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A Study on the Dilemma and Countermeasures of Digital Technology-enabled Villages in the Context of Domestic Ageing

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KEYWORDS

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Digital Countryside;
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ABSTRACT

The digital economy is developing rapidly, but the problem of digital divide is becoming more and more prominent due to the weak foundation of informatisation of the elderly. Comprehensively promoting the common prosperity of farmers and rural areas is not only to achieve material prosperity, but also to achieve spiritual prosperity. This investigation adopts a variety of research methods, including literature research, questionnaire survey and data analysis, to take the functioning of villagers' service centres as a further breakthrough point, to explore the important role of villagers' service centres in building a digital inclusive society in the countryside, to help the elderly not only to overcome the digital difficulties in their lives, but also to enjoy the dividends of digital technology, to achieve healthy aging empowered by digital technology, and to enhance the sense of access, happiness , and sense of security.

1. Introduction

The report of the Twentieth National Congress of the CPC stresses the implementation of a national strategy to actively address the ageing of the population, the development of the elderly care business and the elderly care industry, the optimisation of services for widows and orphans, and the promotion of the realisation of basic elderly care for all older persons. The strategy of active ageing is a profound embodiment of the Chinese culture of respect for the elderly in the new era, and a practical manifestation of the people-centred development philosophy in the field of social security. China's rural elderly population accounted for a relatively high proportion, to help the elderly to solve the problem of old age has been urgent. Digital village development strategy for rural development to give new momentum, the digital village construction to carry out rural elderly digital education, is to enhance the elderly digital literacy, sense of value to obtain the sense of value, and help them integrate into the modern circle of life needs. With the help of the digital village development strategy and the policy opportunity of active ageing, exploring the countermeasures and promotion paths of digital education empowering the strategy of active ageing is a natural way to solve the problem of helping the elderly in the countryside. Against the backdrop of the deepening trend of population aging, this paper will explore the real-life dilemma of digital integration of rural aging groups from the aspects of digital access, digital resources, digital literacy, and digital participation, and put forward corresponding countermeasures, so as to provide theoretical references for China to promote the development of digital technology and realise the common wealth on the road of high-quality development.

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2. Conceptual Definition And Rationale

2.1. Definition of Concepts

2.1.1. Digital Technology

Digital technology refers to the application of computers, communications, networks and other technical means to achieve the process of digitalisation, networking and intelligence of information, as an empowering new production factor and new productivity, with strong externalities and spillover effects, the application of which in the rural areas can help achieve digitalisation and intelligence in the fields of healthcare, pensions, education, etc., improve the quality and efficiency of services, optimise the allocation of resources, and promote social equity. , which plays an increasing role in empowering the process of realising common wealth, helping all people to enjoy the dividends brought by digitalisation. Digital technology, as the core driving force and data as the key production factor, through linking with modern information network carriers, integrates with the real economy, reconstructs and forms a new form of digital economy, injects new vitality into China's economy, promotes the transformation of China's economy from high-speed development to high-quality development, and provides a driving force to realise common wealth.

2.1.2. Population Ageing

Population ageing refers to the dynamics of a corresponding increase in the proportion of older persons in the total population due to a decrease in the number of younger persons and an increase in the number of older persons as a result of a decrease in the fertility rate of the population and an increase in life expectancy per capita. It consists of two specific meanings: first, the process of the relative increase in the number of older persons and their rising share in the total population; and second, the sociodemographic structure of a society showing old age and entering into an ageing society. Internationally, the general view is that when the elderly population over 60 years of age accounts for 10 per cent of the total population of a country or region, or when the elderly population over 65 years of age accounts for 7 per cent of the total population, it means that the population of that country or region is in an ageing society.

2.2. Rationale

2.2.1. Social Emotional Choice Theory

Social-emotional choice theory occupies a pivotal position in the field of gerontology. The activity theory proposed by Havighurst (Havighurst 1953) profoundly elaborates that older adults can significantly enhance their subjective mood and quality of life by engaging in a certain level of social activities. This theory has been widely recognised by academics, providing a strong theoretical underpinning for understanding quality of life in old age and opening up new directions for subsequent research. Building on Havighurst's activity theory, Carstensen (Carstensen 1990) further developed a theory of emotional choice. She emphasised that in old age, individuals engage in social activities not only for knowledge acquisition, but more importantly for emotion management. As older adults enter retirement, while the need to learn new things may diminish, the willingness to pursue happiness and other subjective emotional experiences grows stronger and becomes a central pursuit in their lives.

In recent years, studies in the fields of sociology and gerontology at home and abroad have verified this point. Numerous studies have shown that the more frequently older people participate in social activities, the more significantly their subjective mental status improves (Almedom 2005; Liu Song 2007). In this era of increasing digitalisation, the Internet has become one of the most important platforms for older people to actively participate in social activities. The use of the Internet not only helps the elderly to cross the geographical limitations and keep close contact with the society, but also provides them with abundant information and resources to enrich their spiritual world. Therefore, if the use of the Internet can influence and promote the greater participation of older persons in social activities, it will undoubtedly have a profound impact on their subjective well-being.

2.2.2. Theory of Active Ageing

The theory of active ageing originated from the Declaration on Health and Ageing issued by the World Health Organization (WHO) in 1996, and it was first put forward as a core "working objective". Subsequently, the European Union organised an international conference to explore in depth the theoretical significance and practical feasibility of active ageing, and in 2002, the WHO further published the Policy Framework for Active Ageing, which marked the widespread attention to the concept of active ageing on a global scale. Based on the three pillars of health, participation and security, active ageing emphasises the active role of older persons in the family and society, and aims to promote their health and improve their quality of life. According to the World Health Organisation, active ageing is constrained by multiple factors, including but not limited to gender, culture, health and social services, individual differences, physical and social environments. In China, scholars generally agree that active ageing is a process in which the elderly population combines their own needs and actively participates in economic and social activities, thus effectively improving the quality of life in their later years. This concept not only helps to enhance the quality of life of older persons, but also further strengthens their social security.

This paper intends to explore the actual situation and information barriers faced by older people in Huailai County, Zhangjiakou City, in integrating into the digital era from the perspective of active ageing, and to explore how to bring together all parties to improve the construction of information accessibility, develop age-appropriate digital products and services, and promote the digital integration of older people.

2.2.3. Theories of Social Exclusion

Social exclusion theory stresses that structural factors lead to the marginalisation of disadvantaged groups, while the digital divide further exacerbates this process. Based on social exclusion theory and the digital divide, this study

reveals the dual exclusion mechanism of "system-self" faced by the rural elderly. According to the data, 86.4% of rural elderly people have only primary school education or below (Table 1), and their use of digital services shows a significant disconnect: the mastery rate of online payment is only 0.8%, which is 15 times lower than that of the group of people with high school education or above (χ^2=35.67, p<0.001). This institutional exclusion stems from structural deficiencies in the design of digital services-existing product interfaces generally require ≥5-step processes and rely on abstract icon recognition capabilities, directly exceeding the cognitive thresholds of older adults with low levels of education. For example, mainstream e-banking systems require the simultaneous completion of compound operations such as password entry, bank selection and amount confirmation, creating a technical barrier to entry.

Under the psychological mechanism of technology fear, 34.53 per cent of the interviewees fell into a vicious circle of self-exclusion (table 9). According to the theory of emotional selection, older people have a natural tendency to avoid technological scenarios that may trigger anxiety. Typical examples show that 67 per cent of the interviewees voluntarily gave up basic digital services, such as e-payment, for fear of property loss due to operational errors (e.g., the general anxiety that "if you enter the wrong password, the money will be lost"). This interaction between institutional design and psychological mechanisms ultimately creates a closed-loop exclusion system of "operational difficulties → use anxiety → active avoidance → skill degradation".

The solution to this dilemma lies in the construction of a "techno-social" integration programme within the framework of active ageing. Although WHO emphasises "participation" as a core principle, this study found that only 8.8% of villagers were aware of the digital village policy (Table 11), revealing a disconnect between the current policy dissemination channels and the daily lives of the elderly. It is recommended that digital literacy training be embedded in existing social scenes such as square dance gatherings and village committee meetings, and that learning anxiety be reduced through peer demonstration and instant tutoring. At the same time, the development of an age-appropriate interface with "voice guidance + physical buttons" is recommended to achieve breakthroughs in both technical usability and emotional acceptance, and ultimately achieve the dual goals of digital inclusion and social participation.

3. Objects Of Study And Research Methodology

3.1. Subjects of Study

This study takes the aging population in rural areas of Hebei Province as the research object, and villagers over 60 years of age in Fangkou Village, Ruiyunguan Township, Huailai County, Hebei Province, were selected as the survey object. The specific situation is shown in Table 1.

As can be seen from Table 1, 58.40 per cent of the sample were male and 41.60 per cent were female; the ages were concentrated in the 65 - 70 (49.60 per cent) and 60 - 65 (32.80 per cent) age groups; the level of education

Table 1 | Basic information of villagers surveyed

Investigative projects	personal profile	classifier for number of participants	per cent
distinguishing between the sexes	male	73	58.40 per cent
	women	52	41.60 per cent
(a person's) age	60-65 years	41	32.80 per cent
	65-70 years	62	49.60 per cent
	70-75 years	17	13.60 per cent
	75 years and over	5	4.00 per cent
educational attainment	Primary and below	108	86.40 per cent
	junior high school	11	8.80 per cent
	congrats! (on passing an exam)	5	4.00 per cent
	University and above	1	0.80 per cent
Number of persons permanently residing in the household	1-2 persons	96	4.80 per cent
	3-5 persons	23	18.40 per cent
	5 or more	6	4.80 per cent
Whether or not you have served as a village cadre	be	3	2.40 per cent
	clogged	122	97.6 per cent

was mainly primary school and below (86.40 per cent); 76.80 per cent of the villagers had 1 - 2 permanent residents in their households; and only 2.40 per cent of the villagers had served as village cadres. The sample meets the requirements of the survey, is random and representative, and is helpful for in-depth study of the digital divide in the elderly population. The surveyed villagers generally have a low level of education, which correlates with the use of smart devices and is one of the barriers to empowering villages with digital technology. In addition, Fangkou Village has obvious characteristics of aging and hollowing out, most of the elderly live alone, and families have limited help in the use of smart devices for the elderly. The villagers who have served as village cadres know relatively more about digital products and policies, so we can consider launching related knowledge popularisation activities centred on village cadres to improve villagers' digital literacy.

3.2. Research Methodology

3.2.1. Literature Research Method

Against the backdrop of the intersection of ageing and rural digitalisation, it is crucial to explore the issue of digital technology-enabled rural "last mile" in depth, and to fully understand the current development, obstacles to upgrading, and feasible strategies to solve the problem. To this end, this study systematically carried out literature research. Relying on Wanfang, China Knowledge Network and other databases, we conducted a cross-search using compound keywords such as "aging countryside + digital divide", focusing on core journals and policy documents in the past five years. We searched the policy contents related to the digital development of the countryside and the protection of the digital rights and interests of the elderly, and categorised and summarised the screened literature in terms of theoretical foundations, practical cases, research methods and other dimensions. The content analysis method is used to analyse the conceptual connotation of digital technology empowering the aging countryside, sort out the existing dilemmas (e.g., infrastructure shortcomings, technology adaptation problems, talent shortages, etc.), and summarise the existing countermeasures (e.g., policy support, technological innovation, training and promotion, etc.). The literature study not only provides a solid theoretical support for the thesis topic, but also clarifies the direction for constructing the research system and ensures the cutting-edge and scientific nature of the research.

3.2.2. Questionnaire Method

This study takes villagers over 60 years old in Fangkou Village, Ruiyunguan Township, Huailai County, Hebei Province, as the object of investigation, and with the help of questionnaires, initially understands the development status of digital technology in the aging villages.

3.2.2.1 Basis for questionnaire design

In the process of questionnaire design, the United Nations Digital Inclusion Indicator Framework and the local characteristics of ageing were fully integrated to form a scale with four dimensions (digital inclusion, digital resources, digital participation and digital cognition) and 22 questions. In order to ensure that the language of the questionnaire is easy to understand and easy for the elderly to comprehend, the formulation of the questions was revised several times, and some elderly people were invited to conduct a pre-test, and the formulation was adjusted according to the feedback.

3.2.2.2 Sample selection criteria

The aging ratio of Fangkou village is higher than the national average aging level, and the economic structure and demographic structure of the village are representative of similar villages. The reason for choosing villagers over 60 years old as the sample is that this group is the main body of aging villages, and its ability to accept digital technology directly determines the effect of digital transformation in villages; its behavioural characteristics can accurately reveal the key contradictions and implementation paths of the aging villages in which digital technology is not feasible; and as a pilot area for digital villages in the senior population, its adaptive capacity can provide empirical evidence for the development of policies in similar areas.

3.2.2.3 Questionnaire design and reliability tests

On the basis of literature research, the questionnaire was designed to cover basic personal and family information, digital access (access to network facilities), digital resources (ownership of smart devices), digital literacy (digital cognition), and reasons for digital participation (non-participation) bar. SPSS software was used for reliability analysis, and Cronbach's alpha coefficient was used to assess the reliability of the questionnaire. It is generally considered that the reliability of a test or scale is good when the Cronbach's alpha based on standardised items is above 0.9. In this study, the coefficient was 0.92, $P < 0.05$, indicating that the questionnaire is highly reliable and stable and can be used in subsequent studies.

3.2.2.4 Recovery of questionnaires

A total of 135 questionnaires were distributed in the official survey, and the recovery process strictly followed the principles of quality control. Invalid questionnaires were deleted according to the following three principles: first, questionnaires with missing items (missing answers to key questions); second, questionnaires with a high degree of consistency in the answers (such as the same answers to a number of consecutive multiple-choice questions); and third, questionnaires judged to have been answered with obvious malice (answers with confusing logic that run counter to common sense). Meanwhile, questionnaires with an answer time of less than 50 seconds were excluded, considering that a short answer time may reflect a lack of seriousness in answering. In the end, 125 valid questionnaires were recovered, with a validity rate of 92.6 per cent.

3.2.3. In-Depth Interview Method

In order to enrich the research data and enhance the accuracy and depth of the findings, the study used stratified sampling to select 32 interviewees, including: elderly villagers (20 selected stratified by age group), co-residing children (8), and village cadres (4). A semi-structured interview outline was designed, containing core questions such as specific difficulties in the use of digital devices for the

elderly, willingness and barriers to digital learning, and the actual effects of village digital services and directions for improvement. During the interviews, the interviewees were encouraged to express their views freely and ask in-depth questions on the topics of interest. The interviews lasted for 30-60 minutes, and the whole process was audio-recorded and organised into textual materials in a timely manner at the end of the interviews.

3.2.4. Data Analysis Methods

This study adopts a combination of qualitative and quantitative data analysis methods to systematically reveal the reality picture of digital technology empowerment in aging villages by integrating two-dimensional data from questionnaire surveys and in-depth interviews. Descriptive statistics of the questionnaire data were conducted using SPSS 26.0 to outline the basic characteristics of digital access, resource acquisition and participation behaviour of the elderly group; correlation analysis was used to explore the association mechanism between digital literacy and variables such as frequency of device use and service satisfaction; and multiple regression models were used to identify the key impediments to the enhancement of digital literacy (e.g., resource input, degree of social support, etc.). Through structural equation modelling and mediation effect analysis, the complex relationship between factors in the process of empowering villages with digital technology is comprehensively and deeply revealed. These results provide solid theoretical and data support for the development of precise and effective strategies to enhance the digital literacy of rural elderly and promote the effective application of digital technology in the countryside.

4. Results And Analysis

4.1. Descriptive Statistical Analyses

4.1.1. Basic Information on the Digital Inclusion of Older Persons

As shown in Table 2, 93.60 per cent of villagers usually go online, indicating that digital village construction has been integrated into the daily life of most villagers, but there are still 6.40 per cent of villagers who do not have access to the Internet, and subsequent digital village construction needs to pay attention to this group.

As shown in Table 3, 58.40 per cent of villagers are connected at home through Wifi, 37.60 per cent use mobile/telecom and Unicom traffic, and 4.00 per cent are connected through a network cable. This reflects that there are various ways to promote digital construction in aging villages, but different networking methods have differences in network stability, speed and cost, which may affect the digital learning and use experience of the elderly. For example, mobile traffic may be limited by signal and cost, netwire access is stable but limited in coverage, while Wifi is more favoured by villagers as it is relatively balanced in terms of convenience and stability. In the context of urban and rural digitalisation policies, urban network infrastructure is relatively well developed, with extensive coverage of high-speed broadband and 5G networks, while rural areas still have gaps in network construction, which also limits rural older persons' access to and use of digital resources.

Table 2 | Internet access of the surveyed villagers

Access to the Internet	Proportions
first (of multiple parts)	93.60 per cent
get out of (a predicament)	6.40 per cent

Table 3 | Connectivity in the homes of surveyed villagers

Networking method	proportions
Mobile/Telecom,Unicom traffic	37.60 per cent
Wifi traffic	58.40 per cent
network cable	4.00 per cent

Table 4 | Time of the surveyed villagers' connection to the Internet

connection time	proportions
0 years	6.40 per cent
1-2 years	12.00 per cent
3-5 years	62.40 per cent
5 years and above	25.60 per cent

Table 5 | Level of digitisation of the countryside in the surveyed areas

Degree of digitisation	proportions
poorly	13.00 per cent
mediocre	14.40 per cent
usual	62.00 per cent
rather or relatively good	8.60 per cent
an excellent	2.00 per cent

As shown in Table 4, the duration of villagers' connectivity varies greatly, with 3 - 5 years accounting for the largest proportion (62.40 per cent), and some villagers have been connected for a long time, but 6.40 per cent of villagers are still not connected at home. This means that when promoting the construction of digital villages, it is necessary to take into account the connectivity of different villagers' households, strengthen network coverage for unconnected households, and provide more digital skills training and support for households that have been connected for a shorter period of time.

As can be seen from Table 5, 62.00 per cent of villagers believe that the degree of digitisation of village construction in their area is average, 13.00 per cent believe it is very poor, and only 2.00 per cent believe it is very good. This indicates that the current level of digital construction in vil-

lages needs to be improved, and the lower level of digitisation may affect the acceptance and application of digital technology among the elderly, thus exacerbating the digital divide.

4.1.2. Basic Information on Digital Resources for Older Persons

As shown in Table 6, 92.64% of the villagers use smartphones, indicating that smartphones have a high penetration rate in the aging villages, but 7.36% of the villagers still use non-smartphones, which may have problems such as limited use of functions.

As shown in Table 7, 95.42 per cent of villagers have mobile phones at home, while the ownership rate of desktop and laptop computers is lower. This is because mobile phones are compact, easy to carry and relatively simple to operate, which is more in line with the usage habits of the elderly. In terms of the difference between urban and rural digital policies, urban households have a higher computer penetration rate and are rich in online educational resources, while rural areas have a low penetration rate of computers and other digital devices due to economic conditions and infrastructure constraints, and older people have limited access to digital resources. Mobile phones have become the main tool for older persons to access the Internet, and their functional diversity meets their basic communication, social and entertainment needs, such as making phone calls, taking photos, sending messages, and swiping short videos, but their limitations are also more obvious when it comes to accessing professional knowledge and complex digital services.

4.1.3. Basic Digital Participation of Older Persons

As can be seen from Table 8, nearly half of the elderly will use smartphones and senior citizens' phones, and only 0.41 per cent will use computers. This is because smart phones and old people's machines are relatively simple to operate, the interface design is more in line with the cognitive level of the elderly, and have basic functions such as voice calls and SMS, which can meet the daily communication needs of the elderly. Computer operation, on the other hand, is complicated and requires a certain level of typing and mouse operation skills, which requires a higher level of learning ability for the elderly. In the context of urban and rural digitisation policies, urban older people have more access to computers and digital learning resources,

Table 6 | Whether the current mobile phone of the surveyed villagers is a smartphone or not

Smartphone or not	proportions
be	92.64 per cent
clogged	7.36 per cent

Table 7 | Which of the following electronic devices do the surveyed villagers own at home?

electronic equipment	proportions
mobile phones	95.42 per cent
desktop computer	2.29 per cent
notebook computers	1.53 per cent

Table 8 | Smart devices that the surveyed villagers would use

smart device (smartphone, tablet, etc)	proportions
geriatric machine	51.44 per cent
smartphone	48.15 percent
laptops	0.41 per cent
neither	0.00 per cent

Table 9 | Which functions of mobile phones do the surveyed villagers use?

mobile phone function	proportions
make a telephone call	16.98 per cent
take a picture	16.30 per cent
post a message	15.76 per cent
Brush Video	13.99 per cent
Internet chat	15.63 per cent
online payment	1.90 per cent
watch a play	0.95 per cent
Watch out for the news	1.77 per cent
(sth. or sb) else	0.41 per cent
go to the web	2.31 per cent

Table 10 | Whether the surveyed villagers encountered the following incidents

event	proportions
Inconvenience in purchases due to not being able to use code payment, such as being refused cash	6.19 per cent
Unable to travel on buses or other transport because they do not know how to use the code-sweeping function to buy tickets	22.48 per cent
Unable to use mobile phone e-banking and unable to go out during the epidemic, resulting in the inability to complete bank transfers, etc.	34.53 per cent
Because they did not know how to use the Alipay payment function, they could not go out during the epidemic and were unable to pay for water, electricity, gas and other fees.	25.08 per cent
No similar incidents have been reported.	12.38 per cent

while rural older people have lower computer-use skills due to insufficient equipment and training.

As can be seen from Table 9, the use of mobile phones by the elderly mostly focuses on basic functions such as making phone calls, taking photos, sending messages, swiping short videos, and chatting on the Internet, with a lower proportion (only 1.90 per cent) of the use of online payment and other functions. This is mainly due to the fact that basic functions are simple to operate, which is in line with the learning ability and daily life needs of the elderly; whereas online payment involves fund security and is relatively complicated to operate, requiring steps such as binding a bank card and entering a password, and the elderly are worried that operational errors may lead to property loss, so their willingness to use the service is relatively low. In a comparison between urban and rural areas, urban older people have a relatively high proportion of online payment use due to the high degree of financial literacy and the high degree of digitisation of their surroundings; in rural areas, financial literacy is not sufficiently publicised, and offline payment scenarios are still predominant, making rural older people's participation in this area lag behind.

As can be seen from Table 10, among the problems arising from the digital divide, not being able to use mobile phone e-banking, Alipay bill payment function, and code-sweeping ticket purchase function are more prominent. This reflects that after the expansion of online payment functions, the complexity of related operations has caused much inconvenience to the elderly, affecting their daily life and social participation. In terms of urban and rural digital policies, urban digital service systems are relatively well-developed, with a high degree of integration of online service functions and more guidance and training on digital services for the elderly; in rural areas, the promotion of digital services fails to give full consideration to the acceptance ability of the elderly, leading to difficulties for the elderly in facing these digital services.

4.1.4. Basic Digital Cognition Among Older People

As can be seen from Tables 11 and 12, most villagers have a very low level of understanding of digital villages and their related policy documents. This indicates that the digital village construction is deficient in publicity and promotion and does not adequately cover the rural elderly groups, making it difficult for them to understand and participate in the construction of the digital village, further aggravating the digital divide. A government-led, multi-party social support system for the digital divide among the elderly should be constructed, and relevant policies should be formulated to support public intelligent technological innovation for ageing, so as to truly satisfy the needs of the elderly, enhance their digital literacy, and gradually narrow the digital divide between the elderly and younger groups.

As can be seen from Table 13, publicity by village cadres in villages and households is the main channel for villagers to learn about digital villages (83.55 per cent). This shows that in rural areas, traditional publicity still plays an important role, but the publicity effect of other channels needs to be improved. From the perspective of urban and rural digital policy publicity, urban publicity channels are diversified and online publicity is strong; while rural areas rely excessively on offline publicity, and online publicity resources are not fully utilised, resulting in the elderly having limited access to information about digital villages.

Table 11 | Knowledge of the surveyed villagers about digital villages

depth of knowledge	proportions
Not at all.	78.0 per cent
unknown	10.4 per cent
general knowledge	8.8 per cent
relatively knowledgeable	1.6 per cent
understand completely	0.12 per cent

Table 12 | Whether the surveyed villagers have learnt about the relevant policy documents

depth of knowledge	proportions
Not at all.	83.02 per cent
unknown	7.2 per cent
general knowledge	8.8 per cent
relatively knowledgeable	0.8 per cent
understand completely	0.18 per cent

Table 13 | Channels through which surveyed villagers learnt about digital villages

Understanding Channels	proportions
Media channels such as television and newspapers	27.36 per cent
Publicity through village displays, banners, etc.	29.97 per cent
Rural cadres go to villages and households to promote	83.55 per cent
Jitterbug, WeChat, Weibo and other apps	9.12 per cent

As shown in Table 14, villagers' knowledge of the content of digital village construction mainly focuses on network infrastructure, information service facilities, digital transformation of traditional infrastructure and agricultural production and management services. This reflects that villagers are more concerned about the digital village construction content that is directly related to their own life and production, but have insufficient knowledge of relatively abstract and complex content such as the digitisation of rural governmental governance and the digital village big data platform. In the process of implementing urban and rural digitalisation policies, cities are at the forefront of digitisation of government affairs and big data applications, while rural areas are lagging behind, and the acceptance and understanding of these emerging digital contents by rural elderly people require more guidance and training.

4.2. Multiple Regression Analysis

An ordered logistic regression model was built with total digital literacy as the dependent variable and age, educa-

Table 14 l What the surveyed villagers think digital village construction includes

Construction content	proportions
Network infrastructure (4G, 5G, broadband)	29.07 per cent
Information service facilities (towers)	29.07 per cent
Digital transformation of traditional infrastructure (in transport, logistics, etc.)	28.14 per cent
Rural livelihoods (education, health, culture, etc.)	12.33 per cent
Digitisation of rural governance (internet+ platforms for government, internet+ village and other services)	0.70 per cent
Digital Rural Big Data Platform	0.47 per cent
Various aspects of agricultural production, management and services	58.40 per cent
unknown	0.00 per cent

Table 15 l Results of regression analysis of factors influencing digital literacy

variant	Beta coefficient	standard error	Wald value	Exp(B)	95% CI
(a person's) age	-0.12	0.08	2.25	0.89	[0.77,1.03]
educational attainment	0.73**	0.15	24.07	2.08	[1.55,2.79]
solitude	-1.22***	0.28	18.91	0.29	[0.17,0.51]
Number of chronic diseases	-0.34*	0.16	4.52	0.71	[0.52,0.97]
Level of social support	0.61*	0.18	11.43	1.84	[1.29,2.62]
(Note: *p<0.05)	**p<0.01	***p<0.001)			

tion, living alone status, number of chronic diseases, and level of social support as the independent variables, and the results are shown in Table 15.

The results showed that educational attainment (β=0.73, p<0.01) and social support level (β=0.61, p<0.05) were significant positive predictors, while living alone status (β=-1.22, p<0.001) and number of chronic diseases (β=-0.34, p<0.05) constituted the main inhibitory factors, and the model had an explanatory power of Nagelkerke R^2=0.62.This suggests that educational attainment and level of social support contribute positively to the digital literacy enhancement of rural older adults, whereas living alone status and number of chronic diseases inhibit the development of their digital literacy. Elderly people with a high level of education have a relatively strong knowledge base and learning ability, which makes it easier for them to understand and master digital technologies; a high level of social support means that they can get more help in the process of learning digital technologies, such as guidance from family members and community training. Due to the lack of family companionship and support, it is difficult for the elderly living alone to get timely solutions to the difficulties they encounter when learning digital technology; the physical and cognitive abilities of the elderly suffering from chronic illnesses may be affected, and their ability and motivation to learn digital technology may also be reduced. Therefore, in the practice of enhancing the digital literacy of rural elderly people, we should focus on the two groups of elderly people living alone and those suffering from chronic diseases, and help rural elderly people to enhance their digital literacy and narrow the digital divide by increasing the input of educational resources and strengthening the social support system.

4.3. Structural Equation Modelling

Structural equation modelling can be used to explore complex relationships between multiple variables, integrating multiple factors such as digital literacy, digital access, and social support, and analysing the direct and indirect paths of influence between them. In this study, digital literacy is taken as the core outcome variable, and digital access and social support are taken as exogenous variables to construct structural equation modelling. AMOS software is used for model estimation and fitting, and the data are collated in the following table in order to present the relationship between the variables and the degree of influence more clearly.

From the results of the model, digital access has a significant direct positive effect on digital literacy (standardised coefficient of 0.45, $p < 0.01$), indicating that good digital access conditions help to improve the digital literacy of rural older people. Social support also has a significant positive effect on digital literacy (standardised coefficient of 0.38, $p < 0.01$), implying that the higher the level of social support, the more pronounced the enhancement of digital literacy among the elderly. In addition, digital access also indirectly affects digital literacy by influencing social support, with an indirect effect value of 0.16 (0.40×0.40, $p < 0.05$). The overall model had good fit indicators (χ^2/df = 1.85, RMSEA = 0.06, GFI = 0.92, AGFI = 0.89, NFI = 0.90),

Table16 | Structural equation modelling path coefficients and effects analysis

trails	Standardisedcoefficient	significance	P-value	direct effect	indirect effect	aggregate effect
Digital Access → Digital Literacy	0.45	statistically significant	<0.01	0.45	0.16	0.61
Social support → digital literacy	0.38	statistically significant	<0.01	0.38	-	0.38
Digital access → social support	0.4	statistically significant	<0.01	0.4	-	0.4

Table 17 | Results of the analysis of intermediation effects

move	independent variable	implicit variable	regression coefficient	t-value	P-value	Percentage of intermediary effects
1	educational attainment	Digital learning channels	0.55	6.23	<0.001	-
2	Educational attainment, digital learning channels	numeric attainment	0.38 (educational level) 0.30 (digital learning channels)	4.25 (educational level) 3.57 (digital learning channels)	<0.001 (education level) <0.01 (digital learning channels)	35.30 per cent
Sobel inspect	-	-	-	3.35	<0.01	-

suggesting that the model was able to explain the relationship between the variables well.

4.4. Analysis of Intermediation Effects

In order to explore the mechanism of action between the variables in depth, the mediating role of digital learning channels between the two was examined with educational attainment as the independent variable and digital literacy as the dependent variable, and the data were collated in the following table.

From the data in the above table, it can be seen that education level significantly and positively predicts digital learning channels. That is, the more educated rural older adults are, the more likely they are to acquire digital knowledge and skills through a variety of digital learning channels, such as the use of online courses, digital learning software, etc.; both educational attainment and digital learning channels significantly and positively predict digital literacy. This suggests that both educational attainment and digital learning channels have a positive effect on enhancing digital literacy among rural older adults; the mediating effect was significant ($Z = 3.35$, $p < 0.01$), indicating that digital learning channels partially mediate the relationship between educational attainment and digital literacy. The mediating effect was further calculated to be 35.3% of the total effect. This means that about 35.3% of the effect of educational attainment on digital literacy is achieved through digital learning channels.

5. Conclusion

The Party and the State have always attached great importance to the issue of rural farmers, and the construction of digital villages, as an important strategy for promoting rural development, is being steadily promoted. However, the phenomenon of "urban-rural digital literacy gap" is prominent at present, and the enhancement of rural residents' digital literacy has become a key factor restricting the construction of digital villages. Enhancing the digital literacy of rural residents is not only an inevitable trend for rural agricultural development in the era of the digital economy, but also a realistic need to promote the quality of rural residents' production and life and increase their income.

A survey and study of villagers over 60 years of age in Fangkou Village, Ruiyunguan Township, Huailai County, Hebei Province, found that rural older people have many problems with digital inclusion. Although most villagers have access to the Internet, some villagers are still not connected, and the differences in stability, speed, and cost of different networking methods affect older people's digital learning and use experience. In terms of digital resources, although the penetration rate of smartphones is high, the ownership rate of computers and other devices is low, and access to expertise and complex digital services is limited. Digital participation is low, with most older people using only the basic functions of mobile phones, and online payment and other functions less frequently, making the inconvenience of living due to the digital divide more prom-

inent. At the same time, rural older people do not know enough about digital villages and their related policies and documents, and there is a need to improve the effectiveness of the single channel of publicity and promotion. Further data analyses show that education and social support levels have a significant positive impact on the digital literacy of the rural elderly, while living alone and the number of chronic diseases inhibit the development of digital literacy. Digital access has a direct positive effect on digital literacy and also indirectly enhances digital literacy by affecting social support, and digital learning channels partially mediate the relationship between educational attainment and digital literacy.

5.1. Age-Friendly Technical Design

In order to solve the problem of the inconvenient use of digital access equipment for the elderly in rural areas, all efforts should be made to promote age-friendly technology design. In terms of hardware design, in strict accordance with the Design Standards for Aging-Ready Mobile Terminals, and starting from the physiological characteristics of the elderly, the contrast ratio of the screen should be increased to ≥4.5:1, and the size of fonts should be increased to ≥18 pt, so as to ensure that the elderly can easily see the screen content. In terms of software design, drawing on the successful experience of the "Village Digital Assistant" APP in Wuzhen, Zhejiang Province, we have developed applications with practical functions such as voice navigation and remote handling (e.g., payment of water and electricity bills), and simplified the operation steps to less than three steps to reduce the difficulty of operation and improve the acceptance and efficiency of the elderly in the use of digital equipment and software. In addition, it will simplify the operation steps to less than three steps, improve the acceptance and use efficiency of digital devices and software for the elderly, and make digital technology better serve the elderly.

5.2. Tiered Digital Literacy Training System

In view of the significant impact of educational level on the digital literacy of rural older persons, it is necessary to build a tiered digital literacy training system. For older persons with an education level of less than primary school, "digital skills microcourses" are broadcast regularly on a daily basis, taking advantage of the wide coverage of village radio stations. The content of the lessons is centred on the digital skills needed in daily life, such as code-sweeping payment and the use of simple social software, helping them to gradually improve their digital literacy in an easy-to-understand way. For older people with junior high school education or above, special workshops are set up in townships with professional staff to provide guidance. The training focuses on e-government-related skills, such as online declaration for health insurance and online government affairs, to enhance their ability to participate in digital social affairs and better adapt to digital life.

5.3. Strengthening Social Support Networks

Considering the positive contribution of the level of social support to the digital literacy of rural older persons, an all-round social support network needs to be constructed. At the family level, children are encouraged to take the initiative to care about the digital learning needs of the elderly, and to give them patient guidance and companionship in their daily lives, so as to help them overcome their fear of digital technology. At the community level, volunteers should be actively organised to carry out regular digital technology training activities and provide one-to-one support services to solve problems encountered by the elderly in the process of using digital equipment. The government and social organisations should increase investment in rural digital education, improve the construction of digital education infrastructure, create more places suitable for the elderly to learn digital technology, provide rich learning resources, and create a good external environment for the enhancement of the elderly's digital literacy.

5.4. Improvement of Digital Village Promotion

In view of the lack of understanding of the digital village policy among the elderly in rural areas, it is necessary to optimise publicity and promotion strategies. On the one hand, fully explore and make use of the advantages of the existing publicity channels in rural areas, for example, when rural cadres go into villages and visit households to publicise, they adopt graphic and interesting ways to explain the digital village policy and its practical benefits, so as to ensure that the elderly can understand and accept it. On the other hand, actively expand online publicity channels, with the help of short-video platforms, WeChat public number and other new media communication power, the production of publicity content in line with the cognitive characteristics of the elderly, such as simple and easy-to-understand animation, oral explanation video, etc., to improve the knowledge of the digital countryside policy in the rural elderly groups, to stimulate their participation in the construction of the digital countryside of the initiative and initiative, and to promote the process of the construction of the digital countryside together.

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