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Research on Digital Literacy of Humanities and Social Science Students

-- Based on the Background of Education: Power

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Abstract: [Purpose / Significance] In the info society, digital education is vital for digital society building. College students, as digital transformation helpers, should have basic digital literacy. [Method / process] This study targets humanities and social science students, integrating national digital literacy initiatives and domestic/international frameworks. A digital literacy framework was built using Delphi and AHP. 402 valid questionnaires were analyzed with descriptive stats & cluster analysis. [Results / Conclusion]Humanities students' digital literacy includes: info/data literacy, learning/thinking ability, digital citizenship, and tech application. Self-reported literacy is generally good, but tech innovation is a weakness. All dimensions show hierarchical characteristics. This study proposes: integrating digital literacy with professional training, building educational programs, and providing diverse training scenarios for comprehensive digital literacy development.

Keywords: Humanities and Social Sciences; Digital Literacy; Delphi Method; Factor Analysis; AHP.

1. Introduction

1.1. Background

Under the info society backdrop, digital reform is today's consensus. Digital education is key for digital society building. The 20th Party report advocates digitalizing education to foster a lifelong learning society. As digital natives and transformation partners, college students should possess basic digital literacy.

With IT advancements, economy and society transform, pushing digital transformation as societal consensus. Digital economy demands high digital literacy for professionals, requiring education [3]. College students, as higher ed recipients, should lead digital literacy cultivation. However, curriculum limits lead humanities students to perceive lower digital literacy than STEM peers, especially in tech application [4,5].

1.2. Purpose

This study takes humanities and social science students as the research object, and constructs a set of digital literacy evaluation framework for humanities and social science students according to the Outline of Action for Improving National Digital Literacy and Skills, combined with the existing digital literacy evaluation system at home and abroad [1]. The Delphi method was modified with expert suggestions, and hierarchical analysis (AHP) was used as the index, and the rationality of the framework was tested by issuing questionnaires. Finally, SPSS software was used to conduct data analysis, aiming to understand the status of digital literacy level of the group through the questionnaire results, and to explore the differences in the abilities of the groups with different subdivided characteristics, so as to put forward targeted strategies for college students, in order to provide reference for the improvement of digital literacy of college students in humanities and social sciences.

2. Model

2.1. Construction of Digital Literacy Indicators

By access to foreign influential multiple framework index, combed the domestic about college students 'digital literacy framework construction, offer, according to the humanities and social science college students' professional characteristics, preliminary build college students' digital literacy framework, divided into the following four dimensions: information and data literacy, learning ability and thinking ability, digital citizens, digital technology application [2]. The information and data literacy and innovation literacy in the EU Digital Literacy framework will be retained and streamlined according to the characteristics of college students. It is preliminarily composed of 4 first-level indicators, 17 second-level indicators and 11 third-level indicators.

In this study, the hierarchical analysis method was used to weight the indicators, and after the preliminary framework construction, it is necessary to determine the weight of the indicators. In this study, a hierarchical analysis method was used to weight the indicators. Hierarchical analysis, also known as AHP, establishes a hierarchical decision model and constructs a pair of comparison array, and provides quantitative basis for the final framework by comparing the importance of various related factors layer by layer.

Table 1. indicator definition table

Level 1 ability	Level 2 ability	Part of the three-level indicators
Information and Data Literacy A	Information retrieval capability A1	
	Information assessment ability A2	
	Data integration and application ability A3	A31 Microsoft Office software A32 image processing software A33 for the statistical analysis software
	Results expression ability A4	
Learning ability and thinking ability B	Digital course learning ability B1	B11 to the degree of interest B12 Academic importance B13 mastery of basic principles B14 practical operation proficiency
	Academic exchange and writing B2	
	Interdisciplinary thinking ability B3	
	Critical thinking, B4	
	Computational thinking ability B5	
	Programming B6	
Digital Citizen C	Digital identity using C1	
	Digital information communication, C2	
	Digital Security Consciousness C3	
	Digital property rights awareness C4	
Digital technology application D	The cognition degree of digital economy and knowledge D1	D11: The role for the human being D12: the cognition of new technology products
	Reality application capability D2	D21 Use digital tools to solve problems in life, study and student work D22 plans for its future development through digital technology

3. Data and Solution

3.1. Questionnaire and Data Collection

We designed the questionnaire according to the predetermined index, and distributed the questionnaire to college students in Tianjin. The obtained data excluded the samples of science and engineering. Finally, 96 invalid questionnaires were eliminated, and 402 valid questionnaires were obtained.

In order to simplify the presentation of the cloned Bach coefficient, the team gathered the data of each second-level index into the corresponding first-level index in a table for analysis. The analysis results find that the coefficient values are above 0.7 and 0.8, so the reliability of this questionnaire is good.

Table 2. Reliability analysis

Scale dimension	Cronbach's α	Normalized Cronbach's α	T	N
A	0.826	0.869	6	402
B	0.834	0.887	9	402
C	0.712	0.786	4	402
D	0.745	0.792	4	402
Total metric scale	0.825	0.885	23	402

The validity analysis is performed below. The team performed the KMO test and the Bartlett test first. The KMO value was found to be 0.924 and the Bartlett was 0.000. It is clearly suitable for doing factor analysis.

Table 3. Validity analysis

KMO test and Bartlett		
KMO		0.924
Bartlett Sphelicity test	chi square	1808.321
	df	300
	P	0.000***

Exploratory factor analysis was conducted according to the rules obtained in the total variance interpretation table, and 23 indicators were classified into 6 factor dimensions by the factor values of each indicator. Considering the number of items, some indicators that do not have enough representativeness and research value need to be excluded. Therefore, factor 5 and factor 6 (including two indicators) are excluded.

The index was re-divided through exploratory factor analysis, and named the four factor dimensions with F1-F4 and given new names. At the same time, the name of each indicator will be fine-adjusted accordingly. Subsequent processing continues to unfold in the following sections.

3.2. Weight Determination of Digital Literacy Indicators

The judgment matrix R constructed based on the supply five features based on the expert scoring method, where the standardization process is as follows: the maximum feature root is γ_{max}, and the consistency index can be recorded as:

$$\mathrm{CI} = \frac{\gamma_{max} - n}{\mathrm{n}-1} \tag{1}$$

Table 4. Total variance interpretation

Total variance interpretation						
	Rate of variance interpretation before rotation			Rate of variance interpretation after rotation		
	characteristic root	Variance interpretation rate (%)	Cumulative variance interpretation rate (%)	characteristic root	Variance interpretation rate (%)	Cumulative variance interpretation rate (%)
1	4.388	17.553	17.553	354.348	14.174	14.174
2	2.182	8.729	26.282	214.581	10.479	24.653
3	1.741	6.964	33.245	189.586	9.673	34.326
4	1.338	5.35	38.596	182.743	7.31	41.636
5	1.267	5.068	43.664	137.094	6.582	48.218
6	1.145	4.578	48.242	127.625	6.537	54.755
...	...	...	...			
21	0.48	1.919	96.938			
22	0.404	1.618	98.556			
23	0.361	1.444	100			

Table 5. Factor load coefficient after rotation

	factor 1	factor 2	factor 3	factor 4	factor 5	factor 6
A2	**0.7411**	-0.003	0.113	0.079	0.112	-0.324
A31	**0.678**	0.26	-0.052	0.165	-0.165	0.373
A32	**0.573**	0.357	0.008	0.099	-0.057	0.046
A33	**0.779**	0.13	0.083	0.101	-0.025	0.1
A4	**0.668**	-0.031	-0.034	0.055	0.055	0.256
B3	**0.624**	0.121	0.249	0.139	0.216	-0.265
B6	**0.5714**	0.23	0.054	0.115	0.168	-0.047
B11	0.28	**0.622**	-0.094	0.081	-0.016	-0.231
B12	0.328	**0.585**	-0.04	-0.036	-0.048	-0.061
B13	0.068	**0.691**	-0.043	0.109	-0.056	0.027
B14	-0.009	**0.696**	-0.132	0.019	0.051	0.205
B2	-0.443	0.198	**0.682**	0.018	-0.385	-0.187
B4	0.064	-0.201	**0.652**	0.033	0.114	-0.112
C1	-0.045	-0.113	**0.648**	-0.069	0.051	-0.049
C2	0.264	-0.053	**0.586**	-0.174	-0.096	0.113
C3	-0.14	0.17	**0.513**	0.24	0.286	0.44
D11	0.007	0.018	**0.758**	-0.304	-0.019	0.067
C4	-0.346	-0.099	-0.171	**0.545**	0.031	0.069
D12	0.262	0.089	-0.029	**0.599**	0.096	0.101
D21	0.189	0.087	-0.028	**0.623**	-0.321	-0.069
D22	0.2	0.108	-0.18	**0.7263**	-0.044	0.887
B5	-0.015	-0.024	0.05	-0.154	**0.763**	0.073
A1	0.123	-0.032	-0.055	0.016	-0.068	**0.695**

The criteria for the judgment of the CI are:

The closer the CI is to 0, the stronger the consistency. If CI=0, it means complete consistency; the larger the CI, the more serious the inconsistency. Mean random consistency index corresponding to the table RI:

Table RI. Mean random consistency index corresponding

n	1	2	3	4	5	6	7	8	9
RI	0	0	0.58	0.90	1.12	1.24	1.32	1.41	1.45

The consistency proportion CR was then calculated by CI in CR.

$$\mathrm{CR} = \frac{\mathrm{CI}}{\mathrm{RI}} \tag{2}$$

If CR <0.1, the consistency of the judgment matrix is acceptable

If the CR is> 0.1, it indicates that a further correction of the judgment matrix is required

After assigning the value according to the importance degree assignment rule of the hierarchical structure model, 5 judgment matrices including first-level dimensions and four second-level dimensions are constructed combined with the index framework [6]. The index weight W and consistency of each judgment matrix are calculated with the help of Yaahp. The test results are as follows:

W_i= (W_1,W_2,W_3,W_4)=(0.2894,0.1750,0.2894,0.2463),

The CR value of this judgment matrix was 0.0227, less than 0.1, which passed the consistency test.

W_{A_i}=(W_{A_1},W_{A_2},W_{A_3},W_{A_4},W_{A_5},W_{A_6},W_{A_7})=(0.1566,0.3150,0.0464,0.0471,0.0744,0.2006,0.1598), the CR value of this judgment matrix was 0.0992, less than 0.1, which passed the consistency test.

W_{B_i}=(W_{B_1},W_{B_2},W_{B_3},W_{B_4})=(0.2002,0.1305,0.3010,0.3682) ,the CR value of this judgment matrix was 0.0909, less than 0.1, which passed the consistency test.

W_{C_i}=(W_{C_1},W_{C_2},W_{C_3},W_{C_4},W_{C_5},W_{C_6})=(0.0853,0.1197,0.2477,0.2171,0.0985,0.2317),the CR value of this judgment matrix was 0.0726, less than 0.1, which passed the consistency test.

W_{D_i}=(W_{D_1},W_{D_2},W_{D_3},W_{D_4})=(0.2876,0.0787,0.3071,0.3267), the CR value of this judgment matrix was 0.0092, less than 0.1, which passed the consistency test.

The following table shows the data display of each capability indicator.

Table 6. Index weight table

Level 1 ability	Level 1 capacity proportion	Level 2 ability	Secondary capacity proportion
F1 software use and information reading capability	0.2894	A2	0.0453
		A31	0.0581
		A32	0.0911
		A33	0.0134
		A4	0.0453
		B3	0.0136
		B6	0.0215
F2 Computer skills mastery level	0.175	B11	0.0228
		B12	0.0527
		B13	0.035
		B14	0.0544
F3 digital software interactive communication awareness	0.2894	B2	0.0247
		B4	0.0717
		C1	0.0346
		C2	0.0671
		C3	0.0285
		C11	0.0628
F4 digital technology innovation consciousness	0.2463	C4	0.0756
		D12	0.0708
		D21	0.0194
		D22	0.0804

3.3. Analysis of the Empirical Results

After completing the combination empowerment of all levels of indicators, it is necessary to further multiply it with the original effective data. The initial results of some of the secondary indicators obtained in this step are shown in Table 7, and sum the final results of the final scores of a single subject. The final calculation results are shown in Table 7.

Table 7. Empirical Results of Secondary Index (Part)

order number	A2	A31	A32	A33	A4	B3	B6	B11	...	D22
1	0.0453	0.2324	0.3644	0.0134	0.0453	0.0136	0.0215	0.0456	...	0.0804
2	0.0906	0.1743	0.2733	0.0402	0.0453	0.0408	0.043	0.0684	...	0.0804
3	0.1359	0.2324	0.2733	0.0268	0.0453	0.0408	0.043	0.0912	...	0.0804
4	0.0906	0.2324	0.4555	0.0268	0.0453	0.0408	0.0215	0.0912	..	0.1608
5	0.1359	0.1162	0.0911	0.0134	0.0453	0.0272	0.0215	0.0684	...	0.2412
...	...	...	...	...	...	..	...	...	...	...
402	0.1359	0.2324	0.2733	0.0134	0.0453	0.0136	0.0215	0.114	...	0.0804

Table 8. Final Positive Results of Multivariate Evaluation (Part)

order number	F1	F2	F3	F4	score
1	0.7359	0.6473	0.2894	0.2462	1.9188
2	0.7075	0.4947	0.6244	0.412	2.2386
3	0.7975	0.6613	0.5869	0.4876	2.5333
4	0.9129	0.644	0.7142	0.4682	2.7393
5	0.4506	0.5824	0.4588	0.79	2.2818
...	...	...	...	...	...
402	0.6726	0.5474	0.7485	0.285	2.2535

Table 9. Dimension scores table

dimension	Sample mean score	Single full marks	specific value
F1	0.9989	1.4415	0.693
F2	0.6596	0.8245	0.8
F3	0.6846	1.447	0.4731
F4	0.5458	1.231	0.4434
Fscore	2.8889	4.944	0.5843

Based on the table's results, regulated personnel excel in "software use & info reading" and some in "computer skills mastery" and "digital software interaction awareness." Sample averages and single-out ratios reveal strengths in "computer skills" and "software/info reading" (>0.6), but weaknesses in "digital software interaction" and "digital tech innovation" (<0.6). Humanities/social science students are proficient in computer skills but lack software usage and digital innovation, likely due to computer exams promoting basic skills and limited exposure to math, science, engineering principles [7].

4. Conclusion

With the promotion of new liberal arts construction, its demand in China is growing urgent. Despite numerous theoretical studies, research on digital literacy among this group is scarce, lacking a scientific, targeted evaluation standard. To enhance humanities and social science students' digital literacy, this paper designs a math literacy evaluation index and constructs a new ability evaluation framework based on digital literacy research. Utilizing hierarchical analysis, SPSS, and YAAHP for data processing, the study analyzes survey results, summarizes influencing factors, and offers recommendations.

4.1. Improve the Digital Participation of College Students

By gradually improving the digital infrastructure construction of colleges and universities, it provides basic material conditions and practical basis for cultivating college students' digital literacy. In order to realize the sharing and exchange of learning information resources among students, colleges and universities can use digital means to build a three-dimensional, comprehensive and wide-coverage knowledge information service system. Thus narrowing the unbalanced gap in digital literacy education among students.

4.2. Improve the Information Retrieval Ability and Evaluation Ability

The school regularly conducts reader training focused on electronic resources related to various majors. Humanities and social science students can attend training and thematic workshops to understand database features, learn retrieval basics, consult librarians on free online databases, and improve skills by seeking guidance from teachers. College students should also enhance retrieval strategies through practice and inquire about achieving high-quality results.

4.3. Improve the Ability of Data Integration and Results Presentation

Study the relevant courses offered by the school carefully, improve their ability to use wps, excel, SPSS, stata and other software, pay attention to and make full use of the free digital teaching resources of the school library. Develop the habit of reading academic journals regularly, learn the standardized academic language in classic literature and papers, and make their academic writing language more scientific, accurate, logical and concise.

4.4. Improve the Digital Knowledge Teaching System

Integrate the concept and application of digital economy into the curriculum education, and guide students to watch documentaries on the development of digital technology. The library can hold the digital knowledge base competition to enhance the initiative and enthusiasm of college students, further improve and optimize the digital literacy cultivation system of the library.

4.5. Practice Tool-based Skills

College students can learn some advanced tool skills according to their own goals, and practice the learned tool skills in the learning and life, so as to improve the efficiency of completing the work. Usually do more repeated training, step by step to improve my digital literacy.

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