

China's Digital Divide: A Comparative Study of 2012 and 2020 (Postprint)

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Abstract

[Purpose/Significance] This study endeavors to answer two questions: First, has the digital divide narrowed over the past decade? Second, have the formation mechanisms of the digital divide undergone significant changes during this ten-year span? [Method/Process] Based on questionnaire data collected through rigorous field surveys in 2012 and 2020, this study investigates the temporal evolution of the digital divide. [Results/Conclusion] The findings reveal that disparities in China's digital divide across three dimensions—access, usage, and online activities—have all diminished, and the formation mechanisms associated with these three dimensions exhibit several diachronic variation characteristics. These discoveries further corroborate the trend of a contracting digital divide in China. The conclusions of this study not only contribute to understanding the distribution of the digital divide in China, but also, by analyzing the temporal changes in its formation mechanisms, assist policymakers in developing targeted digital governance policies based on these mechanisms.

Full Text

Preamble

A Comparative Study of China's Digital Divide Between 2012 and 2020

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Abstract: [Purpose/Significance] This study addresses two research questions: First, has the digital divide narrowed over the past decade? Second, have the

formation mechanisms of the digital divide changed significantly during this ten-year period? [Method/Process] Based on questionnaire data collected through rigorous fieldwork in 2012 and 2020, this paper examines cross-temporal changes in the digital divide. [Result/Conclusion] The findings reveal that gaps in China's digital divide across three dimensions—access, use, and Internet activities—have all narrowed, with the formation mechanisms associated with these three dimensions exhibiting several diachronic changes. These findings further confirm the trend of shrinking digital divide in China. The conclusions of this study not only contribute to understanding the distribution of digital divide in China but also, by analyzing temporal changes in its formation mechanisms, help policymakers formulate targeted digital governance policies.

Keywords: digital divide; Internet development; comparative study; China

Classification Number: G203

1 Research Background

1.1 China's Internet Development and Popularization

With the rapid development of mobile devices and Internet technology, Chinese urban and rural residents are entering a highly information-based and digitalized daily living environment. The 49th “Statistical Report on China's Internet Development” released by the China Internet Network Information Center (CNNIC) shows that as of December 2021, China's overall netizen population continued to grow, the urban-rural Internet usage gap continued to narrow, and the historical problem of communication difficulties in impoverished areas has been solved. China's rural netizen population has reached 284 million, with an Internet penetration rate of 57.6% in rural areas, an increase of 1.7 percentage points from December 2020. The urban-rural Internet penetration rate gap narrowed by 0.2 percentage points compared to December 2020. The elderly population is sharing in the achievements of information development alongside other age groups. The proportion of elderly netizens who can independently use ICT devices to participate in instant messaging, online news, and online payment has reached 90.6%, 77.9%, and 70.6%, respectively [2].

Meanwhile, Internet development has brought increasingly rich online activities and content products. Emerging technology platforms represented by social media, news applications, and lifestyle service applications are reshaping Chinese netizens' daily lives across different dimensions such as information acquisition, communication, and organizational management [3-4]. Against this backdrop, ensuring that socially disadvantaged groups with relatively weak Internet usage can enjoy the convenient information services provided by the Internet has become an important research topic in this new stage of Internet development. This study addresses this key research question by comparing changes in the formation mechanisms of China's digital divide over the past decade.

1.2 Digital Divide: Theoretical Framework and Formation Mechanisms

1.2.1 Theoretical Origins and Conceptual Evolution Academia began studying Internet-related social inequalities as early as the initial stages of Internet popularization. Early empirical research on the digital divide focused on the use of information and communication technologies, particularly digital technology access gaps between urban and rural areas in developed countries [8-10]. This period's empirical research found significant generational differences in Internet access, with elderly populations using the Internet less frequently [11-12]. D. Hindman [13], by tracing U.S. questionnaire data from 1995-1998, found that socioeconomic and demographic variables such as age, education, gender, and income were more strongly correlated with digital technology access than the digital divide between large and non-large cities. This study spanned a considerable time period and holds significant importance for understanding temporal changes in the digital divide.

In recent years, empirical research on the digital divide has gradually evolved from focusing on information technology infrastructure popularization [14] to information technology usage [15-16], and further to user interaction with emerging technologies [17]. Digital divide researchers note that emerging information technologies, particularly mobile Internet, have accelerated network popularization in developing countries while simultaneously presenting new challenges for digital inclusion. J. Donner [18] proposed the "after access" conceptual framework, emphasizing the importance of dimensions such as divergence in Internet devices, quality of connection, affordability of connectedness, and digital skills for bridging the digital divide in developing countries or regions. Domestic and international Internet researchers have discussed the manifestations and influencing factors of the expanded digital divide concept at the information behavior level through empirical studies. For instance, R. Savolainen combined Bourdieu's Habitus concept from sociology to explore how different social classes' unequal cultural capital affects information accessibility and availability in daily information-seeking behaviors, reminding researchers to pay attention to the complexity of measuring digital divide in everyday information behavior dimensions.

As a multidimensional sociological concept, scholars have recently emphasized that the digital divide concept needs to move beyond simple binary divisions of digital poverty and digital affluence [19], suggesting instead the use of more complex, continuous, and pluralistic perspectives ("a continuum of digital inclusion" [20]). Researchers have further refined measurement dimensions of information skills and information behaviors under the digital divide framework. For example, A. van Deursen and J. van Dijk [21] operationalized digital skills into operational, formal, informational, and strategic skills. Their empirical research found that while Internet usage experience typically accompanies improvements in operational network skills, significant gaps remain in the other three dimensions of digital skills, which may lead to digital divide formation.

The formation and expansion of digital divide has important impacts on social development. Empirical research on China's digital divide [22] found that disadvantaged poor residents not only face job displacement by emerging technologies but also cannot enjoy the dividend from digital economy spillover effects. R. Schroeder [23] proposed that as information technology increasingly permeates Internet users' daily lives, research on digital inequality in today's information society needs to transcend usage-level studies of technology itself and further focus on digital divides emerging in new media environments.

1.2.2 Empirical Research on China's Digital Divide Chinese government and academic attention to the digital divide began roughly in the early 21st century. At the UN Millennium Summit in 2000, Jiang Zemin pointed out: "The widening 'digital divide' demonstrates that there is a huge gap in technological levels between developed and developing countries, which will inevitably lead to further widening of the North-South wealth gap" [24]. In Volume II of "Xi Jinping: The Governance of China," General Secretary Xi Jinping emphasized "focusing on resolving issues such as development imbalances, governance dilemmas, digital divides, and distribution gaps, and building an open, inclusive, balanced, and beneficial economic globalization" [25].

As the digital divide attracted high-level government attention, Chinese academia also turned its focus to this field. Due to later recognition of information society issues compared to foreign counterparts, Chinese academic research on the digital divide began with introducing Western research findings. For example, Cao Rongxiang [26] systematically introduced the concept of "digital divide" and related foreign research. Yan Hui and Sun Lili [27] reviewed past research and categorized "digital divide" studies into four generations: access, use, information resource knowledge, and new developments. Chinese researchers have also emphasized connecting their research findings with national governance of information differentiation. For instance, Chen Yanhong [28] argued that information technology, information resources, information subjects, and information policies contribute to China's "digital divide" and proposed corresponding countermeasures. Yan Hui et al. [29] proposed strengthening infrastructure and other suggestions from a digital inclusion perspective to narrow the "digital divide." Hu Angang and Zhou Shaojie analyzed three major digital divides facing China, proposing that the core of digital divide governance policy is to promote resource flows toward fields that can drive economic and knowledge development [30]. They further proposed accelerating transformation toward an "information society" and "knowledge society" to continuously narrow the information gap with "information-rich" countries, representing an important strategic choice for developing countries in the context of economic globalization and information technology revolution [31].

In recent years, Chinese researchers have conducted extensive studies from perspectives such as enterprise digital divide [32], digital divide in digital finance

development [33], digital divide among elderly populations [34-35], and digital divide in education and teaching (particularly online learning during the pandemic) [36-37].

1.2.3 Limitations of Existing Research With the development of Internet technology, the conceptual framework of the digital divide has evolved from focusing on Internet infrastructure popularization to network technology usage, and further to Internet activity participation and users' daily information-seeking behaviors. As an important interdisciplinary research field, digital divide research has integrated theoretical foundations and empirical findings from communication, sociology, information science, and other disciplines. However, against the backdrop of the Internet's increasing integration into daily life in China, empirical research on the digital divide still has shortcomings. First, the conceptual construction of digital divide in information-seeking behavior research remains inadequate. The access, use, and Internet activity dimensions of digital divide need further integration with information behavior research, particularly search engine usage-based information-seeking behavior research, requiring operational measurement and comparative studies among different social groups. Second, existing research mostly focuses on the digital divide's manifestation in a specific time period, lacking longitudinal comparative studies across substantial time spans. However, the rapid development of information and communication technologies necessitates updating and supplementing empirical research data with technological advancement. Cross-temporal empirical studies on digital divide help capture the longitudinal temporal changes in the manifestation and influencing factors of digital inequality against the backdrop of technological progress.

In summary, this study continues the dimensional division of digital divide into access, use, and Internet activities. By conducting comparative analysis of questionnaire data spanning nearly ten years, it examines the specific manifestations and changing formation mechanisms of digital divide in information behavior. Theoretically, this study helps capture the manifestation of digital divide in information behavior processes against China's Internet popularization background. Empirically, it supplements changes in influencing factors of digital divide across different periods, providing empirical evidence for exploring structural digital inequality. Based on questionnaire data from 2012 and 2020 collected through rigorous fieldwork, this study addresses the following two research questions: First, has China's digital divide narrowed over the past decade? Second, have the formation mechanisms of China's digital divide changed significantly during this ten-year period?

2 Research Design

2.1 Data Collection

This study conducts a comparative analysis of China's digital divide in 2012 and 2020. The research sample consists of two components: (1) In 2012, ques-

tionnaires based on the “Personal Information World Scale” were distributed in Dongguan City (Guangdong Province), Tianjin City, Taiyuan City (Shanxi Province), Yangquan City (Shanxi Province), Lanzhou City (Gansu Province), and Dalian City (Liaoning Province) for data collection. To improve sample representativeness, researchers selected locations and populations as diversely as possible to enhance respondent representativeness and heterogeneity. Taking the Dongguan survey as an example, strict stratified sampling was employed. Based on the total population and distribution in the “2011 Dongguan National Economic and Social Development Statistical Bulletin,” the number of questionnaires to be distributed in each district was calculated. A total of 4,548 questionnaires were distributed. After excluding questionnaires with excessive missing values and those failing “lie detection” questions, 3,368 valid questionnaires were recovered, yielding a response rate of 74.05%. (2) In July 2020, the research team conducted questionnaire surveys and data collection in Longxi County, Gansu Province. During fieldwork, the team used interview-style questionnaires, where team members conducted face-to-face interviews with respondents and made audio and text recordings. In sample selection, emphasis was placed on selecting adults heterogeneous in variables such as age, education level, and occupation type, consciously including rural populations such as left-behind elderly, migrant young laborers, and rural women. A total of 714 respondents were surveyed. Since each questionnaire was completed by team members through individual interviews with full respondent consent, the response rate was 100%. To enhance comparability, the 2012 sample selected respondents from Lanzhou City, Gansu Province, totaling 634 samples. The 2020 sample used the entire sample group to control for cross-regional effects on research results.

2.2 Variable Selection

For the three levels of digital divide in research—primary access, secondary use (adoption), and tertiary Internet activities—this study operationalizes measurement using the Internet accessibility, availability, and information asset dimensions from Yu Liangzhi and Zhou Wenjie’s “Personal Information World Scale,” specifically search engine usage. This scale, based on Professor Yu Liangzhi’s “Personal Information World” framework, is a measurement tool for personal information poverty and wealth. It was developed in 2012 and passed reliability and validity tests, subsequently being used in empirical research [38-40]. Specific measurement indicators for Internet accessibility, availability, and information asset dimensions are shown in Table 1.

In Table 1, the access divide (Internet as accessible information source), use divide (Internet as available information source), and network activity divide (search engine as information asset) in 2012 all use binary variables. The 2020 network activity divide (search engine as information asset) uses Likert scale ordinal measurement. This study assigns scores to all variables in this dimension through expert rating to unify measurement units. For control variables, refer-

ring to existing digital divide literature, this study selects gender, age, education years, whether occupation is professional or managerial, daily time spent on information searching, and income as control variables [22, 41-42]. All variable scoring rules are shown in Table 2 .

2.3 Descriptive Statistics

Descriptive statistics for variables in the sample are shown in Table 3 . As shown in Table 3, regarding Internet variables, the mean for accessible information sources is 2.394 (variance 1.452), the mean for available information sources is 2.553 (variance 1.143), and the mean for information assets is 6.297 (variance 4.427), all approaching their respective maximums, indicating that the Internet has entered the lives of the vast majority. In the sample population, there are 491 males (45.13%) and 597 females (54.87%), with roughly equal gender distribution. In terms of age, those aged 30 and below account for 24.55%, ages 31-40 account for 33.33%, ages 41-50 account for 35.51%, and ages 51 and above account for 6.61%, with fewer elderly netizens compared to young and middle-aged respondents. Regarding occupation, professional or managerial personnel account for 48.41%, close to the proportion of non-managerial or non-professional personnel. In terms of income, the ratio of low-income, middle-income, and high-income groups is approximately 2:5:3. The education median is 15, indicating that more than half of the sample population has received college education or above, with an average education duration of 13.84 years. The mean daily time spent on information searching is 2.934, indicating that the average person spends about 1-3 hours daily on information searching. Regarding income, the sample is predominantly middle-income (mean approximately 2), with a standard deviation of about 0.7 and a standard deviation-to-mean ratio of about 0.35, indicating some income variation among individuals.

Comparing 2012 and 2020 data reveals: In terms of information divide, the use divide did not change significantly, while both the access divide and network activity divide in 2020 were larger than in 2012. In terms of demographic variables, gender and income did not change substantially. The 2020 sample was younger than the 2012 sample, and the 2020 education duration was lower than the 2012 sample because the 2012 survey was conducted in urban areas while the 2020 survey focused mainly on rural areas. Regarding information searching, the 2012 sample's information search time was lower than that of the 2020 sample.

3 Empirical Testing

3.1 Regression Model Construction

This paper uses equation (1) to test changes in the access divide (Internet as accessible information source) between 2012 and 2020, equation (2) to test changes in the use divide (Internet as available information source), and equation (3) to test changes in the network activity divide (search engine as information asset).

Access Divide (Internet as Accessible Information Source) = $\beta_0 + \beta_1 \text{Year} + \beta_2 \text{Gender} + \beta_3 \text{Age} + \beta_4 \text{Education Years} + \beta_5 \text{Occupation} + \beta_6 \text{Information Search Time} + \beta_7 \text{\$2019 Income} +$

Use Divide (Internet as Available Information Source) = $\beta_0 + \beta_1 \text{Year} + \beta_2 \text{Gender} + \beta_3 \text{Age} + \beta_4 \text{Education Years} + \beta_5 \text{Occupation} + \beta_6 \text{Information Search Time} + \beta_7 \text{\$2019 Income} +$

Network Activity Divide (Search Engine as Information Asset) = $\beta_0 + \beta_1 \text{Year} + \beta_2 \text{Gender} + \beta_3 \text{Age} + \beta_4 \text{Education Years} + \beta_5 \text{Occupation} + \beta_6 \text{Information Search Time} + \beta_7 \text{\$2019 Income} +$

In equations (1), (2), and (3), β represents regression coefficient indicators.

3.2 Regression Model Estimation

This study employs Ordinary Least Squares (OLS) estimation for the models in equations (1), (2), and (3). Table 5 presents the estimation results. The adjusted model fit for equation (1) is 0.0834, indicating that the selected variables have some explanatory power for the network access divide. The year variable is significant with a regression coefficient of 0.443, indicating that, controlling for other variables, Internet as an accessible information source improved significantly compared to 2012. The adjusted model fit for equation (2) is 0.146, indicating that the existing variables have strong explanatory power for the dependent variable Internet as available information source. The year regression coefficient is 0.206, significant at the 5% level, indicating that Internet as available information source improved significantly compared to 2012. The adjusted model fit for equation (3) is 0.150, proving the reasonableness of variable selection. The independent variable's regression coefficient is positively significant, indicating significant improvement in Internet usage (search engine as information asset) compared to 2012. Regarding control variables, education years and information search time are positively significant in all three models at the 1% significance level, indicating that Internet access, use, and network activities all increase with education years and information search time.

To verify that the estimation results in Table 5 are not accidental and possess robustness, this study replaces the 2019 income variable with 2010 income to test the robustness of Table 5's results. If the independent variable results do not change significantly, it indicates that the regression results in Table 5 are robust. Table 6 presents the robustness test regression results. Comparing the results in Table 5 and Table 6 shows that variables with statistical significance in the three models are basically consistent between the original model and the robustness test model, thus confirming that the main regression results in Table 5 are robust.

3.3 Temporal Changes in Digital Divide Formation Mechanisms

With the development of information communication technology and the economy and society, the manifestation and mechanisms of digital divide between 2012 and 2020 have inevitably undergone tremendous changes. To explore changes in regression coefficients across different years, this study uses Seemingly Unrelated Regressions to comprehensively examine differences in regression coefficients. Table 7 presents the coefficient difference test results.

In the regression of access divide (Internet as accessible information source), females were at a disadvantage in 2012 but converged with males in 2020. The regression coefficient difference for information search time is significant at the 5% level, changing from positively significant in the 2012 regression to non-significant in the 2020 regression, indicating that the significant positive effect of information search time on Internet as accessible information source has disappeared. Regarding the regression coefficient difference for high income, high-income groups had more Internet accessible information sources than low-income groups in 2012, but this advantage disappeared in 2020.

In the regression of Internet as available information source, the 2012 regression coefficient for information search time is significant at the 1% level at 0.251, indicating that longer information search time correlates with higher Internet available information sources. However, this significant positive correlation disappeared in 2020, and the 2020 regression coefficient changed significantly compared to 2012.

In the regression of search engine as information asset, the impact of education years on Internet information assets decreased from 0.225 in 2012 to 0.0718 in 2020, and this change is significant at the 10% level. The regression coefficient difference for information search time is also significant, changing from positively significant in 2012 to non-significant in 2020.

To check whether the regression results in Table 7 are robust, this study replaces the 2019 income variable with the 2010 income variable. If the coefficient difference results are consistent, it proves that the results in Table 7 are reliable. The robustness results are shown in Table 8. In the Internet accessible information source regression, the gender coefficient difference remains robust. The information search time regression coefficient difference is not significant, indicating that the results regarding information search time changes in Table 7 are not robust. The high-income regression coefficient difference remains robust. In the cross-year comparison of Internet as available information source regression, the information search time regression coefficient difference is significant. In the cross-year comparison of search engine as information asset regression model, the education years regression coefficient difference remains significant, and the information search time regression coefficient difference remains significant.

4 Research Conclusions and Discussion

As an important concept for studying the social impact of the Internet, the digital divide conceptual framework captures social inequality phenomena arising during the development and popularization of information and communication technologies [23, 43-44]. Related empirical research on digital divide reveals its manifestations in technology access, use, and network activities [45]. This study analyzes changes in China's digital divide across these three dimensions over the past decade and the temporal changes in significant factors influencing the digital divide through questionnaire data comparison.

First, this study encompasses multiple dimensions of digital divide: access divide (Internet as accessible information source), use divide (Internet as available information source), and network activity divide (search engine as information asset). Building on R. Savolainen's [46] research foundation of social class differences in daily information-seeking behavior, this study measures network activity divide to analyze differences in digital divide in information behavior across Chinese social groups, supplementing conceptual construction and empirical evidence in this field. The findings reveal that gaps across the three dimensions of digital divide have all narrowed. Compared to 2012, the 2020 access divide (Internet as accessible information source), use divide (Internet as available information source), and network activity divide (search engine as information asset) have all diminished. The Internet has become more accessible, available, and widely used in search engines over the ten-year period. This finding verifies the comprehensive popularization of information and communication technology in China. In particular, the gap in digital divide in daily information acquisition has also narrowed, further confirming that China's Internet development has entered the "after access" stage [18], where Internet users actively obtaining daily information through search have become more proactive [47].

Second, by comparing digital divide influencing factors across different periods, this study explores temporal changes in formation mechanisms related to the three dimensions of digital divide. Specifically, gender-based differences in China's Internet access divide are gradually disappearing, with female Internet users achieving equal status with male users. Additionally, the original advantage of high-income groups in network access has gradually disappeared over the past decade, with Internet popularization gradually converging across different income groups. The declining influence of gender and income in Internet access processes shows similar trends in other emerging economies [18, 48]. In Internet usage, the usage divide caused by education level is also gradually narrowing, specifically manifested in the disappearance of significant differences in search engine use between high-education and low-education groups. The narrowing of network access and use divides provides opportunities for information society development while also presenting new requirements for policymakers, social workers, and Internet industry practitioners. With the diversified development of network access groups, the information and communication technology industry has generated more diverse demands, including female-friendly cultural

and entertainment content products, technology innovations for elderly adaptation, and more friendly platform economy models for flexible employment of low-income groups.

Moreover, in network usage (Internet as accessible information source) and network activities (search engine usage), information search duration, which was previously significantly positively correlated with network usage and activities, no longer has a significant effect, indicating that the network usage divide is no longer significantly correlated with network information search duration.

The empirical conclusions of this study have important implications for formulating digital governance policies. The gaps in digital divide in Internet access, use, and network activities are gradually narrowing, and the significance of traditional socio-demographic or network usage variables causing digital divide—such as female gender, lower education level, and network information search duration—is declining. However, these findings do not signify the complete disappearance of digital divide. Digital divide theory finds that technological inequality in the digital age is gradually transitioning from technology popularization dimensions to content creation [17] and artificial intelligence and algorithmic literacy [49]. The narrowing of China's digital divide in access, use, and network activities provides important insights for policymakers promoting technology for social development: the focus needs to gradually shift to new issues such as how users use the Internet and other information communication technologies to obtain information after technology popularization, and how they interact with complex information technology systems.

References

- [1] QIU J L. Working-class network society: communication technology and the information have-less in urban China[M]. Cambridge: MIT Press, 2009.
- [2] China Internet Network Information Center (CNNIC). Statistical report on China's Internet development[EB/OL]. [2022-08-12]. http://www3.cnnic.cn/NMediaFile/old_{attach}/P02022
- [3] YAN P, SCHROEDER R. Variations in the adoption and use of mobile social apps in everyday lives in urban and rural China[J]. *Mobile media & communication*, 2020, 8(3): 318-341.
- [4] CHEN Y, MAO Z, QIU J L. Super-sticky WeChat and Chinese society[M]. Bingley: Emerald Publishing Limited, 2018.
- [5] KATZ J E, RICE R E. Social consequences of Internet use: access, involvement, and interaction[M]. London: MIT, 2002.
- [6] ROBINSON L, SCHULZ J, BLANK G, et al. Digital inequalities 2.0: legacy inequalities in the information age[J/OL]. *First Monday*, 2020, 25(7)[2022-08-12]. <https://journals.uic.edu/ojs/index.php/fm/article/view/10842>.
- [7] ROBINSON L, SCHULZ J, DUNN H S, et al. Digital inequalities 3.0: emergent inequalities in the information age[J/OL]. *First Monday*, 2020, 25(7)[2022-08-12]. <https://journals.uic.edu/ojs/index.php/fm/article/view/10844>.
- [8] LENTZ R G, ODEN M D. Digital divide or digital opportunity in the Mississippi Delta region of the US[J]. *Telecommunications policy*, 2001, 25(5):

291-313.

- [9] PARKER E B. Closing the digital divide in rural America[J]. Telecommunications policy, 2000, 24(4): 281-290.
- [10] RIDEOUT V. Public access to the Internet and the Canadian digital divide[J]. Canadian journal of information and library science-*Revue Canadienne Des Sciences De L' Information Et De Bibliotheconomie*, 2000, 25(2/3): 1-21.
- [11] RICE R E, KATZ J E. Comparing Internet and mobile phone usage: digital divides of usage, adoption, and dropouts[J]. Telecommunications policy, 2003, 27(8/9): 597-623.
- [12] LOGES W E, JUNG J Y. Exploring the digital divide: Internet connectedness and age[J]. Communication research, 2001, 28(4): 536-562.
- [13] HINDMAN D. The rural-urban digital divide[J]. Journalism & mass communication quarterly, 2000, 77(3): 549-560.
- [14] DIMAGGIO P, HARGITTAI E, CELESTE C, et al. Digital inequality: from unequal access to differentiated use[M]//NECKERMAN K M. Social inequality. New York: Russell Sage Foundation, 2004: 355-400.
- [15] PEARCE K E, RICE R E. Digital divides from access to activities: comparing mobile and personal computer Internet users[J]. Journal of communication, 2013, 63(4): 721-744.
- [16] SU Lanlan, PENG Yanling. Digital education, digital literacy, and farmers' digital life[J]. Journal of South China Agricultural University (Social Science Edition), 2021, 3(20): 27-40.
- [17] HARGITTAI E, WALEJKO G. The participation divide: content creation and sharing in the digital age[J]. Information, communication & society, 2008, 11(2): 239-256.
- [18] DONNER J. After access: inclusion, development, and a more mobile Internet[M]. Cambridge: The MIT Press, 2015.
- [19] SELWYN N. Reconsidering political and popular understandings of the digital divide[J]. New media & society, 2004, 6(3): 341-362.
- [20] LIVINGSTONE S, HELSPER E. Gradations in digital inclusion: children, young people and the digital divide[J]. New media & society, 2007, 9(4): 671-696.
- [21] VAN DEURSEN A, VAN DIJK J. Internet skills and the digital divide[J]. New media & society, 2011, 13(6): 893-911.
- [22] HE Zongyue, ZHANG Xun, WAN Guanghua. Digital finance, digital divide, and multidimensional poverty[J]. Statistical research, 2020, 37(10): 79-89.
- [23] SCHROEDER R. A Weberian analysis of global digital divides[J]. International journal of communication, 2015, 9: 2819-2837.
- [24] Jiang Zemin' s speech at the UN Millennium Summit[N]. [2022-08-12]. <http://www.chinanews.com.cn/2000-09-07/26/45215.ht>.
- [25] Bridging the digital divide and promoting digital economy development[N]. [2022-08-12]. https://news.gmw.cn/2020-08/04/content_{34054458}.htm.
- [26] CAO Rongxiang. Introduction to digital divide: information inequality and digital opportunities[J]. Marxism & Reality, 2001(6): 20-25.
- [27] YAN Hui, SUN Lili. Review of domestic and international digital divide

- research since 1989: connotation, manifestation dimensions, and influencing factors[J]. *Journal of Library Science in China*, 2012, 38(5): 82-94.
- [28] CHEN Yanhong. Theoretical analysis and coping strategies for China' s digital divide problem[J]. *Archives Science Bulletin*, 2005(6): 60-63.
- [29] YAN Hui, ZHANG Xincan, YIN Xianbin. Research progress on digital inclusion: connotation, influencing factors, and public policy[J]. *Library & Information*, 2018(3): 80-89.
- [30] HU Angang, ZHOU Shaojie. How China should respond to the widening "digital divide" [J]. *China Industrial Economics*, 2002(3): 5-12.
- [31] HU Angang, ZHOU Shaojie. New global wealth gap: the widening "digital divide" [J]. *Social Sciences in China*, 2002(3): 34-48.
- [32] WANG Jun, YUAN Qinjian. Analysis of influencing factors of enterprise digital divide[J]. *Competitive Intelligence*, 2022, 18(2): 40-48.
- [33] ZHANG Xun, WAN Guanghua, WU Haitao. Narrowing the digital divide: the development of digital finance with Chinese characteristics[J]. *Social Sciences in China*, 2021(8): 35-51.
- [34] MA Qi, YANG Wei, LIAO Fangyi. Research on the formation mechanism of elderly digital integration dilemma in the digital governance era[J]. *Peking University Political Science Review*, 2021(1): 153-177.
- [35] WANG Juan, ZHANG Jinsong. Digital divide: the impact of AI embedded in social life on the elderly and its governance[J]. *Hunan Social Sciences*, 2021(5): 123-130.
- [36] ZHENG Lei, ZHENG Yimin. Family digital divide and academic literacy gap between urban and rural students—a study based on PISA 2018 data from four Chinese provinces/municipalities[J]. *China Educational Technology*, 2021(7): 43-51.
- [37] GUO Jiao. Evolution of digital divide: from network access to mental investment—a survey of college students' online learning during the pandemic[J]. *Journal of East China Normal University (Educational Sciences)*, 2021, 39(7): 16-26.
- [38] YU Liangzhi. "Personal information world" —the discovery and interpretation of an information inequality concept[J]. *Journal of Library Science in China*, 2013, 39(1): 4-12.
- [39] YU Liangzhi, ZHOU Wenjie. Information poor and information rich: personal-level information inequality measurement review[J]. *Library & Information*, 2015(1): 53-60.
- [40] ZHOU Wenjie. Research on information differentiation based on personal information world[D]. Tianjin: Nankai University, 2013.
- [41] CHEN Menggen, ZHOU Yuanren. New progress in digital inequality research[J]. *Economic Perspectives*, 2022(4): 123-139.
- [42] JIANG Feng. Research on new digital divide[J]. *Library Journal*, 2013, 32(1): 8-16.
- [43] VAN DIJK J. The digital divide[M]. Cambridge: Polity, 2020.
- [44] ROBINSON L, COTTEN S R, ONO H, et al. Digital inequalities and why they matter[J]. *Information communication & society*, 2015, 18(5): 569-582.
- [45] VAN DEURSEN A, VAN DIJK J. The first-level digital divide shifts from

inequalities in physical access to inequalities in material access[J]. New media & society, 2019, 21(2): 354-375.

[46] SAVOLAINEN R. Everyday information practices: a social phenomenological perspective[M]. Lanham: Scarecrow Press, 2008.

[47] NEUMAN W R. The digital difference: media technology and the theory of communication effects[M]. London: Harvard University Press, 2016.

[48] ARORA P. The next billion users: digital life beyond the West[M]. Cambridge: Harvard University Press, 2019.

[49] YU P K. The algorithmic divide and equality in the age of artificial intelligence[J]. Florida law review, 2020, 72: 331-389.

Author Contributions:

Yan Pu: Research design, main writing;

Lin Weijie: Data cleaning and analysis, empirical results writing;

Zhou Wenjie: Data collection, literature review and theoretical construction.

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

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