

Analysis Methods and Hypotheses

The authors conducted a pilot survey (Appendix 1) with a random sampling frame of undergraduate students from G University with a traditional high-low binary independent sample t-test for item analysis, Cronbach's alpha coefficient for reliability, Kaiser-Meyer-Olkin (KMO) value, and Bartlett's test of sphericity for structural validity of the questionnaire, and factor analysis for structure analysis. Therefore, by eliminating invalid questions based on the pilot survey analysis, the researchers formed a formal information literacy questionnaire with five dimensions and 25 questions (Appendix 2). As for the formal questionnaire research data, the authors used descriptive statistical analysis, ANOVA, t-test, and analysis of variance to test whether the selected five factors would influence students' information literacy. For all the statistical analyses in this paper, the authors used SPSS23. Table 1 shows the hypotheses.

Questionnaire Response Data

As for the pilot survey, the researchers distributed 130 questionnaires by random sampling from February to March 2022. They collected 111 questionnaires, of which 104 were valid; the questionnaire recovery rate was 85.38%, and the ratio of valid questionnaires to recovered questionnaires was 93.69%. They also conducted the formal questionnaire with a random sampling method in April 2022. They distributed a total of 620 questionnaires and collected altogether 596 questionnaires, of which 581 were valid. Hence, they obtained a return rate of 96.13% and a ratio of 97.48% of valid questionnaires to the returned questionnaires.

PILOT SURVEY

Item Analysis

Item analysis is a study of item discrimination, which refers to the ability of test items in the questionnaire to distinguish the respondents' psychological characteristics and differentiate the

Table 1. Research hypotheses

H1: There is a significant relationship between information consciousness and information literacy.
H2: There is a significant relationship between information knowledge and information literacy.
H3: There is a significant relationship between information skills and information literacy.
H4: There is a significant relationship between information morality and information literacy.
H5: There is a significant relationship between information safety and information literacy.
H6: There are significant differences in the effects of gender on the 5 factors of information literacy.
H7: There are significant differences in the effects of grade on the 5 factors of information literacy.
H8: There are significant differences in the effects of profession on the 5 factors of information literacy.
H9: There are significant differences in the effects of household registration on the 5 factors of information literacy.

respondents' levels with high accuracy. For the item analysis in this study, the researchers used the traditional high-low two-group independent sample t-test method. First, based on the returned valid questionnaires, the authors computed the total scores of each of the five-dimensional questions in the second part of the pilot survey questionnaire and ordered them from the highest to the lowest based on the returned valid questionnaires. The researchers used 27% as the cut-off point for the high and low groups based on the distribution of responses; in other words, the samples with the top 27% of the total scores represented the high group with a cut-off score of 84 and the samples with the bottom 27% of the total scores were used as the low group with a cut-off value of 66. Next, the authors analyzed the means of the high and low subgroups for differences using independent sample t-tests. If the decision value of the question item did not reach a significant level, they considered the question item non-discriminative and that it could not accurately measure the degree of response of different respondents. Table 2 below shows the results of the item analysis of the pilot survey questionnaire.

The results in Table 2 show that the t-values of most of the question items reached a significant level, indicating that most of the questionnaire items can accurately reflect the differences in the responses of different samples. However, the P-value of the t-test for questions 8, 12, 21, 26, 27, 28, 29, 35, 36, and 37 was all greater than 0.01, so the researchers removed these ten questions and analyzed the reliability and validity of the retained question items next.

Factor Analysis

Then, the researchers used principal component analysis to extract the common factors with eigenvalues greater than one by the orthogonal rotation method. Figure 3 evidences that it tends to level off from the sixth point. The previous five points belong to the steep slope on the scree plot.

Table 3 shows that five factors have eigenvalues greater than 1, which means the five common factors can be extracted from the information literacy questionnaire; the total explanatory power (cumulative percentage) of these five factors in the information literacy questionnaire reached 68.691%.

Based on the measurement of a factor loading coefficient higher than 0.50, Table 4 indicates that the question items corresponding to factors 1, 2, 3, 4, and 5 are Q5-Q11 (excluding Q8), Q13-Q18, and Q19-Q25 (excepting Q21), Q30-Q34, and Q38-Q39, respectively. The number of factors extracted by the principal components above is consistent with the dimensions contained in the information literacy questionnaire. Consequently, the extracted factors are named according to the content of each question and its dimensions.

Formal Questionnaire Development

Through the pilot survey and data analysis, the authors finally formed the information literacy questionnaire with five factors and 25 questions. Besides, the reliability and structural validity of the questionnaire met the requirements of questionnaire practice. The researchers renumbered the official questionnaire Q5-Q29 after deleting the ten questions that did not meet the demand from the pilot survey. The formal questionnaire also retained questions Q1-Q4 from the first part of the pilot questionnaire on demographics.

RESEARCH FINDINGS

Demographic Characteristics of Formal Questionnaire Sample

According to Table 5, the proportion of female students is 69.5%, nearly twice as high as that of male students. There are 280 students from the first year of G University, with the highest proportion at 48.2%, accounting for nearly half of the total number of students, followed by juniors, sophomores, and seniors at 32%, 12%, and 7.7%, separately. Besides, 65.4% of the students majored in liberal arts, 30.6% are from the Department of Science and Engineering, and the remaining are in arts and sports. Moreover, more than half of the students are in agricultural household registration.

Table 2. Independent samples test

		t-Test for Equality of Means		
		t	df	Sig. (2-Tailed)
Q5	Equal variances assumed	-3.096	58	.003*****
	Equal variances not assumed	-3.176	39.027	.003***
Q6	Equal variances assumed	-2.812	58	.007***
	Equal variances not assumed	-2.855	50.476	.006***
Q7	Equal variances assumed	-3.629	58	.001***
	Equal variances not assumed	-3.679	51.928	.001***
Q8	Equal variances assumed	.643	58	.523
	Equal variances not assumed	.636	49.637	.528
Q9	Equal variances assumed	-2.723	58	.009***
	Equal variances not assumed	-2.726	57.957	.008***
Q10	Equal variances assumed	-3.922	58	.000***
	Equal variances not assumed	-3.983	50.408	.000***
Q11	Equal variances assumed	-6.920	58	.000***
	Equal variances not assumed	-7.071	43.326	.000***
Q12	Equal variances assumed	.427	58	.671
	Equal variances not assumed	.441	30.000	.662
Q13	Equal variances assumed	-5.109	58	.000***
	Equal variances not assumed	-5.075	54.205	.000***
Q14	Equal variances assumed	-4.659	58	.000***
	Equal variances not assumed	-4.640	56.039	.000***
Q15	Equal variances assumed	-5.114	58	.000***
	Equal variances not assumed	-5.033	45.249	.000***
Q16	Equal variances assumed	-4.819	58	.000***
	Equal variances not assumed	-4.772	51.539	.000***
Q17	Equal variances assumed	-4.584	58	.000***
	Equal variances not assumed	-4.547	53.172	.000***
Q18	Equal variances assumed	-6.484	58	.000***
	Equal variances not assumed	-6.574	51.889	.000***
Q19	Equal variances assumed	-8.657	58	.000***
	Equal variances not assumed	-8.753	54.335	.000***
Q20	Equal variances assumed	-10.151	58	.000***
	Equal variances not assumed	-10.329	48.063	.000***
Q21	Equal variances assumed	-.967	58	.338
	Equal variances not assumed	-1.000	30.000	.325
Q22	Equal variances assumed	-8.056	58	.000***
	Equal variances not assumed	-8.145	54.335	.000***
Q23	Equal variances assumed	-6.818	58	.000***
	Equal variances not assumed	-6.875	56.214	.000***

continued on following page

Table 2. Continued

		t-Test for Equality of Means		
		t	df	Sig. (2-Tailed)
Q24	Equal variances assumed	-7.454	58	.000***
	Equal variances not assumed	-7.476	57.984	.000***
Q25	Equal variances assumed	-7.569	58	.000***
	Equal variances not assumed	-7.657	53.950	.000***
Q26	Equal variances assumed	-.526	58	.601
	Equal variances not assumed	-.531	55.260	.598
Q27	Equal variances assumed	.808	58	.423
	Equal variances not assumed	.826	42.582	.413
Q28	Equal variances assumed	.967	58	.338
	Equal variances not assumed	1.000	30.000	.325
Q29	Equal variances assumed	.047	58	.963
	Equal variances not assumed	.047	57.413	.963
Q30	Equal variances assumed	-6.694	58	.000***
	Equal variances not assumed	-6.728	57.610	.000***
Q31	Equal variances assumed	-7.020	58	.000***
	Equal variances not assumed	-6.963	53.065	.000***
Q32	Equal variances assumed	-6.371	58	.000***
	Equal variances not assumed	-6.454	52.638	.000***
Q33	Equal variances assumed	-8.870	58	.000***
	Equal variances not assumed	-8.975	53.693	.000***
Q34	Equal variances assumed	-6.724	58	.000***
	Equal variances not assumed	-6.745	57.964	.000***
Q35	Equal variances assumed	-1.315	58	.194
	Equal variances not assumed	-1.360	30.000	.184
Q36	Equal variances assumed	-.784	58	.436
	Equal variances not assumed	-.802	41.901	.427
Q37	Equal variances assumed	-1.907	58	.061
	Equal variances not assumed	-1.958	37.904	.058
Q38	Equal variances assumed	-6.542	58	.000***
	Equal variances not assumed	-6.645	54.743	.000***
Q39	Equal variances assumed	-9.515	58	.000***
	Equal variances not assumed	-9.538	50.245	.000***

Note. ***p<0.01

Reliability Analysis

The authors also conducted the reliability analysis of the formal questionnaire for the five factors (i.e., information consciousness, information knowledge, information skills, information morality, and information safety); the results are in Table 6.

Table 6 illustrates that Cronbach's alpha coefficients of the five dimensions are all greater than 0.7, suggesting that the formal questionnaire meets practical implications.

Figure 3. Scree plot

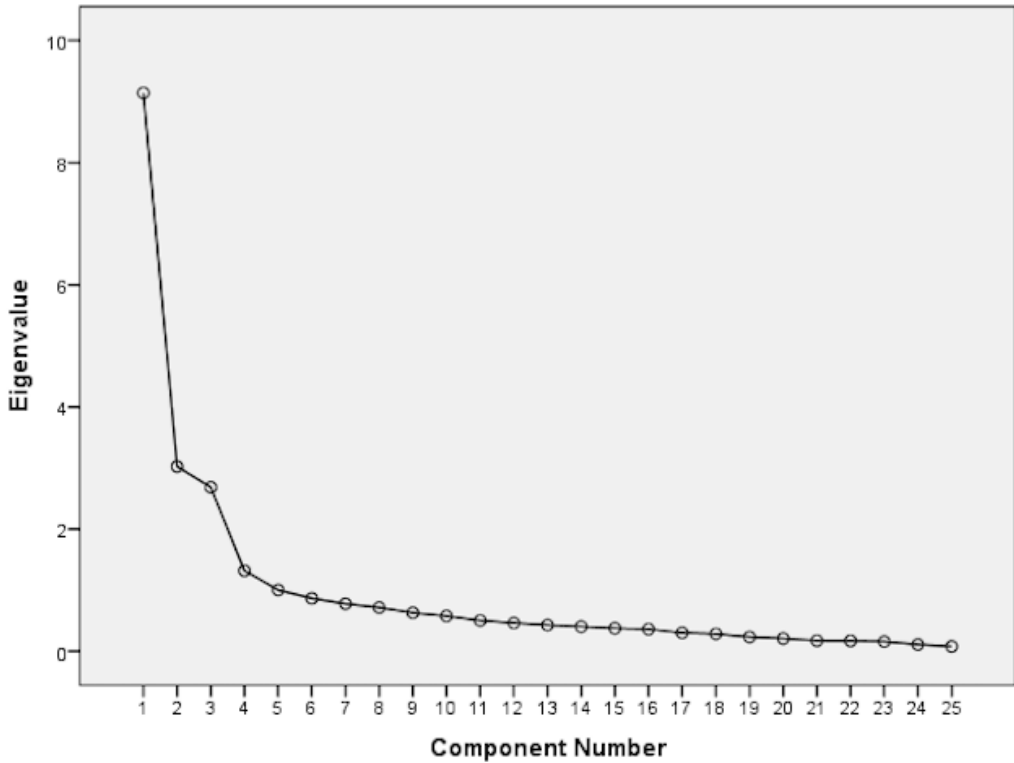


Table 3. Total variance explained

Factor	Initial Eigenvalues			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	9.142	36.566	36.566	3.963	15.853	15.853
2	3.025	12.099	48.665	3.858	15.432	31.285
3	2.684	10.737	59.402	3.835	15.341	46.626
4	1.319	5.276	64.677	3.294	13.177	59.803
5	1.003	4.014	68.691	2.222	8.888	68.691

Structural Validity Analysis

In the structural validity analysis of the formal questionnaire, the authors also used the KMO value and Bartlett's test of sphericity. The results of the analysis are in Table 7. The KMO value was 0.917, and Bartlett's test of sphericity was 6302.324 ($p = 0.000$, $df = 0.000$), significant at a 1% level. It can be concluded that the questionnaire has good structural validity.

Descriptive Statistical Analysis

The authors conducted a descriptive statistical analysis of the information literacy questionnaire to further analyze the mean scores of corresponding questions of the five factors and the whole.

Table 4. Rotated component matrix

	Component				
	Factor1 Information Consciousness	Factor2 Information Knowledge	Factor3 Information Skills	Factor4 Information Morality	Factor5 Information Safety
Q5	.746				
Q6	.842				
Q7	.743				
Q9	.747				
Q10	.718				
Q11	.740				
Q13		.726			
Q14		.781			
Q15		.715			
Q16		.636			
Q17		.669			
Q18		.502			
Q19			.513		
Q20			.639		
Q22			.751		
Q23			.800		
Q24			.745		
Q25			.664		
Q30				.714	
Q31				.776	
Q32				.902	
Q33				.823	
Q34				.794	
Q38					.778
Q39					.706

Extraction method: Principal component analysis.

Rotation method: Varimax with Kaiser normalization.

a. Rotation converged in 6 iterations.

Table 8 gives evidence that, among the six questions of the information consciousness factor, Q5 has the highest mean score of 4.79, and Q6 has the lowest mean value of 4.37. For the six questions of the information knowledge factor, the highest average score of Q16 is 3.96, and the lowest average score of Q13 is 2.57. As for information skills, the average values for Q11 to Q16 are between 3.48 and 3.90. Five questions concern information morality; the largest and smallest mean scores are 4.43 and 3.89. The information safety factor only contains two questions, whereas their average scores are 3.61 and 3.27.

A comparison of the factor means among the five dimensions gives evidence that information consciousness has the largest number at 4.50, which states that it has the greatest contribution to

Table 5. Demographic characteristics of formal questionnaire sample

Demographic Variables	Category	Frequency (N)	Percentage (%)
Gender	Male	177	30.5
	Female	404	69.5
Grade	Freshman	280	48.2
	Sophomore	70	12.0
	Junior	186	32.0
	Senior	45	7.7
Major	Science and Engineering	178	30.6
	Liberal arts	380	65.4
	Art and sports	23	4.0
Household registration	Agricultural household registration	339	58.3
	Nonagricultural household registration	242	41.7

Table 6. Reliability analysis results

Factor	Number of Questions	Cronbach's Alpha Coefficient
Information consciousness	6	0.812
Information knowledge	6	0.729
Information skills	6	0.883
Information morality	5	0.847
Information safety	2	0.741
Total	25	0.907

Table 7. KMO and Bartlett's test

KMO Measure of Sampling Adequacy		0.917
Bartlett's test of sphericity	Approx. chi-square	6302.324
	df	300
	Sig.	0.000

information literacy, while the information knowledge factor average is just 2.95, which contributes the least. Therefore, the five factors listed in descending order of influence are information consciousness, information morality, information safety, information skills, and information knowledge. Figure 4 shows the five factors.

Analysis of Variance

Gender-Based Variance Analysis

Table 9 shows that the mean values for the five factors of male and female students differ. We implemented the analysis by an independent sample t-test to verify whether this difference is significant. The P-values for the information consciousness and morality dimensions are 0.253 and

Table 8. Descriptive statistical analysis of information literacy

Factor	Question	Average Value of Questions	Factor Means
Information consciousness	Q5	4.79	4.50
	Q6	4.37	
	Q7	4.40	
	Q8	4.41	
	Q9	4.61	
	Q10	4.41	
Information knowledge	Q11	2.74	2.95
	Q12	2.85	
	Q13	2.57	
	Q14	2.79	
	Q15	2.75	
	Q16	3.96	
Information skills	Q17	3.90	3.76
	Q18	3.87	
	Q19	3.57	
	Q20	3.88	
	Q21	3.48	
	Q22	3.85	
Information morality	Q23	4.01	4.18
	Q24	3.89	
	Q25	4.43	
	Q26	4.28	
	Q27	4.31	
Information safety	Q28	3.61	3.44
	Q29	3.27	

0.247, which means there is no significant difference in the average value of the two factors at the 5% level. On the contrary, the t-test for the other three dimensions has a significance probability P lower than 0.05. Therefore, we concluded that, at the 5% level, there is a significant difference between the mean scores of male and female students for the remaining three factors.

Grade-Level-Based Variance Analysis

The authors adopted a one-way ANOVA analysis method to test whether there were significant differences among average scores of the five dimensions, based on grade level. According to Table 10, all five factors are significantly different across grade levels at a 5% significance level, as the P-values are lower than 0.05, except for the information knowledge dimension, for which the probability of significance is 0.154.

Figure 4. Five-factor score Tudor chart

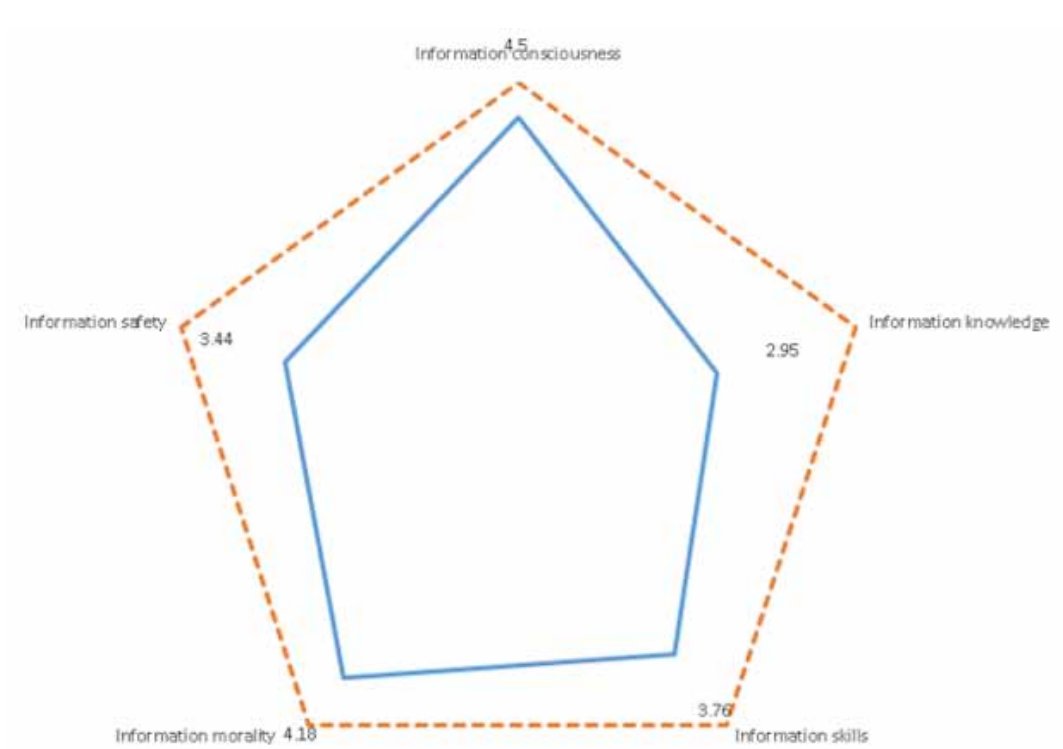


Table 9. The influence of gender on information literacy

	Gender	N	Mean	Std. Deviation	Std. Error Mean	t	Sig. (2-Tailed)
Information consciousness	Male	177	4.53	0.438	0.033	1.144	0.253
	Female	404	4.48	0.434	0.022		
Information knowledge	Male	177	3.06	0.737	0.055	2.813	0.005
	Female	404	2.90	0.604	0.030		
Information skills	Male	177	3.85	0.775	0.058	2.202	0.028
	Female	404	3.72	0.619	0.031		
Information morality	Male	177	4.14	0.753	0.057	-1.160	0.247
	Female	404	4.20	0.557	0.028		
Information safety	Male	177	3.65	1.030	0.077	3.706	0.000
	Female	404	3.35	0.844	0.042		

Majors-Based Variance Analysis

We also used the one-way ANOVA analysis to test the significance level of average scores for the five factors at a major base; Table 11 shows the results. Excepting for the information knowledge dimension, the remaining four factors do not significantly differ in the mean scores across majors at the 5% significance level.

Table 10. The influence of grade on information literacy

Grade		N	Mean	Std. Deviation	Std. Error	F	Sig.
Information consciousness	Freshman	280	4.41	0.452	0.027	13.114	0.000
	Sophomore	70	4.44	0.377	0.045		
	Junior	186	4.60	0.405	0.030		
	Senior	45	4.72	0.361	0.054		
	Total	581	4.50	0.435	0.018		
Information knowledge	Freshman	280	2.89	0.609	0.036	1.761	0.154
	Sophomore	70	3.07	0.668	0.080		
	Junior	186	2.96	0.707	0.052		
	Senior	45	3.02	0.624	0.093		
	Total	581	2.95	0.652	0.027		
Information skills	Freshman	280	3.61	0.645	0.039	9.906	0.000
	Sophomore	70	3.78	0.677	0.081		
	Junior	186	3.93	0.662	0.049		
	Senior	45	3.93	0.682	0.102		
	Total	581	3.76	0.672	0.028		
Information morality	Freshman	280	4.13	0.672	0.040	3.034	0.029
	Sophomore	70	4.08	0.634	0.076		
	Junior	186	4.27	0.556	0.041		
	Senior	45	4.28	0.500	0.075		
	Total	581	4.18	0.623	0.026		
Information safety	Freshman	280	3.29	0.883	0.053	5.225	0.001
	Sophomore	70	3.51	0.967	0.116		
	Junior	186	3.61	0.890	0.065		
	Senior	45	3.58	1.000	0.149		
	Total	581	3.44	0.915	0.038		

Household-Registration-Based Variance Analysis

To further verify whether the difference is significant, the authors analyzed it through an independent sample t-test. As Table 12 shows, dimensions of information consciousness and safety have a significant t-test probability at 0.071 and 0.119, respectively. Therefore, at the level of 5%, the two factors cannot confirm that the mean scores have significant differences in the attribute of household registration. The significance probability of the t-test of the other three dimensions is 0.025, 0.000, and 0.001, separately. Consequently, the mean scores for the three dimensions have significant differences in household registration at 5%.

Summary of Variance Analysis

Table 13 shows the variance analysis results for the five factors under four different conditions. Only grade level will influence information consciousness significantly, while only this condition will not affect information knowledge. As for information skills, there is no significant difference in the effect

Table 11. The influence of major on information literacy

Major		N	Mean	Std. Deviation	Std. Error	F	Sig.
Information consciousness	Science and Engineering	178	4.54	0.411	0.031	0.997	0.369
	Liberal arts	380	4.48	0.445	0.023		
	Art and sports	23	4.46	0.444	0.093		
	Total	581	4.50	0.435	0.018		
Information knowledge	Science and Engineering	178	2.97	0.600	0.045	3.592	0.028
	Liberal arts	380	2.91	0.668	0.034		
	Art and sports	23	3.28	0.690	0.144		
	Total	581	2.95	0.652	0.027		
Information skills	Science and Engineering	178	3.81	0.695	0.052	2.161	0.116
	Liberal arts	380	3.72	0.664	0.034		
	Art and sports	23	3.96	0.597	0.125		
	Total	581	3.76	0.672	0.028		
Information morality	Science and Engineering	178	4.22	0.686	0.051	0.573	0.564
	Liberal arts	380	4.16	0.586	0.030		
	Art and sports	23	4.17	0.719	0.150		
	Total	581	4.18	0.623	0.026		
Information safety	Science and Engineering	178	3.46	0.939	0.070	0.518	0.596
	Liberal arts	380	3.42	0.895	0.046		
	Art and sports	23	3.61	1.066	0.222		
	Total	581	3.44	0.915	0.038		

Table 12. The influence of household registration on information literacy

		N	Mean	Std. Deviation	Std. Error Mean	t	Sig. (2-Tailed)
Information consciousness	A	339	4.47	0.442	0.024	1.806	0.071
	B	242	4.54	0.423	0.027		
Information knowledge	A	339	2.89	0.677	0.037	2.253	0.025
	B	242	3.02	0.609	0.039		
Information skills	A	339	3.67	0.694	0.038	3.653	0.000
	B	242	3.88	0.623	0.040		
Information morality	A	339	4.11	0.662	0.036	3.335	0.001
	B	242	4.28	0.550	0.035		
Information safety	A	339	3.39	0.902	0.049	1.562	0.119
	B	242	3.51	0.930	0.060		

A: Agricultural household registration
B: Nonagricultural household registration

of major. Information morality has significant differences under grade-level and household registration conditions. Besides, gender and grade level cause significant differences in information safety.

Table 13. Summary of the 5-factor variance analysis

P<0.05	Gender	Grade	Major	Household Registration
Information consciousness		**		
Information knowledge	**		**	**
Information skills	**	**		**
Information morality		**		**
Information safety	**	**		

DISCUSSION

This paper reports the status of information literacy among undergraduate students at G University through questionnaire surveys and statistical analysis. The findings supported the initial hypotheses H1, H2, H3, H4, and H5. Gender, household registration, grade, and major all have different degrees of influence on the five factors. Ma et al. (2009), Huang (2017), and Zhao et al. (2010) analyzed students from universities in Hubei, Sichuan, and Shandong provinces, and the effects of grade and gender on information literacy were consistent with this paper's study; however, it was argued that major differences would only affect information skills, while this paper concluded that they would affect information knowledge, and household registration had a significant effect on information knowledge, information technology, and information morality. Some institutions or organizations in other countries have designed more systematic competency development systems for teachers' information literacy competency development, such as the Data Wise Improvement Process model, which is more maturely developed and commonly used (Boudett et al., 2013).

The information environment is the material basis for information literacy education and the interface for students to integrate into an information society's daily life, study, and work (Wang, 2008). Through this study of information literacy, the key element of lifelong learning, G University should take the initiative to promote the modern transformation of information literacy education and create a positive information environment for students (Pei & Liu, 2013). This requires multiple university departments, including librarians, faculty, and institutional administrators, to collaborate on information literacy curriculum development, hardware support, and resource development (Albitz, 2007; Louise, 2017).

In China, the MOOCs platform can gather abundant information literacy courses that transform students from the original one-dimensional library learning scenario to the Internet digital media learning scenario, which is more conducive to students' learning according to their needs (Zhang & Wei, 2016). The faculty and curriculum are imperfectly built as G University was developed rapidly. Therefore, introducing resources from MOOCs and other educational platforms will improve students' enthusiasm and initiative to learn information literacy will be a more economical and feasible solution. These e-learning resources offer a wealth of beneficial information to students, providing a platform to support their continuous learning and promoting the spread of education sustainable development (Anyim, 2021; Cui, 2012).

There are different effects on different factors of information literacy in terms of gender, grade, major, and household registration. Hence, G University should provide focused information literacy differentiated training. For example, more training for female students in information knowledge, information skills, and information safety can be fulfilled by establishing information literacy clubs, study groups or workshops. Based on significant differences and urban-rural disparities, the focus on information literacy development is varied so that different training levels can be targeted. These can help students acquire more information literacy and encourage them to apply what they have learned to achieve longevity (Shi et al., 2016).

As the world moves into a “knowledge-based economy” era with high-tech industries as the backbone, intellectual resources as the basis, and education as the foundation, unprecedented challenges have been posed to education. According to Franco et al. (2018), Wu and Xie (2004), and many other scholars, the realization of global sustainable development requires the establishment of sustainable development values and the learning of sustainable life skills, and therefore the cultivation of lifelong learning habits, which cannot be developed without the support of higher education. The United States, the United Kingdom, Finland, Portugal, and other countries have increased funding for education, expanded higher education learning options, and improved the structure of higher education. Many countries, such as Canada and Germany, are developing digital learning and promoting the creation and use of open educational resources. Information literacy, as a crucial indicator of the comprehensive quality of university students, is a good entry point for countries seeking educational transformation. The countries can build and improve the information literacy evaluation system based on the five elements mentioned in this paper, considering the actual education situation. Universities like G University can enhance students’ information literacy by improving the informatization education environment, introducing online education platform resources, and creating an informatization cultivation curriculum system that meets the needs of modern society. Besides, the current research mainly involves basic education and leading universities. The authors hope that the research will enrich information literacy content at the level of non-governmental universities in China and homogenous schools worldwide.

CONCLUSION

In this study, the authors analyzed the status of information literacy among students at G University in five dimensions with the expectation of providing insights into the development of information literacy among undergraduate students at G University and tail-end independent undergraduate universities in China, as well as universities similar to G University in the world.

The authors gathered data through questionnaires and adopted factor analysis, descriptive statistical analysis, and variance analysis to test factors that influence information literacy at G University. Among the five factors that affect students’ information literacy, information consciousness and morality perform better, information safety and information skills are at a medium level, and information knowledge is the weakest. Besides, there are different effects on the five factors of information literacy depending on gender, household registration, grade, and major of study.

CONFLICTS OF INTEREST

The authors declare no competing interests.

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APPENDIX 1

Pilot Survey Questionnaire

亲爱的同学您好:

大学是一个人综合能力形成和发展的重要时期,而信息素养是其中的一个重要方面。信息素养为个人终身学习、可持续发展打下基础。为全面了解我校学生信息素养现状以及存在的问题,探索提升大学生信息素养的改革思路和对策建议,我们真诚渴望得到您的支持。

问卷采用匿名形式,请您根据实际情况填写。本问卷共计39个题,大约需要5分钟完成。感谢您的参与和为我们提供宝贵的资料。

第一部分 个人基本情况

1. 性别:
 - A男 B女
2. 年级:
 - A大一 B大二 C大三 D大四
3. 专业:
 - A理工类 B文科类 C艺体类
4. 户籍类型:
 - A 农业户口 B 非农业户口

第二部分 信息素养情况

一、信息意识情况(共7题)

5. 你认为在现代生活中,及时掌握外界信息,对于我们的学习、生活来说()。
 - A 极不重要 B 不重要 C 不确定 D 重要 E 非常重要
6. 你会通过各种方式了解所下载资料的背景、文化及其来源,分析其是否对学习有用,对此你()。
 - A 完全不同意 B 不同意 C 不确定 D 同意 E 完全同意
7. 对于将计算机和网络运用于日常学习,你的态度是()。
 - A 完全不赞成 B 不赞成 C 无所谓 D 赞成 E 完全赞成
8. 你平均每天上网的时间为2个小时或以上()。
 - A 完全不同意 B 不同意 C 不确定 D 同意 E 完全同意
9. 你经常上网查阅学习资料()。
 - A 非常不符合 B 不符合 C 有时符合 D 符合 E 非常符合
10. 你愿意了解、查询自己需要的信息()。
 - A 完全不愿意 B 不愿意 C 不确定 D 愿意 E 非常愿意
11. 你能够表达出信息需要,并能及时地去查询或主动利用信息系统来满足这种需求()。
 - A 完全不同意 B 不同意 C 不确定 D 同意 E 完全同意

二、信息知识情况(共7题)

12. 你对于使用网络资源(如专业网站、网络图书馆、在线知识教育等)进行学习()。
 - A 完全不懂 B 不太熟悉 C 有些熟悉 D 比较熟悉 E 非常熟悉
13. 在学习过程中,你对于选用与专业相适应的软件(如SPSS, Stata, Dreamweaver, Photoshop, Flash, Authorware, 3DS等)()。
 - A 完全不懂 B 不太熟悉 C 有些熟悉 D 比较熟悉 E 非常熟悉
14. 你对下面几个概念了解吗(如:TCP/IP协议、数据库、人工智能)?()
 - A 不了解 B 不太了解 C 有点了解 D 比较了解 E 非常了解
15. 你有使用过微信公众号、B站、抖音、Blog或其他多媒体网络发表自己的文章或作品吗?()
 - A 从未如此 B 很少如此 C 有时如此 D 时常如此 E 总是如此
16. 你了解计算机病毒及网络安全问题吗?()
 - A 不了解 B 不太了解 C 有点了解 D 比较了解 E 非常了解

17. 你能编辑程序和进行网页的设计与制作()。
 - A完全不同意 B不同意 C不确定 D同意 E完全同意
 18. 你能成功地连接、安装和使用常见输入设备(如鼠标、键盘、麦克风等)和输出设备(如显示器、打印机、机箱等)()。
 - A完全不同意 B不同意 C不确定 D同意 E完全同意
- 三、信息技能情况(共11题)
19. 在学习过程中,你能够确定所需信息的类型和范围()。
 - A完全不同意 B不同意 C不确定 D同意 E完全同意
 20. 你能概括合适的关键词及特定词汇,制定良好的检索策略()。
 - A完全不同意 B不同意 C不确定 D同意 E完全同意
 21. 你对一些网络信息搜索工具,如:“百度”、“Google”等()。
 - A完全不懂 B不太熟悉 C有些熟悉 D比较熟悉 E非常熟悉
 22. 在进入不同的检索系统查找信息时,你能正确地了解其用户界面及操作引擎,采用不同的检索方法查找信息吗?()
 - A不了解 B不太了解 C有点了解 D比较了解 E非常了解
 23. 你能利用各种检索工具如(Web浏览器和检索引擎工具、在线图书馆目录、杂志、报刊索引等)检索各种信息(如声音、图形、文字材料等)()。
 - A完全不同意 B不同意 C不确定 D同意 E完全同意
 24. 你能确定各检索内容之间的差别,重新编制一条检索策略()。
 - A完全不同意 B不同意 C不确定 D同意 E完全同意
 25. 你能利用文字软件、图像软件、电子表格等处理所下载的资料()。
 - A完全不同意 B不同意 C不确定 D同意 E完全同意
 26. 当你从网络上取得大量有关学科专业知识时,你会对其进行总结与归类()。
 - A完全不同意 B不同意 C不确定 D同意 E完全同意
 27. 你能根据收集到的信息,综合主要的思想,对学习和生活中的问题形成新的解决思路()
 - A非常不符合 B不符合 C有时符合 D符合 E非常符合
 28. 你能通过电子邮件Email、公告板BBS、实时聊天等信息技术工具与同学、老师、专家和其他人进行交流、学习()。
 - A非常不符合 B不符合 C有时符合 D符合 E非常符合
 29. 你能判断信息和信息源的可靠性、准确性、权威性和时限性()。
 - A非常不符合 B不符合 C有时符合 D符合 E非常符合
- 四、信息道德情况(共5题)
30. 面对信息资源的良莠不齐,你能自觉地抵御和消除垃圾信息及有害信息的干扰和侵蚀()。
 - A非常不符合 B不符合 C有时符合 D符合 E非常符合
 31. 你会维护信息资源、设备、系统和相关设施的完整性()。
 - A非常不符合 B不符合 C有时符合 D符合 E非常符合
 32. 对于在网上进行交流和传递信息要遵循伦理道德规范和相应的礼节,你()。
 - A完全不同意 B不同意 C不确定 D同意 E完全同意
 33. 你会合法获取、存储、传播文本、数据、图像和声音等信息。()
 - A非常不符合 B不符合 C有时符合 D符合 E非常符合
 34. 在信息和网络世界里,为尊重别人的知识产权与劳动成果,当你参考和引用时你会列明出处和标记引用()。
 - A完全不同意 B不同意 C不确定 D同意 E完全同意
- 五、信息安全情况(共5题)
35. 信息安全保密关乎国家的安全,对此你()。
 - A完全不同意 B不同意 C不确定 D同意 E完全同意
 36. 你懂得如何对计算机进行维护,并能用杀毒软件(如360安全卫士、瑞星、诺顿、金山毒霸等)定时对计算机进行病毒防范与清除,对此你()。
 - A非常不符合 B不符合 C有时符合 D符合 E非常符合

37. 你知道《中华人民共和国国家安全法》、《中华人民共和国网络安全法》等法律法规对信息安全的规定吗? ()
- A 完全不懂 B 不太熟悉 C 有些熟悉 D 比较熟悉 E 非常熟悉
38. 移动介质(如照相机、U盘、移动硬盘等)管理不好,可能造成泄密,对此你()。
- A 完全不懂 B 不太熟悉 C 有些熟悉 D 比较熟悉 E 非常熟悉
39. 你熟悉以下信息保护技术吗(加密、身份认证、访问控制、防火墙、安全路由等)?()
- A 完全不懂 B 不太熟悉 C 有些熟悉 D 比较熟悉 E 非常熟悉

APPENDIX 2

Formal Questionnaire

亲爱的同学您好:

大学是一个人综合能力形成和发展的重要时期,而信息素养是其中的一个重要方面。信息素养为个人终身学习、可持续发展打下基础。为全面了解我校学生信息素养现状以及存在的问题,探索提升大学生信息素养的改革思路和对策建议,我们真诚渴望得到您的支持。

问卷采用匿名形式,请您根据实际情况填写。本问卷共计29个选择题,大约需要3分钟完成。感谢您的参与和为我们提供宝贵的资料。

第一部分 个人基本情况

- 性别:
 - A 男 B 女
- 年级:
 - A 大一 B 大二 C 大三 D 大四
- 专业:
 - A 理工类 B 文科类 C 艺体类
- 户籍类型:
 - A 农业户口 B 非农业户口

第二部分 信息素养情况

一、信息意识情况(共6题)

- 你认为在现代生活中,及时掌握外界信息,对于我们的学习、生活来说()。
- 你会通过各种方式了解所下载资料的背景、文化及其来源,分析其是否对学习有用,对此你()。
- 对于将计算机和网络运用于日常学习,你的态度是()。
- 你经常上网查阅学习资料()。
- 你愿意了解、查询自己需要的信息()。
- 你能够表达出信息需要,并能及时地去查询或主动利用信息系统来满足这种需求()。

二、信息知识情况(共6题)

- 在学习过程中,你对于选用与专业相适应的软件(如SPSS, Stata, Dreamweaver, Photoshop, Flash, Authorware, 3DS等)()。
- 你对下面几个概念了解吗(如:TCP/IP协议、数据库、人工智能)?()

13. 你有使用过微信公众号、B站、抖音、Blog或其他多媒体网络发表自己的文章或作品吗?
()
● A从未如此 B很少如此 C有时如此 D时常如此 E总是如此
14. 你了解计算机病毒及网络安全问题吗? ()
● A不了解 B不太了解 C有点了解 D比较了解 E非常了解
15. 你能编辑程序和进行网页的设计与制作()。
● A完全不同意 B不同意 C不确定 D同意 E完全同意
16. 你能成功地连接、安装和使用常见输入设备(如鼠标、键盘、麦克风等)和输出设备(如显示器、打印机、机箱等)()。
● A完全不同意 B不同意 C不确定 D同意 E完全同意
- 三、信息技能情况(共6题)
17. 在学习过程中,你能够确定所需信息的类型和范围()。
● A完全不同意 B不同意 C不确定 D同意 E完全同意
18. 你能概括合适的关键词及特定词汇,制定良好的检索策略()。
● A完全不同意 B不同意 C不确定 D同意 E完全同意
19. 在进入不同的检索系统查找信息时,你能正确地理解其用户界面及操作引擎,采用不同的检索方法查找信息吗?()
● A不了解 B不太了解 C有点了解 D比较了解 E非常了解
20. 你能利用各种检索工具如(Web浏览器和检索引擎工具、在线图书馆目录、杂志、报刊索引等)检索各种信息(如声音、图形、文字材料等)()。
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29. 你熟悉以下信息保护技术吗(加密、身份认证、访问控制、防火墙、安全路由等)?()
● A完全不懂 B不太熟悉 C有些熟悉 D比较熟悉 E非常熟悉

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