



Development and application of the digital literacy scale for Chinese elderly

Ke Jiang*

Communication University of China, Advertising School, No.1 Dingfuzhuang East Street, Chaoyang District, Beijing, 100024, China

* Corresponding Author Email: kejjiang@cuc.edu.cn - ORCID: 0000-0002-3976-7562

Article Info:

DOI: 10.22399/ijcesn.1811

Received : 03 March 2025

Accepted : 22 April 2025

Keywords :

Digital literacy,
Chinese elderly,
Scale.

Abstract:

Population aging and societal digitization are two major trends intersecting and paralleling in today's world. On the one hand, the pace of population aging is accelerating globally; on the other hand, the wave of digitization is sweeping across the world. Accurately assessing the digital literacy level of the elderly can help enhance their social adaptability, thereby unlocking the potential of the aging population and promoting sustainable social development. However, existing measurements of citizens' digital literacy are typically based on large-scale social survey items and do not consider the heterogeneity of the population. Developing a self-assessment scale specifically designed to benchmark the development ability standards of elderly digital literacy, and validated through educational and psychometric means, can help more accurately grasp the development level and improvement direction of the elderly in different dimensions of digital literacy.

1. Introduction

1.1 Research background

With the continuous growth of population, the survival rate and mortality rate of the population have been continuously declining, and aging has become a global trend. At the end of the 19th century, the process of population aging began to accelerate, first with the birth rate in developed countries falling below the replacement rate, followed by the accelerated population growth in developing countries. The population size, structure, and geographical distribution show a worldwide trend of aging development. While the average life expectancy and fertility levels of humans have been steadily developing in the 17th and 18th centuries, they have also been continuously increasing. With changes in population conditions, the total world population has begun to grow slowly after rapid growth. At the end of the 19th century, the birth rate in developed European countries continued to decline, and the phenomenon of aging began to emerge in some countries. Since the 1970s, population aging has evolved from a national and regional issue to a global problem. European countries are typical aging countries. Without significant differences in

the proportion of elderly population, countries with large populations also have a large elderly population. Therefore, China, India, and the United States are the countries with the largest elderly population. In 1975, China had 41 million elderly people, and the total elderly population exceeded the total population of many countries. According to data released by the National Bureau of Statistics of China, by the end of 2019, the population aged 65 and above in China was about 176 million, accounting for about 12.6% of the total population, and the elderly dependency ratio was 17.8%. The "14th Five-Year Plan" period is an accelerated development period for population aging in China. By the end of the "14th Five-Year Plan" period, the elderly population in the country will exceed 300 million, entering a "moderate aging" society. According to the National Office for Aging, by 2050, the elderly population aged 60 and above in China will increase to about 487 million. In addition, an indicator of accelerated aging is the time interval for the proportion of people over 65 years old to rise from 7% to 14%. In France, this time interval is 115 years (1865-1980), in Sweden it is 85 years (1890-1975), in the United States it is 69 years (1944-2013), and in the United Kingdom it is 45 years (1930-1975). In comparison, Japan took 26 years (1970-1996), while in China's 2020

census, over 65% of the population had reached the age of 14. This means that China (2000-2020) has only taken 20 years to become a giant in terms of the number of elderly people, and it is accelerating faster than other developed countries in terms of aging indicators. China is highly likely to become a region with severe aging like Europe.

The digital divide among the elderly has become prominent, and the lack of digital literacy has become a widespread social issue. Nicholas Negroponte pointed out in "Being Digital" that although "information DNA" has been embedded in the living environment of ordinary people, "being digital" still faces many uncertainties. Especially for the elderly group, who are in a digitally vulnerable position, if their digital literacy cannot be effectively improved, it is highly likely to exacerbate the sense of digital exclusion among the elderly and trigger social contradictions of digital inequality. Currently, the convergence of "digitalization" and "aging" in China has formed new characteristics of the era. In the flood of "digital life", most of the focus is on the younger generation, while the digital survival issues of the middle-aged and elderly groups are neglected. The elderly, as a digitally vulnerable group forgotten by the wave of new media, have gradually been "marginalized". As the indigenous people of the digital age, the younger generation has natural advantages in facing digital life, while for the middle-aged and elderly, it is a brand new and unfamiliar world that requires adaptation and learning, thus generally facing the problem of digital divide. As learners of digital media, after owning digital products such as smartphones and tablet computers, the elderly learn online shopping, news search, and social networking. However, due to their late exposure to digital media and insufficient digital literacy, they become a vulnerable group in the application of digital skills, which is a widespread social problem. The elderly who are at a loss in the digital world are called "digital immigrants" or even "digital refugees".

1.2 Proposal of the problem

Facing the contradiction between the old and the new, the intensifying issue of population aging, and the advent of a new digital society that is changing rapidly, the problem of population aging is becoming increasingly severe. The enhancement of digital literacy has become an important issue related to the development of the national economy. Due to the heterogeneity among groups, research on digital literacy by group has become a trend. In domestic research, scholars such as Chen Danyin have analyzed the case of young people and found

that bridging the digital capability gap can bring a more friendly and positive acquisition experience to the youth digital group. Studies have shown that the digital literacy of the youth group, especially the student group, is significantly related to family supervision and socioeconomic status. Scholars such as He Jing, Yang Wenhui, and Zhang Jingjing have paid attention to rural residents, confirming that the deeper their digital participation, the stronger their sense of happiness. It has paid sufficient attention to the current situation of media literacy among vulnerable groups such as migrant workers, cultivating their ability to use mass media to serve their personal lives, and guiding them to rationally and critically accept and process media information [1-6]. This is an important way to help them gain social recognition and integrate into urban society as soon as possible. Wang Qian and Li Yingyi have paid special attention to left-behind children in rural areas, believing that only by improving the imbalance in relationships between families, schools, and society can the media literacy of migrant children be established [7].

Foreign research started earlier than domestic research and has conducted extensive studies on the digital literacy of the elderly population. Positive studies show that the elderly can benefit greatly from participating in digital life. Negative studies show that using computers and the internet does not seem to bring convenience to the elderly population. In Selwyn's research, the elderly believed they did not need information and communication technology (ICT). According to a report by Dutton et al., their reasons for not using the internet include lack of usefulness or interest, lack of necessary skills to operate ICT, lack of ICT equipment or internet connection, and pressure from expensive equipment [8].

Research indicates that in China, systematic attention to digital literacy among the elderly is insufficient due to the ambiguity of the concept, inadequacies in empirical research, and a lack of systematic measurement indicators. This study aims to establish a comprehensive, multi-dimensional digital literacy measurement system based on clarifying the concept and combining domestic and international digital literacy frameworks. In foreign research, contradictory conclusions have emerged in numerous digital literacy studies, likely due to regional differences among elderly populations. Therefore, it is necessary to establish a group-specific and localized digital literacy measurement framework to conduct localized research on the Chinese elderly population and provide experience for future cross-country comparative studies. Based on this, the research questions of this paper are proposed:

- 1) How to construct the framework and scale of digital literacy for the elderly population in China?
- 2) What is the digital literacy status of the elderly population in China based on this scale.

2. Literature Review and Establishment of Measurement Framework

2.1 The concept and framework of digital literacy

In the measurement of digital literacy, scholars in China have also conducted some explorations. Hu Zhihui and Sun Yaowu proposed that the digital literacy of Chinese residents can be divided into four dimensions: professional knowledge domain, life application domain, information domain, and communication domain [9]. Based on a review of digital literacy evaluation frameworks issued by foreign research institutions and combined with the three-stage model of digital literacy, Ma Xing constructed an evaluation of college students' digital literacy that includes four dimensions: "digital acquisition," "digital creation," "digital dissemination," and "digital identity," with 17 indicators [10]. Zhong Zhixian and others established a literacy evaluation index system based on the three research orientations of "ability, process, and goal" constructed from foreign media literacy assessment frameworks [11]. In the measurement process, China's digital literacy measurement should respond to the demands of the media ecology in the era of all-media; transcend the research bias of single methods; highlight the cultural adaptability of local considerations, thereby constructing an evaluation framework that "fits the times, is based on the local, integrates the world, and expresses China." These studies provide references for the framework construction of digital literacy. Based on the research on digital literacy measurement in China, the author has organized a systematic global digital literacy framework [12-18].

EU framework

In March 2000, at a special summit held in Lisbon, the capital of Portugal, leaders from 15 EU member states reached a consensus on the EU's economic plan for the next decade and formulated the "Lisbon Strategy". To implement the "Lisbon Strategy", the EU launched the "Education and Training 2010 Plan", of which the formation of the EU's eight core competencies was a specific outcome. At the European Commission meeting held in Lisbon, the "new basic competencies" were proposed, which encompassed five aspects: scientific and technological culture, information technology,

foreign languages, entrepreneurial spirit, and social skills. "Digital literacy" is one of the EU's eight core competencies, originating from the "information technology" aspect of the "new basic competencies" adopted at the Lisbon meeting in 2000. Among the four versions of the EU's core competencies, digital literacy remains relatively stable, although the specific names vary, namely "information technology", "information technology skills", and "digital literacy". With the official release of the EU's core competencies, research on digital literacy has become more extensive and in-depth. Among them, the "European Digital Agenda" and the "Digital Competency Programme" (DIGCOMP) are important components of the EU's digital literacy framework, with the "Digital Competency Programme" being a key part.

Framework of the Cyberspace Administration of China

Due to the cross-population and cross-disciplinary nature of the concept of digital literacy, it has once again garnered widespread attention from all sectors of society following the release of the "Key Points for Enhancing Digital Literacy and Skills for All in 2022" (hereinafter referred to as the "Key Points") in 2022. The "Key Points" state that by the end of 2022, positive progress will be made in enhancing digital literacy and skills for all, and a systematic promotion model will be initially formed. The supply of digital resources will become more abundant, a lifelong digital learning system for all will be initially established, the digital work capabilities of workers will be accelerated, the digital living standards of the people will be improved, digital innovation vitality will be unleashed, the digital security protection barrier will become stronger, the legal and moral standards of the digital society will continue to improve, and the development environment for digital literacy and skills for all will also be continuously optimized. Among them, digital awareness encompasses internalized digital sensitivity, the authenticity and value of digital information, the motivation to actively discover and utilize authentic and accurate digital information, the sharing of real, scientific, and effective data in collaborative learning and work, and proactive maintenance of data security.

2.2 Establishment of the localization framework

Framework

There are primarily two challenges in assessing digital literacy in China: firstly, the absence of a corresponding performance indicator system; secondly, the lack of reasonable assessment tools.

Referring to digital literacy assessment methods from other countries is one approach, especially as China is in the initial stage of constructing its digital literacy assessment system. Special attention should be paid to the scientific design concepts and rigorous development processes of other countries. In terms of assessment tools, what is important is not the type of tool, but rather selecting and redeveloping existing tools based on the assessment needs of different groups, to ensure consistency with the assessment objectives and forms. Considering the comprehensive and reasonable content of the EU Digital Literacy Framework, its content reflects a view of literacy as a multidisciplinary complex of knowledge, skills, and attitudes; it also facilitates the parallel progression of theoretical and empirical research, maintaining the coherence of continuous tracking research while reflecting the macro-systematic nature of the research. The scale construction in this paper is

based on the EU Framework and the UNESCO Framework, supplemented by effective scale items from domestic and international research. It attempts to present a multi-dimensional and systematic framework with diverse applicability. Table 1 is Digital literacy framework and dimensions and table 2 is Digital Literacy Domain Coding and Specific Literacy Content.

Scale

Scales are of great significance in the field of social science. Scale tools originated from psychophysical measurement theory, and their essence lies in objectively quantifying and evaluating behavioral samples. This paper sorts out digital literacy frameworks both domestically and internationally, designs and compiles a scale based on them, and conducts a quantitative analysis of digital literacy among the elderly population in China through the construction of indicator theory.

Table 1. Digital literacy framework and dimensions

EU Framework	China Framework	Dimension
Operation domain, information domain	Ability to acquire and use digital technology	Ability dimension
Security awareness domain	Safety and security, ethics and morality	Quality dimension
Content creation domain	Digital production and innovation capability	Ability dimension
Communication Domain	Information exchange and sharing capability	Ability dimension
Information field	Information evaluation ability	Quality dimension

Table 2. Digital Literacy Domain Coding and Specific Literacy Content

Domain of Literacy	code	Specific literacy
Operational Domain	A01	Physical operation of digital device hardware
	A02	Operating digital device software, software operation
Information field	B01	Browse, retrieve, and filter information
	B02	evaluative information
	B03	Store information, Manage information
Communication Domain	C01	Interact through technology
	C02	Information and content sharing
	C03	Internet user identity
	C04	Collaborate
	C05	Online behavior norms
	C06	Management of digital identity
Content creation domain	D01	Create Content
	D02	Integration and reinterpretation
	D03	Copyright and License
	D04	programming
Security awareness domain	E01	protection equipment
	E02	Protect personal data
	E03	protect health
	E04	protect the environment

After reviewing digital literacy frameworks both domestically and internationally, this study opted for the clear and explicit EU framework to facilitate the construction of a digital literacy scale pool. The EU digital literacy framework proposes five domains: Information, Communication, Content Creation, Safety Awareness, and Problem Solving. Based on the EU digital literacy framework, the UNESCO framework adds an Operations domain and a Career-related domain.

The operational domain refers to the physical and software operations of digital devices (hardware). The information domain focuses on the ability to identify, locate, retrieve, store, organize, and analyze digital information, as well as to judge the relevance of information. The communication domain focuses on sharing resources, communicating and collaborating with others through digital tools on the internet, participating in online community interactions, and possessing cross-cultural awareness. In short, it refers to the quality and ability to communicate in the digital environment. The content creation domain focuses on the ability to create and edit new content, from text processing to graphics, images, videos, etc., to reintegrate previous knowledge and content, generate creative expressions of information, as well as media output and programming, and the ability to reasonably apply intellectual property rights. The security awareness domain focuses on the qualities of personal protection, data maintenance, digital identity protection, security measures, and sustainable utilization.

2.3 Construction, optimization, and measurement of the scale pool

In assessing digital literacy needs, China must choose between two opposing perspectives: whether to view digital literacy as a professional or general competency, and whether to assess digital literacy primarily for screening or development purposes. Clearly, it is difficult to address both perspectives comprehensively. Therefore, different scales need to be constructed based on the research subjects. Considering that the research subjects of this study are middle-aged and elderly individuals aged 50 and above, they are regarded as general competency aimed at development, rather than professional competency aimed at screening, as selected in youth digital literacy tests. Since this group of people is in the stage of imminent retirement or already retired, career-related domains are not investigated, and problem-solving domains are considered too complex for middle-aged and elderly individuals in focus group

interviews and are not included in the consideration. Therefore, in the measurement, the author did not include career-related domains and problem-solving domains in the design of the scale, but focused on measuring operational, informational, communicational, content creation, and security awareness domains.

Based on the digital literacy framework of the European Union and the UNESCO framework, we screened relevant digital literacy measurement questions both domestically and internationally, using content fit as the selection criterion and removing questions targeted at specific groups. A total of five literacy domains, including a pool of 120 alternative questions, were designed, as shown in table 3.

After the preliminary establishment of the scale pool, it is necessary to optimize its items and length. The first step in optimizing the scale involves the method of expert meetings, where relevant professional experts and doctors are invited to review and localize the design of the scale, and make revisions to the scale, mainly by deleting irrelevant and repetitive questions, and replacing foreign expressions such as "facebook" with localized digital applications like "Weibo". Finally, a scale pool containing 90 questions is obtained. The second step involves conducting focus group interviews, where 26 middle-aged and elderly people aged 50 to 70 are invited to test the questionnaire. The author and the interviewees work together to record the questions raised by the interviewees during the process of answering questions, and delete options that they cannot understand or have obvious ambiguities. Finally, a scale containing 57 questions is obtained and incorporated into the questionnaire survey (table 3).

3. Research Methods and Results

3.1 Research methods

Assessing the digital literacy of middle-aged and elderly individuals poses significant challenges. Due to the older age of the respondents and the length of the questionnaire, researchers must reasonably select and combine various assessment methods based on the assessment objectives and targets, while also ensuring that the assessment has sufficient reliability and validity. To achieve these objectives, this study primarily adopts a mixed questionnaire survey model combining self-assessment scales and auxiliary assessments.

1) Self-assessment scale. Based on self-report using a scale, it measures the "level of digital literacy". By distributing the scale, respondents are

Table 3. Optimized Digital Literacy Scale Pool

Question number	Question line	Dimension	Question items
1	Q11_Line 1	Operational Domain	I know how to turn on and turn off the device
2	Q11_Line 2	Operational Domain	I can connect to a WiFi network (wireless network)
3	Q11_Line 3	Operational Domain	I can save the pictures or files I find online
4	Q11_Line 4	Operational Domain	I know how to download and store files onto a USB drive or cloud storage
5	Q11_Line 5	Operational Domain	I know how to find and open the files I have stored
6	Q12_Line 1	Information field	I can browse news online
7	Q12_Line 2	Information field	I will use tools such as Baidu to search for the information I want
8	Q12_Line 3	Information field	I can select the most appropriate keywords for retrieval according to my needs
9	Q12_Line 4	Information field	When gathering information, I will consider which medium is better to use
10	Q12_Line 5	Information field	I can turn off push notifications for different applications
11	Q12_Line 6	Information field	I can prevent the promotion of paid applications, games, or advertisements
12	Q12_Line 7	Information field	I can distinguish useless or harmful online information and content
13	Q12_Line 8	Information field	I am able to assess the credibility of information by seeking corroborative evidence
14	Q12_Line 9	Information field	Be able to judge the credibility of information through the title, content, etc
15	Q12_Line 10	Information field	I am capable of assessing the potential impact of media information content on individuals or society
16	Q12_Line 11	Information field	I can judge the credibility of information based on the authority of the information publishing institution
17	Q12_Line 12	Information field	I know that not all online information is reliable
18	Q13_Line 1	Communication Domain	I can chat with friends online
19	Q13_Line 2	Communication Domain	I know the meanings of some popular internet slang terms
20	Q13_Line 3	Communication Domain	I can learn about the updates of others, family members, friends, celebrities, etc. on the internet
21	Q13_Line 4	Communication Domain	I can express my own opinions online
22	Q13_Line 5	Communication Domain	I can participate in topic discussions using the internet
23	Q13_Line 6	Communication Domain	I can always find people with common hobbies through the internet
24	Q13_Line 7	Communication Domain	I can share my updates online
25	Q13_Line 8	Communication Domain	I can take photos or videos with my smartphone and share them
26	Q13_Line 9	Communication Domain	I use Weibo, WeChat, QQ, and other platforms to express my thoughts or opinions
27	Q13_Line 10	Communication Domain	I will pay attention to hot-button issues on the internet and express my own opinions
28	Q13_Line 11	Communication Domain	I will use a computer or mobile phone to shop online
29	Q13_Line 12	Communication Domain	I know how to order takeout
30	Q13_Line 13	Communication Domain	I know how to register for a medical appointment online
31	Q13_Line 14	Communication Domain	I know how to hail a taxi via my mobile phone
32	Q13_Line 15	Communication Domain	I know how to pay with my mobile phone
33	Q13_Line 16	Communication Domain	I know what kind of content can and cannot be shared on the Internet plus
34	Q13_Line 17	Communication Domain	I know that in any online information and content, there exist different viewpoints
35	Q13_Line 18	Communication Domain	I know not all content can be broadcast live online
36	Q13_Line 19	Communication Domain	I will not ridicule or insult others online
37	Q13_Line 20	Communication Domain	I know not everyone can publish news on the internet
38	Q14_Line 1	Content creation domain	I can publish my own original videos, audios, and other online content
39	Q14_Line 2	Content creation domain	I know how to create new works from online music or videos

40	Q14_Line 3	Content creation domain	I can edit new video or music content
41	Q14_Line 4	Content creation domain	I am capable of converting formats and compressing audio and video materials
42	Q14_Line 5	Content creation domain	I am capable of performing format conversion, compression, and enhancement on image materials
43	Q14_Line 6	Content creation domain	I am capable of reediting and processing information and content on the internet
44	Q14_Line 7	Content creation domain	I know which websites require copyright and permission
45	Q14_Line 8	Content creation domain	I know that not all information and content on the internet can be edited, processed, and disseminated
46	Q14_Line 9	Content creation domain	I know that copyright needs to be protected when using online information
47	Q15_Line 1	Security awareness domain	I know that I shouldn't post the chat content with friends online without permission
48	Q15_Line 2	Security awareness domain	I believe that discussing personal privacy issues online should not be allowed
49	Q15_Line 3	Security awareness domain	I can delete a person from my contacts
50	Q15_Line 4	Security awareness domain	I can change the sharing settings to determine who can see the content I share
51	Q15_Line 5	Security awareness domain	I can change my personal information (such as WeChat, QQ)
52	Q15_Line 6	Security awareness domain	I can turn off the sharing of my location
53	Q15_Line 7	Security awareness domain	I won't remit money to strangers through the internet
54	Q15_Line 8	Security awareness domain	I always spend a lot of money online unintentionally
55	Q15_Line 9	Security awareness domain	I won't easily disclose my personal information and that of my family online
56	Q15_Line 10	Security awareness domain	I know my network account password
57	Q15_Line 11	Security awareness domain	I will not disclose my account and password to strangers

invited to conduct self-assessment of their digital literacy. Through the distribution of online questionnaires, eligible testers are invited to conduct self-assessment. The main focus is on the basic demographic variables of the respondents, their participation in digital life, measurement of digital literacy, and influencing factors of digital literacy. The selection of the scale is based on mature scales, literature, and relevant theories, and all scales have undergone reliability and validity analysis after testing, demonstrating good reliability and validity.

2) Auxiliary assessment form. Due to the length of the questionnaire and the involvement of some professional terminology, the author adopted an auxiliary assessment mode, which allows for a young assistant to ask questionnaire questions to the respondents online, while the testers or family members of the respondents record and enter the answers of the respondents. Table 4 is localization sub-domains and scores of digital literacy. During the question-and-answer process, testers can observe the respondents and appropriately ask non-structural questions. Alternatively, the testees' children or grandchildren can be invited to accompany the elderly to answer together.

This study conducted a questionnaire survey through a professional research institution in China, and a total of 505 valid questionnaires were collected. The research framework for digital literacy among the middle-aged and elderly population in China includes the operational domain, information domain, and communication domain. After the initial establishment of a scale pool containing 120 items, the scale was optimized through expert meeting and focus group methods. The optimized scale, consisting of 57 items, was incorporated into the questionnaire survey. Through exploratory factor analysis, digital literacy was ultimately reclassified into five dimensions: Information Acquisition and Application (IAA), Basic Knowledge and Norm (BKN), Digital Content Creation (DCC), Digital Interaction and Communication (DIC), and Digital Information Evaluation (DIE),

3.2 Research results

Digital Literacy (DL)

The scoring levels of the five literacy modules for Chinese middle-aged and elderly people (Basic Knowledge and Norms of Behavior (BKN) >

Table 4. Localization sub-domains and scores of digital literacy

project	IAA	BKN	DCC	DIC	DIE
N	505	505	505	505	505
average value	3.8684	4.3873	3.2414	3.9366	3.6482
Mean standard error	.03191	.02221	.03812	.03146	.03328
Standard deviation	.71715	.49914	.85658	.70696	.74778
variance	.514	.249	.734	.500	.559

Digital Interaction and Communication (DIC) > Information Access and Application (IAA) > Information Evaluation (DIE) > Digital Content Creation (DCC)),

DL (Digital Literacy) = (IAA+BKN+DCC+DIC+DIE) /5=3.82

Information Acquisition and Application (IAA)

From the origin and development of digital literacy, it can be seen that an important part of digital literacy is the acquisition and application of information. Digital literacy refers to the awareness, skills, understanding, and reflective methods necessary for comfortable operation in an environment rich in information and supported by information technology. Information acquisition and application correspond to storage ability, search ability, shared information, and digital life ability (such as ordering taxis, ordering takeout, online shopping, and online medical treatment) in the information domain of digital literacy, which belong to the category of abilities. It includes 1) abilities to browse, retrieve, and filter information,

identify, locate, retrieve, and store digital information. For example, being able to select the most appropriate keywords for retrieval, using search tools to find the desired information, and saving pictures and files. 2) information and content sharing, which refers to sharing the content and sources of discovered information with others; being willing and able to share knowledge, content, and resources. 3) the ability to use information to participate in digital life, such as ordering taxis, ordering takeout, online shopping, and online medical treatment.

Table 5 is items and Factor Loads of Information Acquisition and Application (IAA) and table 6 is items and Factor Loads of Basic Knowledge and Norms (BKN).

Basic common sense and behavioral norms

Basic common sense and behavioral norms correspond to basic operations in digital literacy (such as how to turn on and off a device) and digital citizenship norms (digital ethics), such as not mocking or insulting others online, not discussing

Table 5. Items and Factor Loads of Information Acquisition and Application (IAA)

variable	code	topic	factor loading
Information Acquisition and Application (IAA)	IAA01	I know how to download and store files onto a USB drive or cloud storage	0.762
	IAA02	I know how to locate and open the files I have stored	0.728
	IAA03	I can select the most appropriate keywords for retrieval according to my needs	0.717
	IAA04	I can use tools like Baidu and Google to search for the information I want	0.684
	IAA05	I know how to hail a taxi via my mobile phone	0.682
	IAA06	I can save the pictures or files I find online	0.624
	IAA07	I know how to order takeout	0.623
	IAA08	When gathering information, I will consider which medium is better to use	0.599
	IAA09	I can turn off push notifications for different applications	0.581
	IAA10	I can change the sharing settings to determine who can see the content I share	0.544
	IAA11	I can turn off sharing my location	0.54
	IAA12	I know how to register for a medical appointment online	0.521
	IAA13	I can connect to a WiFi network (wireless network)	0.504
	IAA14	I will make online shopping via computer or mobile phone	0.498
	IAA15	I know the meanings of some popular internet slang terms	0.483
	IAA16	I can prevent the promotion of paid applications, games, or advertisements	0.482

personal privacy topics, etc., as well as some topics in the domain of security awareness, such as not remitting money to strangers and not disclosing personal information. The basic awareness that digital citizens should possess includes understanding the security risks and threats from the internet, having privacy awareness, being able to protect themselves from online harm, and reflecting the basic moral standards of digital citizens. This scale mainly reflects the basic qualities of the interviewees in the digital world and belongs to the category of quality.

Digital content creation

The content creation domain focuses on the ability to create and edit new content ranging from text processing to graphics, images, videos, etc., to reintegrate previous knowledge and content, generate creative expressions of information, as well as media output and programming, and the ability to reasonably apply intellectual property rights. Digital content creation belongs to the intermediate and advanced category of digital application capabilities. For the content creation domain in the digital literacy domain, it includes the ability to edit, process. This scale reflects the interviewees' high digital application capabilities in the digital world, belonging to the higher capability category. It includes: 1) Content creation: Creating content in different forms (including multimedia); editing and refining content created by others, and expressing creatively through digital media and technology. 2) Integration and reinterpretation:

Creating new content and knowledge through modifying, refining, and combining existing resources. 3) Copyright and licensing: Understanding the relevant knowledge and procedures applied to copyright and licensing of information content. Table 7 is digital Content Creation (DCC) Items and Factor Loadings. Table 8 is items and Factor Loads of the Dynamic Interaction and Communication (DIC) Scale and table 9 is items and Factor Loads of the DIE (Data Information Evaluation).

Interaction and communication

The communication domain focuses on sharing resources, communicating and collaborating with others, and participating in online community interactions through digital tools. In brief, it refers to the quality and ability of communication in the digital environment. The interaction and communication part corresponds to the communication domain in the digital literacy domain, including items such as using instant messaging tools to express one's thoughts, connect with others, share updates, and participate in topic discussions. This scale reflects the interviewees' ability to interact and communicate in the digital world, belonging to the category of ability.

Information evaluation

Information evaluation is an evaluation branch within the information domain of digital literacy, encompassing 1) the ability to comprehend and

Table 6. Items and Factor Loads of Basic Knowledge and Norms (BKN)

variable	code	topic	factor loading
Basic Knowledge and Norms (BKN)	BKN01	I won't remit money to strangers through the internet	0.678
	BKN02	I can chat with friends online	0.615
	BKN03	I know that I shouldn't post the chat content with friends online without permission	0.614
	BKN04	I believe that discussing personal privacy issues online should not be allowed	0.567
	BKN05	I won't easily disclose my personal information and that of my family online	0.563
	BKN06	I know how to turn on and turn off the device	0.557
	BKN07	I can take photos or videos with my smartphone and share them	0.547
	BKN08	I will not ridicule or insult others online	0.539
	BKN09	I know not all content can be broadcast live online	0.535
	BKN10	I can browse news online	0.528
	BKN11	I won't disclose my account and password to strangers	0.524
	BKN12	I know that in any online information and content, there exist different viewpoints	0.503
	BKN13	I know that not all online information is reliable	0.502
	BKN14	I know what kind of content can and cannot be shared on the Internet plus	0.469

Table 7. Digital Content Creation (DCC) Items and Factor Loadings

variable	code	topic	factor loading
Digital Content Creation (DCC)	DCC01	I am capable of converting formats and compressing audio and video materials	0.694
	DCC02	I can edit new video or music content	0.687
	DCC03	I am capable of reediting and processing information and content on the internet	0.684
	DCC04	I am capable of performing format conversion, compression, and enhancement on image materials	0.678
	DCC05	I know how to create new works from online music or videos	0.649
	DCC06	I know which websites require copyright and permission	0.636
	DCC07	I know that copyright needs to be protected when utilizing online information	0.511
	DCC08	I know that not all information and content on the internet can be edited, processed, and disseminated	0.507
	DCC09	I can publish my own original videos, audios, and other online content	0.502

Table 8. Items and Factor Loads of the Dynamic Interaction and Communication (DIC) Scale

variable	code	topic	factor loading
Dialogue and Interaction (DIC)	DIC01	I use Weibo, WeChat, QQ, and other platforms to express my thoughts or opinions	0.602
	DIC02	I can share my updates online	0.587
	DIC03	I can express my own opinions online	0.546
	DIC04	I can learn about the updates of others (family members, friends, celebrities, etc.) on the internet	0.542
	DIC05	Be able to participate in topic discussions using the internet	0.515

Table 9. Items and Factor Loads of the DIE (Data Information Evaluation)

variable	code	topic	factor loading
Information Evaluation (DIE)	DIE01	I am capable of assessing the potential impact of media information content on individuals or society	0.536
	DIE02	Be able to judge the credibility of information through titles, content, etc	0.485
	DIE03	I can judge the credibility of information based on the authority of the information publishing institution	0.459

critically evaluate information, and 2) the capacity to assess the credibility of information. This scale reflects the interviewee's critical digital thinking and independent thinking skills in the digital world, falling within the category of higher-level competencies.

4. Conclusion and Discussion

4.1 The issue of digital literacy among the elderly population in China has transitioned from an access gap to a literacy gap.

In the study of digital literacy among the elderly, the digital divide has been mentioned multiple times, and enhancing digital literacy is considered an effective way to bridge the digital divide. Research indicates that the digital divide has shifted from an access divide to a usage divide and a

literacy divide. According to measurements, the digital literacy of the middle-aged and elderly groups in China scores higher in basic knowledge and behavioral norms, interaction, and communication modules, which require lower quality and ability, while it scores lower in information evaluation and digital content creation modules, which require higher quality and ability. Basic Knowledge and Norms (BKN) corresponds to basic operations and digital citizenship norms (digital ethics) in digital literacy; Digital Interaction and Communication (DIC) corresponds to the communication domain in digital literacy, including using instant messaging tools to express one's ideas, connect with others, share updates, participate in topic discussions, etc.; Information Access and Application (IAA) corresponds to storage capabilities, search capabilities, information sharing, digital life capabilities, etc. in the

information domain of digital literacy; Digital Content Creation (DCC) includes editing, processing, and creative abilities for audio and video, as well as copyright protection awareness; Information Evaluation (DIE) corresponds to the evaluation branch in the information domain of digital literacy, reflecting the interviewees' critical digital thinking and independent thinking literacy, which belongs to the category of higher quality literacy.

4.2 The Way for Family and Social Networks to Enhance Quality and Literacy

1. Improvement of information evaluation ability: Compared to elderly people in Western societies, Chinese elderly have smaller social networks and a higher proportion of family members. Their social networks are primarily based on kinship and are gradually transitioning towards geographical relationships. How can we enhance the digital literacy of the elderly through their social relationships? In terms of family composition, individuals who have grandchildren or maintain frequent contact with them have improved their media literacy. Some foreign scholars refer to this "learning process and experience that occurs between different generations" as "intergenerational learning." "Intergenerational learning" has emerged as a new research hotspot internationally in recent years. Communication with family members may be a way to bridge the "digital divide" in terms of information evaluation ability. The issue of literacy has escalated from basic operational issues to one of information evaluation ability. For retired elderly individuals, the opinions of family members influence their identification and evaluation of issues in cyberspace. Intergenerational communication and assistance from family members have opened up a new avenue to address issues such as population aging and empty nests.

2. Improvement of digital content creation ability; unlike basic ICT operation ability, the creation of digital content clearly belongs to a higher level of computer ability, which requires systematic learning for the elderly to achieve. On the one hand, we can leverage the platform advantages of the National Open University's years of experience in modern distance open education to gather and integrate high-quality resources and excellent teachers for elderly education nationwide, build a national platform for sharing and public service of elderly education resources, provide inclusive and basic public services for various elderly education institutions and the vast number of elderly learners, and explore a new model of

"Internet plus elderly education". On the other hand, we can open up a dedicated platform for elderly activities, with the aim of actively promoting aging by providing services based on modern information technology, promoting and facilitating this vulnerable group to receive education and enter the labor market, thereby helping elderly patients and seniors better integrate into society.

Author Statements:

- **Ethical approval:** The conducted research is not related to either human or animal use.
- **Conflict of interest:** The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper
- **Acknowledgement:** The authors declare that they have nobody or no-company to acknowledge.
- **Author contributions:** The authors declare that they have equal right on this paper.
- **Funding information:** The authors declare that there is no funding to be acknowledged.
- **Data availability statement:** The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

References

- [1] Liu Wen, Jiao Pei. (2015) Research on Active Aging from an International Perspective. *Journal of Sun Yat-sen University (Social Science Edition)*, 55(1): 167-180
- [2] Chen Danyin. (2021) Digital Accessibility: Youth Development Based on Digital Capabilities and Digital Usage. *China Youth Studies*, 8: 50-57
- [3] He Jing, He Ting, Niu Gengfeng, et al. (2021). The Relationship between Family Socioeconomic Status and Digital Literacy: The Mediating Role of Parental Online Intervention [C] // *The 23rd National Psychological Conference, 2021, Hohhot, Inner Mongolia, China* (2021): 219-220.
- [4] Yang Wenhui, Li Yao, Shi Xiaohan, et al. (2021) The Impact of Parental Internet Monitoring on Adolescents' Pathological Internet Use: The Mediating Role of Digital Literacy [C]//*Proceedings of the 23rd National Conference on Psychology, 2021, Hohhot, Inner Mongolia, China* (2021): 221-222.
- [5] Zhang Jingjing, Liu Tongshan. (2020), Does Internet use make rural residents happier? Evidence from CFPS2018. *Dongyue Forum*, 41(9): 172-179
- [6] Zheng Suxia. (2010) Investigation and Analysis of the Current Situation of Media Literacy of Migrant

- Workers - Based on the Survey in Zhengzhou City, Henan Province. *Modern Communication (Journal of Communication University of China)*, 10: 121-125
- [7] Wang Qian, Li Yingyi. (2018), Conflict and Reconciliation: A Study on the Construction of Media Literacy of Migrant Children from a Relational Perspective *Journal of Communication University of China*, 40(1): 163-168
- [8] Dutton W, Helsper E J, Gerber M M. The internet in Britain: 2009. *Oxford: Oxford Internet Institute, 2009.*
- [9] Hu Zhihui, Sun Yaowu. (2022), Construction and Empirical Study of the Digital Literacy Indicator System for Chinese Residents. *Science and Management*, 42(2): 79-87
- [10] Ma Xing. (2021) Research on the Construction of Evaluation Indicators for Digital Literacy of College Students. *Education Review*, 10: 66-71
- [11] Zhong Zhixian, Wang Shuli, Yi Kaiyu. (2020), On the Construction of a Framework for Citizen Media Literacy Assessment. *Journal of Educational Technology Research*, 41(1): 19-28+36
- [12] B. Jayakumar, & S. Prabakar. (2025). Leveraging Digital Innovation to Enhance MGNREGA's Impact on Rural Empowerment. *International Journal of Computational and Experimental Science and Engineering*, 11(1). <https://doi.org/10.22399/ijcesen.1050>
- [13] Lawhon T, Ennis D, Lawhon D C. (1996) Senior adults and computers in the 1990s. *Educational Gerontology*, 22(2): 193-201.
- [14] Hernández-Encuentra E, Pousada M, Gómez-Zúniga B. (2009), ICT and older people: Beyond usability. *Educational Gerontology*, 35(3): 226-245.
- [15] Opalinski L. (2001), Older adults and the digital divide: Assessing results of a web-based survey. *Journal of Technology in Human Services*, 18(3-4): 203-221.
- [16] Vuori S, Holmlund-Rytönen M. 55 + people as internet users[J]. *Marketing Intelligence and Planning*, 2005, 23(1): 58-76.
- [17] Blažun H, Saranto K, Rissanen S. (2012), Impact of computer training courses on reduction of loneliness of older people in Finland and Slovenia. *Computers in Human Behavior*, 28(4): 1202-1212
- [18] Ahn M, Beamish J O, Goss R C. (2008) Understanding older adults' attitudes and adoption of residential technologies. *Family and Consumer Sciences Research Journal*, 36(3): 243-260.