Survey and Analysis of Digital Literacy Among the Elderly Population: A Case Study of Nantong City, Jiangsu Province (Postprint)

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Abstract

[Objective/Significance] In the digital era, digital literacy has become an essential competency for citizens. Investigating the digital literacy level of older adults and clarifying the disparities in digital literacy among them is particularly imperative. This paper employs a point-to-surface survey analysis to understand the digital literacy status of the elderly and proposes targeted strategies for digital literacy enhancement. [Method/Process] Taking Nantong City, Jiangsu Province as the research area, this study investigates the digital literacy level of older adults across four dimensions: digital awareness literacy, digital skills literacy, digital security literacy, and digital ethics literacy, and analyzes the existing differences in digital literacy levels within the elderly population. [Results/Conclusion] The study reveals that the overall digital literacy level of older adults in Nantong City is relatively low, and that digital literacy levels vary significantly according to age, educational attainment, physical health status, place of residence, living arrangement, whether children support the use of smart devices, and whether there is a stable source of income. Based on these findings, this paper proposes measures such as helping older adults establish "digital confidence," promoting age-friendly transformation of smart products, advocating for "digital 反哺" from younger generations to older adults within families, encouraging communities to conduct support and training programs for elderly smart device usage, and reducing internet usage costs, thereby providing a reference for effectively enhancing the digital literacy of China' s elderly population.

Full Text

Preamble

Investigation and Analysis of Digital Literacy Among the Elderly: A Case Study of Nantong City, Jiangsu Province

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Abstract: [Purpose/Significance] In the digital era, digital literacy has become an essential competency for citizens. Investigating the digital literacy levels of older adults and clarifying the disparities in their digital capabilities is particularly necessary. This study examines the digital literacy status of the elderly through targeted survey analysis and proposes strategies for improving their digital literacy. [Method/Process] Taking Nantong City, Jiangsu Province as the research site, this study investigates the digital literacy levels of older adults across four dimensions: digital awareness literacy, digital skills literacy, digital security literacy, and digital moral literacy, while analyzing variations in digital literacy within the elderly population. [Result/Conclusion] The findings reveal that the overall digital literacy level of Nantong' s elderly population is relatively low, with significant differences arising from age, education level, physical health status, place of residence, living arrangement, children's support for smart device usage, and availability of stable economic resources. Based on these conclusions, this paper proposes measures including helping older adults establish "digital confidence,"promoting age-appropriate transformation of smart products, advocating "digital back-feeding" from younger family members, encouraging community-based training programs for smart device usage among the elderly, and reducing internet access costs. These recommendations provide valuable references for effectively enhancing digital literacy among China' s elderly population.

Keywords: elderly population; digital literacy; promotion strategies; digital confidence; digital back-feeding

In the digital age, individuals require robust digital literacy and skills to adapt to increasingly intelligent life scenarios. According to the seventh national census data released by the National Bureau of Statistics in 2021, China' s population aged 60 and above accounts for 18.7% of the total population, a figure projected to reach approximately 25% by 2030, indicating that China is rapidly becoming an aging society [1]. With the widespread application of internet technology, digital technology has become fully embedded in the daily lives of older adults. While online services such as grocery shopping, government affairs processing, and medical appointment booking have brought convenience to residents' lives, they have also presented challenges for the elderly population. Some older adults feel at a loss when confronted with smart devices and new digital applications, struggling to enjoy high-quality digital life. Both the State Council' s "Opinions on Strengthening Elderly Care Work in the New Era" and the report from

the 20th National Congress of the Communist Party of China have explicitly emphasized the need to strengthen elderly care work in response to the aging situation [2]. The China Association for Science and Technology and the China Association of Senior Scientists and Technologists have issued the "Silver Age Digital Divide Bridging Science Popularization Special Action Plan (2022-2025)" and the "Three-Year Plan for Smart Elderly Assistance Action," advocating for efforts to improve digital literacy among older adults [3-4]. In light of this, this study takes Nantong' s elderly population as the survey subject to analyze their digital literacy levels and key influencing factors, thereby proposing strategic recommendations for enhancing digital literacy among older adults and providing reference for China' s digital elderly assistance policies and initiatives.

1.1 Research on Digital Literacy

Digital literacy represents an essential skill for human survival in the new digital environment. The concept was first proposed by Gilster [5], who defined digital literacy as the comprehensive ability to access, understand, organize, and critically evaluate digital information. Israeli scholar Yoram [6] further expanded the definition by constructing a digital literacy conceptual framework encompassing six aspects: photo-visual literacy, reproduction literacy, branching literacy, information literacy, socio-emotional literacy, and real-time thinking skills. International research on digital literacy began relatively early, with the most recognized frameworks being the EU Digital Competence Framework and the Global Digital Literacy Framework. The European Commission identifies digital competence as comprising five domains: information, content creation, communication, safety, and problem-solving [7]. UNESCO' s "Global Digital Literacy Framework" posits that digital literacy includes seven competency areas: device operation, information processing, communication and collaboration, content creation, safety protection, problem-solving, and occupation-specific domains [8].

Research on digital literacy in China began in 2006. Wang Youmei et al. [9] argue that information literacy, network literacy, computer literacy, and media literacy form the foundation for constructing a digital competence conceptual framework. Jiang Minjuan [10] views digital literacy as a complex, multi-layered concept composed of meta-knowledge, technical skills, civic participation, and ethical awareness. Compared with information literacy and media literacy, digital literacy places greater emphasis on individuals' ability to utilize digital tools, understand digital information, and engage in innovative and critical thinking [11]. The Cyberspace Administration of China has issued the "Action Outline for Improving Citizens' Digital Literacy and Skills," defining digital literacy and skills as the collection of qualities and abilities that citizens in a digital society should possess for learning, working, and living, including digital acquisition, production, usage, evaluation, communication, sharing, innovation, security protection, and ethical considerations [12].

1.2 Research on Digital Literacy Among the Elderly

Academic research on digital literacy among older adults primarily focuses on the necessity of digital integration for the elderly [13], educational models for improving digital literacy among older adults domestically and internationally [14], bridging the digital divide for older adults [15-16], strategies for enhancing digital literacy among older adults [17], library services for elderly digital literacy [18-19], and frameworks for assessing digital literacy among older adults [20]. Xie Qiushan et al. [13] argue that digital integration for older adults is driven by personal survival and development needs as well as societal demands, and that digital integration can stimulate a second demographic dividend and promote intergenerational harmony. Han Zhenqiu identifies the digital divide among older adults as manifesting in access barriers, digital knowledge barriers, digital mindset barriers, technology application barriers, product supply gaps, digital back-feeding gaps, and personal conceptual issues [21]. Luo Yijie [14] suggests that domestic digital literacy education for older adults could be improved by referencing international models. Zhou Hui [22] proposes creating a favorable digital environment tailored to national conditions and promoting attitude transformation among rural older adults to enhance their digital literacy. Other scholars recommend coordinated, specialized governance from policy, economic, demand, education, community, and family perspectives to bridge the digital divide and improve digital literacy among older adults [23].

To assess digital literacy among older adults and develop effective training programs, New Zealand developed an evaluation framework for elderly digital literacy in 2021, advocating for an assessment framework centered on digital connection, digital life, and digital safety for older adults [20].

In summary, current research on digital literacy primarily concentrates on conceptual studies and evaluation indicator systems, while research on digital literacy among older adults mainly focuses on qualitative studies. Through reviewing and synthesizing domestic and international literature on the specific content of digital literacy, this study finds that existing digital literacy indicator frameworks include dimensions such as awareness, attitude, knowledge, and skills. Research on digital literacy among older adults predominantly focuses on educational models and improvement strategies, with relatively few studies investigating the actual digital literacy levels of elderly populations. To address these research gaps and help this digitally vulnerable group integrate into the digital society and enjoy digital life, this study conducts an investigation and analysis of digital literacy among the elderly population in Nantong City, Jiangsu Province.

2.1 Research Subjects

This study surveyed individuals aged 60 and above in Nantong City, primarily because Nantong' s population aged 60 and above accounts for 30.01% of the city' s total population, ranking first in Jiangsu Province [24]. The survey was

conducted in Nantong from 2022 to 2023, with 180 questionnaires distributed and 180 recovered, yielding 169 valid responses (93.89% validity rate). Among the valid samples, 81 were male and 88 female; 88 were urban residents and 81 rural residents; 84 were aged 60-70, 66 aged 71-80, and 19 aged 81 and above; 91 had primary school education or below, 47 had junior high school education, and 31 had high school education or above.

2.2 Questionnaire Design

Digital literacy evaluation serves to measure and demonstrate individuals' ability to learn and work in a digital environment. With the rapid development of technology, scholars continuously refine evaluation systems. Some have established digital competence evaluation frameworks from perspectives of digital awareness, digital technology usage capability, interactivity, and digital flexibility [25]. Others have constructed digital literacy evaluation systems referencing international frameworks, including indicators such as digital usage capability [26-27], digital evaluation capability [28-29], digital security literacy [30-31], digital creation capability [32-33], digital problem-solving capability [34-35], digital awareness literacy [36], and digital moral literacy [37]. Some scholars have also noted that digital social literacy should be included as an evaluation indicator [38-39].

Based on the definition of digital literacy in the "Action Outline for Improving Citizens' Digital Literacy and Skills" [12] and considering the characteristics of the elderly population, this study streamlined the framework by retaining digital skills, security protection, and ethical morality while introducing the dimension of digital awareness literacy. Through literature review and indicator screening, this study identified four dimensions for the elderly digital literacy framework: digital awareness literacy, digital skills literacy, digital security literacy, and digital moral literacy. Drawing upon digital literacy scales designed by previous scholars and adapting specific items according to the characteristics of older adults, this study developed a digital literacy survey questionnaire for the elderly, as shown in Table 1 . Through synthesis of previous research, this study compiled the "Elderly Digital Literacy Survey Questionnaire," which consists of three parts: the first part introduces the questionnaire, including its purpose and instructions, and emphasizes anonymous completion without involving personal privacy; the second part contains the scale items, which were limited to 12 questions considering the difficulties elderly respondents might face in completing the questionnaire, with each item using a 5-point Likert scale (1-5 points, corresponding from "completely disagree" to "completely agree"), where higher scores indicate higher digital literacy levels; the third part collects demographic information, including gender, age, education, living arrangement, children' s support for smart device usage, and help-seeking preferences when encountering difficulties with smart devices.

2.3 Data Collection

Questionnaires were distributed at community centers, village committees, and public squares in various districts under Nantong' s jurisdiction, with on-site collection. This approach not only avoided potential sample bias from selecting elderly individuals from the same community but also allowed for immediate correction of errors in questionnaire completion, thereby ensuring validity to some extent.

3.1 Overall Digital Literacy Level of the Elderly

This study first tested the reliability of the questionnaire using Cronbach' s alpha coefficient and split-half reliability. The total questionnaire' s Cronbach' s α coefficient was 0.943, with a split-half reliability of 0.795, indicating internal consistency among items. In terms of structural validity, the questionnaire' s KMO value was 0.973, and Bartlett' s test of sphericity showed Sig $<$ 0.001, demonstrating good variable relationships among items and suitability of the collected data for factor analysis.

Statistical results indicated that the mean total score for elderly digital literacy reached 3.91. A one-sample t-test revealed that the mean was significantly higher than the standard value of 3 ($P < 0.05$), suggesting that the digital literacy level of the surveyed elderly sample was at a relatively low level. The average scores across the four dimensions, from highest to lowest, were digital moral literacy, digital security literacy, digital awareness literacy, and digital skills literacy, with all dimension means showing significant differences from the standard value of 3 ($P < 0.05$), indicating relatively low digital literacy levels among this elderly population, as shown in Table 2 . The survey results demonstrate that the overall digital literacy level of the research sample is moderately low.

3.2.1 Digital Awareness Literacy

The digital awareness literacy dimension includes three items. The item "I have awareness of using the internet in daily life" scored 2.67, indicating low internet awareness among the elderly. The item "I believe the internet is valuable" scored 2.81, suggesting a lack of value recognition regarding the internet. The item "When a new digital medium emerges, I am willing to learn more about it" scored 2.72, revealing insufficient digital awareness among older adults.

3.2.2 Digital Skills Literacy

The three items under digital skills literacy scored 2.70, 2.57, and 2.44 respectively, all below 3 points, representing unsatisfactory results. For the item "I can communicate with others through the internet (e.g., using WeChat)," only 17.75% and 11.24% of elderly respondents selected "relatively agree" and "completely agree,"respectively, indicating weak digital communication abilities. The

item "I can proficiently create digital media content (e.g., shooting short videos)" scored 2.44, demonstrating a lack of digital creation skills among the elderly.

3.2.3 Digital Security Literacy

The three items under digital security literacy, addressing anti-fraud awareness and personal privacy protection, scored 2.91, 2.88, and 2.96, all failing to reach 3 points, indicating unsatisfactory results. This reveals weak digital security awareness among the elderly and a lack of emphasis on personal privacy protection. For the item "I usually ignore suspicious text messages," 26.03% and 23.67% of elderly respondents selected "relatively agree" and "completely agree," respectively. Although a considerable portion chose the agree options, frequent incidents of elderly fraud victims warrant attention, as some older adults exhibit low overall digital security literacy.

3.2.4 Digital Moral Literacy

The three items under digital moral literacy scored 2.85, 2.93, and 3.16, all relatively low and unsatisfactory. For the item "I can regulate my words and actions during online interactions," only 23.67% and 20.71% of elderly respondents selected "relatively agree" and "completely agree," respectively, indicating that some older adults may be misled by online information and post inappropriate comments, requiring attention.

3.3 Analysis and Discussion of Digital Literacy Differences Among the Elderly

To further understand differences in digital literacy levels within the elderly population, this study employed the least significant difference (LSD) method and independent samples t-tests for analysis.

3.3.1 Impact of Age on Elderly Digital Literacy

LSD post-hoc multiple comparisons revealed significant differences in digital literacy and its dimensions across different age groups. Elderly individuals aged 60-70 scored significantly higher than other age groups in overall digital literacy and all dimensions, while those aged 81 and above scored the lowest, as shown in Table 3 . These results suggest that age may influence older adults' need for using smartphones and other devices, thereby creating differences in digital literacy levels. The survey found that as age increases, older adults experience memory decline, reduced thinking ability, and decreased interest in new things. Those aged 60-70 demonstrate relatively higher digital literacy levels because they are generally more receptive to new things and more willing to try new smart devices than older cohorts. For more elderly individuals, smartphones are not necessities, and their willingness to use them is very low, with some even refusing to use them due to fear of online fraud.

3.3.2 Impact of Education on Elderly Digital Literacy

One-way ANOVA with post-hoc multiple comparisons across different education levels revealed significant differences in digital literacy and its dimensions. Elderly individuals with college education or above scored highest, those with junior high school and high school/technical secondary school education scored moderately, and those with primary school education or below scored lowest, as shown in Table 4 . These results indicate that higher education levels correlate with higher digital literacy among the elderly. This phenomenon may stem from two factors: first, better-educated older adults can learn to use smart devices through instruction manuals, while those with lower education often face literacy barriers that hinder device usage; second, better-educated older adults are generally more receptive to new technologies, while those with lower education may be less open to new things and more fearful of using smart devices.

3.3.3 Impact of Health Status on Elderly Digital Literacy

LSD post-hoc multiple comparisons revealed significant differences in digital literacy and its dimensions across different health status levels. Elderly individuals in good health scored significantly higher than those in fair or poor health, as shown in Table 5 . These results suggest that better physical health correlates with higher digital literacy. The primary reason may be that health status affects older adults' willingness to use smart devices. During survey interviews, some elderly individuals reported that conditions such as poor vision, stroke, and hemiplegia interfere with daily life, and their poor physical condition makes it inconvenient to use smart devices, resulting in lower digital literacy levels.

3.3.4 Impact of Living Arrangement on Elderly Digital Literacy

LSD post-hoc multiple comparisons revealed significant differences in digital literacy and its dimensions across different living arrangements. Elderly individuals living alone or with spouses demonstrated significantly higher digital literacy than those living with children. Those living with children scored lowest, followed by those living alone, while those living with spouses scored highest, as shown in Table 6 . The main reason may be that elderly individuals living alone or with spouses learn to use smart devices, either actively or passively, to maintain contact with their children. Among these, elderly couples living together showed the highest levels across all digital literacy dimensions, primarily because spouses can help each other during device usage, continuously improving their digital literacy.

3.3.5 Impact of Residence Area on Elderly Digital Literacy

Independent samples t-tests comparing urban and rural elderly populations revealed significant differences in digital literacy and its dimensions, with urban

elderly scoring significantly higher than their rural counterparts, as shown in Table 7 . This phenomenon may be attributed to the broader and deeper penetration of intelligent services in urban areas compared to rural regions. As of June 2022, China' s internet user population reached 1.051 billion, including 758 million urban users and 293 million rural users [47]. On one hand, the digital divide is closely related to the resources available to different populations [48], and rural elderly individuals face greater disparities in information access and digital participation compared to their urban peers, further widening the digital divide. On the other hand, rural residents currently engage in digital activities primarily for social purposes and are still adapting to more advanced digital tools [49], which may also contribute to the significant urban-rural gap in digital literacy among the elderly.

3.3.6 Impact of Stable Economic Source on Elderly Digital Literacy

Independent samples t-tests comparing elderly individuals with and without stable economic sources revealed significant differences in digital literacy and its dimensions, with those having stable economic sources scoring significantly higher, as shown in Table 8 . This phenomenon may be explained by the relatively high cost of smart devices and internet access, which prevents some elderly individuals without stable economic sources from owning smart devices or accessing the internet, resulting in lower digital literacy levels.

3.3.7 Impact of Children' s Support for Smart Device Usage on Elderly Digital Literacy

Independent samples t-tests revealed significant differences in digital literacy and its dimensions between elderly individuals whose children support their smart device usage and those whose children do not, with the former scoring significantly higher, as shown in Table 9 . The main reason may be that children' s support, both financial and technical, enhances older adults' digital literacy. Children can provide financial assistance for purchasing smart devices and internet services, and "digital back-feeding" can help older adults better use these devices when they encounter difficulties.

3.3.8 Impact of Gender on Elderly Digital Literacy

Independent samples t-tests comparing different genders revealed no significant differences in digital literacy and its dimensions, as shown in Table 10 .

4.1 Helping the Elderly Establish "Digital Confidence"

As digitalization accelerates, smart devices and the internet are no longer exclusive to younger generations; an increasing number of intelligent products have entered the daily lives of older adults. When facing these products, the elderly

often exhibit insecurity and lack of confidence due to unfamiliarity, with some even showing resistance. Therefore, transforming older adults' traditional mindsets and helping them build confidence in using smart devices and the internet is crucial, enabling more elderly individuals to dare and voluntarily use these technologies. First, we must help older adults change their self-perception by abandoning the stereotype that they have weak abilities to understand and accept new things, and encourage them to actively participate in and learn to use smart devices. Second, the demands of daily life, emotional needs, and medical requirements compel older adults to use smartphones, and this forced pressure provides strong motivation. Those around them should provide enthusiastic and patient assistance in learning to use smartphones. During the learning process, the positive influence of peers is important. Since elderly neighbors and friends share similar ages and cognitive levels, mutual help and encouragement can more easily generate a sense of achievement and confidence in using smartphones, subtly changing their mindsets. Finally, attention must be paid to older adults' initial experiences with smart devices. Whether they receive patient guidance, experience a sense of achievement upon initial success, and receive encouragement when encountering setbacks are all important factors affecting their digital confidence.

4.2 Encouraging "Digital Back-Feeding" to Help the Elderly Cross the Digital Divide

Digital back-feeding is a crucial means of improving digital literacy among older adults. In addition to purchasing digital devices for their elders, children must emphasize emotional encouragement and technical support. Access back-feeding and concept back-feeding build a bridge for parents to access digital life, and digital back-feeding is the most effective way for children to clear digital obstacles for their elders [50]. Survey results on help-seeking behaviors when encountering smart device difficulties showed that 44.38% of elderly individuals seek help from grandchildren, while 32.54% seek help from their own children. Current research on digital back-feeding primarily focuses on parent-child interactions, lacking discussion on intergenerational back-feeding. China has long had a tradition of intergenerational childcare, and the phenomenon of close grandparent-grandchild relationships is common, making intergenerational digital back-feeding particularly important. Additionally, 21.89% of elderly individuals choose to figure things out themselves or seek help from neighbors and friends rather than asking their children for help. The reason may be that parents traditionally play the role of "educators" while children are the "educated," and this role reversal leads to children' s increasing authority [51]. Therefore, when older adults seek advice from their children, they have usually thought it through carefully. Younger family members should learn to maintain elders' "face" and be mindful of their attitude and behavior during back-feeding. We must 坦然 accept the existence of the digital divide among older adults and gradually narrow it through family-based digital back-feeding.

4.3 "Aging-Friendly" Smart Products to Help the Elderly Board the Digital Express

Currently, China' s technology industry pursues product universality while neglecting the special needs of the aging population, failing to design specifically for older adults' unique circumstances and requirements [52]. This has resulted in insufficient supply of aging-friendly products and services despite China' s deepening aging population. The smart product market for older adults shows considerable prospects. First, as age increases, elderly individuals experience declining physical functions, with varying degrees of degeneration among individuals. Therefore, smart device manufacturers should prioritize aging-friendly product research and development, clearly identify the needs of different elderly populations, and design products that meet their specific requirements. Second, older adults' resistance to digital technology stems from concerns about economic risks, as money represents their final security. The widespread reluctance to use mobile payments among older adults fundamentally reflects their distrust of digital technology and fear of online fraud. In addition to improving policies and regulations to protect older adults from online fraud, internet software companies should develop safer, more reliable, and more user-friendly software tailored to this characteristic, enabling older adults to use smartphones with confidence. Finally, reducing internet usage costs, such as through broadband speed upgrades and fee reductions, smartphone localization, and tiered pricing, can provide more older adults with opportunities to access and use the internet.

4.4 Building a Smart Device Usage Assistance System to Enhance Elderly Digital Literacy

Currently, two problems exist when children help older adults learn to use smart products. On one hand, when elderly individuals encounter difficulties using smart devices, they seek help from family members, but most children work away from home, preventing direct assistance when needed. On the other hand, most young children have limited patience and energy when helping older adults, making it difficult to effectively resolve their smart device usage challenges. Therefore, establishing a training system for smart device usage among the elderly is particularly important. The government can formulate relevant policies to actively call for societal attention to the digital needs of older adults. Public welfare assistance organizations can be established, such as community-based training models, to enrich training methods and create favorable learning environments. With government leadership and active promotion, a training system for elderly smart device usage can be constructed. A group of willing elderly participants can be selected for initial training, with problems identified and corrected during the pilot process. By establishing elderly role models, surrounding older adults can be encouraged to actively participate in training.

5.1 Conclusion

This study investigated the digital literacy levels of Nantong's elderly population and analyzed influencing factors. The results show that the digital literacy level of the studied population is relatively low, with significant differences based on age, education level, physical health status, place of residence, living arrangement, children' s support for device usage, and availability of stable economic resources. Currently, older adults' demand for intelligent and digital life continues to increase. Based on field research and analysis, this paper proposes strategies for improving digital literacy among the elderly: helping them establish "digital confidence" to enhance travel convenience and life satisfaction while narrowing the digital divide; promoting age-appropriate transformation of smart products to reduce usage difficulty; advocating "digital back-feeding" from younger family members; encouraging community-based training programs for smart device usage; and reducing internet access costs to provide more opportunities for older adults to access the internet. These measures can effectively enhance "digital confidence" among the elderly. In the future, cooperation among individuals, families, enterprises, and government can collectively achieve improved digital literacy for older adults.

5.2 Reflection and Outlook

From a research design perspective, this study' s investigation and analysis of digital literacy levels among Nantong' s elderly population, in terms of methodology, sample scope, and size, cannot easily represent the general situation of digital literacy among older adults across China. However, this study focuses on developing new understandings and approaches to emerging issues through case study analysis [53]. The concepts of "digital confidence" and "digital back-feeding" discussed in this study have received relatively limited academic attention, yet these concepts help understand the reasons for low digital literacy levels among the elderly and assist similarly situated older adults in crossing the digital divide and improving digital literacy, representing directions for future in-depth research.

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Note: Figure translations are in progress. See original paper for figures.