International Theory and Practice in Humanities and Social Sciences
2025 Volume2,Issue9 ISSN 3078-4387

The Digital Divide and Rural Education — A Study Based on CFPS Data

Keqiang Dai[1*]

[1] *Tongji University, Shanghai, China*

Accepted
2025-09-07

Keywords
Urban-Rural Gap, Educational Equity

Corresponding Author
Keqiang Dai

Copyright 2025 by author(s)
This work is licensed under the CC BY 4.0

https://doi.org/10.70693/itphss.v2i9.754

Abstract
The question of whether the development of the internet can narrow the educational gap between urban and rural areas remains a controversial topic. Some studies argue that the application of internet technology has brought educational resources to rural regions, providing a platform for the integrated development of urban-rural educational information, thus promoting educational equity. Other studies, however, suggest that the development of information technology has exacerbated the digital divide, as rural students lack the cognitive and experiential skills to effectively utilize the internet for learning, making them more susceptible to the negative impacts of the internet, thereby reducing academic performance and further deepening educational disparities. This paper acknowledges the beneficial development brought to rural education by the "Internet + Education" model, emphasizing the opportunities for educational equity it provides. However, it also points out that social stratification is the root cause of the urban-rural educational gap, a trend that does not appear to have improved in the "Internet +" era. Rural students' disadvantages in internet usage have extended into education, and the digital divide has negatively impacted rural education. Based on empirical research using CFPS data, this paper demonstrates that, in the absence of experience and guidance, rural students' internet behaviors affect academic performance through reduced study time and decreased learning efficiency. The paper also analyzes the heterogeneity and mediating effects of this impact, finding that the digital divide has a more pronounced effect in central and western regions and among school-age children, impacting rural students by reducing internet usage frequency and increasing dependence on after-school tutoring. Based on these findings, targeted suggestions for bridging the digital divide are provided.

1. Introduction

Education is a major national policy. The Party and the country have always adhered to a people-centered development approach in education, focusing on improving the level of education and enhancing educational equity. The comprehensive promotion of educational informatization is an important strategic deployment for improving the quality of education and narrowing the education gap in China. The report of the 20th National Congress of the Communist Party of China (CPC) pointed out the need to accelerate the informatization of education and urban-rural integration, optimize the regional distribution of educational resources, and continuously reduce the educational gaps between urban and rural areas, regions, and groups, so that the achievements of educational reform and development can benefit the largest number of people.

Since the implementation of the compulsory education plan, the central and local governments have gradually promoted the sharing of high-quality educational resources between urban and rural areas. The "Rural Distance Education Project" has been widely implemented in both urban and rural schools, alleviating the shortage of educational resources and teachers in rural areas, especially in central and western regions. Provinces like Jiangsu and Zhejiang have piloted the integration of urban and rural teaching modes through cloud classrooms, gradually realizing mutual connectivity and the sharing of educational resources. With the strong support of the government, urban-rural educational informatization has made significant progress. As of June 2016, 87.5% of primary and secondary schools in China were connected to the internet, and digital education resources have been fully covered in teaching points. The gap in internet infrastructure between urban and rural education has been greatly narrowed.

In recent years, driven by the dual forces of big data, cloud computing, artificial intelligence, and the COVID-19 pandemic, the development of "Internet + Education," represented by the Online-Merge-Offline (OMO) model, has rapidly expanded. As a result, the number of online education users has surged. According to the 48th Statistical Report on the Development of the Internet in China, released by the China Internet Network Information Center (CNNIC) in September 2021, the number of online education users reached 232.46 million in June 2019, accounting for 27.2% of internet users. Following the outbreak of the COVID-19 pandemic, the number of online education users peaked at 422.96 million in March 2020, accounting for 46.8% of internet users, representing an 81.9% increase from June 2019. During the first half of 2020, under the policy of "suspending classes without stopping learning," 282 million students shifted to online courses, significantly increasing public awareness and use of online education. In this deep integration of "Internet + Education," rural students have become increasingly involved with the internet, and rural education has been profoundly affected by the application of internet technology.

The impact of internet technology on education is revolutionary. Many studies have shown that the application of internet technology has driven profound reforms in education and innovative educational ideas (He Kekang, 2019; Zhang Yan, 2016; Huang Ronghuai, 2017). Some research also indicates that innovations in the internet are facilitating systemic changes in education, leading the future direction of educational development (Chen Li, 2018; Xie Jili, 2015). Scholars have high expectations for the role of internet technology in solving educational problems, believing that the transformation brought by the internet can make education more aligned with the needs of society and human development, a point on which there seems to be consensus. However, whether the application of internet technology can promote educational equity and narrow the urban-rural education gap remains a matter of dispute. Some studies suggest that the integration of "Internet + Education" can effectively address the bottlenecks in rural education development, such as the shortage of educational resources, thereby achieving educational equity between urban and rural areas (Sun Dantong, 2015). Other studies argue that the digital divide and the "double-edged sword" effect of the internet present serious challenges to educational equity, as the physical gap in information between urban and rural areas does not effectively promote fairness. Information capital continues to cause educational stratification between urban and rural areas (Gong Botao, 2020; Zhang Jizhou, 2018). This paper agrees that the internet has undeniably brought improved conditions and opportunities to rural education and that "Internet + Education" has greatly improved the fairness of educational opportunities, but whether it has promoted outcome fairness remains to be seen.

Specifically, this paper affirms the positive role of the internet in education while addressing two main questions: 1) Does the internet have a consistent impact on rural and urban students? 2) What specific effects does the internet have on rural students, and what are its characteristics?

This paper reviews the relevant literature on the internet impact on urban-rural education, and based on theoretical analysis and previous studies, proposes hypotheses. These hypotheses suggest that the effects of the internet on education differ between urban and rural areas. Due to unequal access to information resources and lack of experience, the negative effects of the internet are more pronounced in rural areas and have a more significant negative impact on the academic performance of rural students. Empirical analysis based on the CFPS database, using rural samples, proves these hypotheses. Through heterogeneity analysis and mediation effect analysis, this paper explores the characteristics of the impact and some mechanisms.

The marginal contributions of this paper include: 1) Empirically testing the impact of internet use on rural students' academic performance with fixed-effects and ordered logit models, revealing heterogeneous results and offering beneficial suggestions for reducing negative effects. 2) Analyzing the mediating mechanisms of the internet impact on rural education, revealing that smartphone use, in fact, reduces rural students' internet usage frequency, increasing their dependence on after-school tutoring, thus leading to a decrease in academic performance. This mediating mechanism is seldom mentioned in existing literature, differing from traditional beliefs about how internet learning affects students. 3) Providing a valuable contribution to existing research on the impact of internet development on the urban-rural education gap, particularly as few studies focus on the impact of internet technology on the academic performance of school-age children. In the world of high internet penetration and increasing use of smartphones by younger populations, this study has significant theoretical and practical implications.

2. Literature Review and Hypotheses

At present, there is a significant divergence in the literature regarding the impact of internet technology on educational equity. Two opposing viewpoints are particularly notable. One perspective argues that the widespread use of the internet promotes educational equity. For example, Wan Liyong et al. (2022) analyzed the situation of online education in ethnic minority regions during the COVID-19 pandemic and concluded that educational informatization is an effective means of promoting the efficient sharing of educational resources. Some scholars argue that the "Internet + Education" model can effectively shift education equity from starting-point fairness to process fairness, using information technology to foster higher levels of educational equity and gradually eliminate the digital divide (Liao Hongjian et al., 2018; Han Shimei, 2021). Yu Mingya et al. (2017) further argue that the difference in information technology configuration levels and the differences in the recognition of "Internet +" lead to the unequal distribution of the benefits of the internet, which can be addressed through the normalization of internet infrastructure and the sharing of high-quality digital educational resources.

On the other hand, another view contends that the application of internet technology in education has resulted in the divide between "information rich" and "information poor" groups. Information technology does not necessarily make social class relations more open; rather, the possession and use of information capital has become a mechanism for reproducing educational inequality (Zhang Jizhou et al., 2018). The generation with an advantage in information resources can first make educational investments for the new generation through the internet, thus converting the advantage in information resources into human capital advantages. This process leads to the expansion of educational inequality, known as the "digital divide" (Yang Po et al., 2017). Moreover, the internet has two different uses: entertainment and learning. Research shows that children from poor families are more likely to develop an entertainment preference and relatively lack the motivation to use the internet for educational purposes. The preference for internet use thus determines whether the internet has a positive or negative impact on students' academic performance (Chen Chunjin et al., 2017). This has led to the conclusion that the internet may negatively impact academic performance, with many studies abroad reaching similar conclusions (Peña-López, 2015; Golder et al., 2014; DiMaggio et al., 2001).

Based on the literature, this paper proposes that, under the current push for the digital transformation of education in China, the gap in internet educational facilities between urban and rural areas has been significantly reduced, and the physical divide in the internet is close to being bridged. However, the digital divide between urban and rural education is still apparent, primarily due to differences in internet literacy and the social and environmental context. Rural students are, in relative terms, "information poor," and although they have equal opportunities to access information through the internet, they still find themselves at a disadvantage when it comes to obtaining and discerning information. On one hand, rural students are more likely to become trapped in information isolation due to a lack of information literacy and peer effects, and they lack the ability and motivation to proactively seek educational information online. On the other hand, with the widespread availability of mobile devices, rural students are exposed to various types of unhelpful internet information, and without guidance, they are more prone to becoming distracted and losing focus, which affects their academic performance.

However, rural students will accumulate experience in using the internet and gradually receive guidance, which will help mitigate the negative impact of the internet on their education. Based on these analyses, this paper proposes two hypotheses: 1) Rural students are more susceptible to the 1"double-edged sword" effect of the internet compared to urban students. 2) The negative impact of the internet on rural students' academic performance will diminish with experience accumulation and proper guidance.

The empirical analysis in this paper will explore these hypotheses and discuss the mechanisms behind the negative impact of the internet on rural students' academic performance.

3. Data and Model

3.1 Data Description

The data used in this paper comes from the China Family Panel Studies (CFPS), a comprehensive national social tracking survey project implemented by the Institute of Social Science Survey (ISSS) at Peking University. The CFPS aims to collect data at the individual, family, and community levels to reflect changes in Chinese society, economy, population, education, and health. The CFPS uses a stratified multistage sampling method to select survey samples, covering 16,000 households in 25 provinces, cities, and autonomous regions, making its sample representative of approximately 95% of the Chinese population (Xie, 2012). The survey has been conducted every two years since the baseline survey in 2010, and the latest publicly available data is from the 2020 individual questionnaire.

Due to the significant role played by online education during the COVID-19 pandemic in 2020, which led to a sudden surge in internet use across both rural and urban areas, this paper focuses on the 2018 CFPS individual questionnaire data to avoid potential bias from the pandemic's impact on internet use. The study subjects are rural students, so the sample was restricted to individuals who reside in rural areas and are aged 16 or younger. To ensure the sample accurately reflects rural education, data from students attending schools in areas that differ from their registered residence were excluded. After excluding invalid samples with significant missing data and performing data cleaning, a final sample of 1,973 rural students was obtained.

3.2 Model Setup

To examine the impact of internet usage on the academic performance of rural students, we

employ a fixed-effects model. The specific model is as follows:
To examine the impact of internet usage on the academic performance of rural students, we employ a fixed-effects model. The specific model is as follows:

$$Grade_i = \beta_0 + \beta_1 * Internet_i + \beta_2 X_i + r_c + \varepsilon_{ic} \quad (1)$$

Where:

$Grade_i$ represents the academic performance of student i , $Internet_i$ is the main explanatory variable, indicating whether the student uses a smartphone (1 = yes, 0 = no), X_i is a vector of control variables, r_c denotes individual fixed effects to account for unobserved heterogeneity, ε_{ic} is the random error term. We are particularly interested in the coefficient β_1 , which represents the marginal effect of internet usage on academic performance of rural students. We hypothesize that this coefficient will be negative, indicating that internet usage negatively impacts academic performance.

To further analyze the mechanisms through which internet usage affects rural students' academic performance, we will construct a mediation model as follows:

$$Mediat_i = \alpha_0 + \alpha_1 * Internet_i + \alpha_2 X_i + r_c + \varepsilon_{ic} \quad (2)$$

$$Grade_i = \chi_0 + \chi_1 * Mediat_i + \chi_2 Internet_i + \chi_3 X_i + r_c + \varepsilon_{ic} \quad (3)$$

Where:

$Mediat_i$ is the mediating variable, representing the effect of internet usage on rural students' academic performance, α_1 measures the effect of internet usage on the mediator, χ_1 measures the effect of the mediator on academic performance.If they are statistically significant, it would suggest that there is a mediation effect, with the mediator serving as the channel through which internet usage affects academic performance.

3.3 Key Variable Descriptions

The dependent variable in this study is the student's academic performance, which is measured by two indicators: *ClassGrade* and *SchoolGrade*. The data for these indicators were constructed from the "most recent mid-term/final exam class rank" and "most recent mid-term/final exam grade rank." These rankings serve as direct indicators of students' educational levels and help reduce the impact of randomness in exam results. Since the dependent variables are discrete and ordered, an ordered logit model will be used for robustness checks later.

For the independent variables, we use a binary variable indicating whether the student uses a smartphone (1 = yes, 0 = no) as the primary measure of internet usage. Smartphones are currently the most common means of internet access in rural areas. According to the latest data from the CNNIC, in 2018, 81.698 million Chinese people accessed the internet via smartphones, accounting for 98.6% of internet users, a proportion that continues to rise. The survey specifically asked about smartphone use, excluding traditional mobile phones such as the "PHS". Thus, the variable indicating smartphone use is a reliable proxy for rural students' exposure to the internet. Additionally, the study uses the variable *Computer* to represent computer usage, which also reflects internet use but with some differences in how the internet is accessed.

Control variables include personal characteristics(*P_Controls*) such as age, gender, and ethnicity, as well as family and school characteristics(*PS_Controls*) like family size, household income, whether the student attends a boarding school, whether they attend a key school, and whether they are in a key class. Table 1 provides descriptive statistics for these variables.

Table 1: Descriptive Statistics of the Sample

Variable	Description	N	Mean	Sd
ClassGrade	Class rank (ranked from low to high, assigned 1-6)	1973	3.047	1.686

SchoolGrade	School rank (ranked from low to high, assigned 1-6)	1942	3.532	1.764
Phone	Whether the student uses a phone (binary variable 0 = no, 1 = yes)	1973	0.586	0.493
Computer	Whether the student uses a computer (binary variable 0 = no, 1 = yes)	1973	0.243	0.429
Age	Age (16 years and under)	1973	13.772	2.761
Gender	Gender (0 = female, 1 = male)	1973	2.878	1.997
Ethnic	Whether the student is from a minority group (binary variable 0 = no, 1 = yes)	1973	0.075	0.201
Num	Number of family members	1973	5.187	1.813
School_Board	Whether the student attends a boarding school (binary variable 0 = no, 1 = yes)	1973	0.794	0.434
KSchool	Whether the student attends a key school (binary variable 0 = no, 1 = yes)	1973	0.293	0.456
KClass	Whether the student is in a key class (binary variable 0 = no, 1 = yes)	1973	0.822	0.479
InterStudy	Frequency of internet use for learning (ranked from low to high, assigned 1-6)	1973	3.500	1.872
Cram	Whether the student actively participates in extracurricular tutoring (binary variable 0 = no, 1 = yes)	1973	0.135	0.342

4. Empirical Analysis

4.1 Baseline Regression

Table 2 presents the baseline regression results for the impact of internet usage on rural students' academic performance. The independent variable is whether the student uses a smartphone, and the dependent variable is the student’s rank within their class. All models control for county-level fixed effects and progressively include control variables for individual, family, and school characteristics. In column (1), only the core independent *Phone* variable is included, and the regression coefficient is significantly negative at the 1% level. Since the independent variable is a binary variable (1 = yes, 0 = no), we do not discuss the coefficient values in detail. In columns (2) and (3), individual, family, and school control variables are progressively included, and the coefficient remains significantly negative. This indicates that smartphone use has a negative impact on rural students' academic performance, confirming our earlier hypothesis.

To ensure the robustness of the baseline regression results, we also use the student’s rank within their school as an alternative dependent variable, re-running the regression. The results are reported in columns (5), (6), and (7), and the conclusions remain unchanged.

To further verify the specificity of the internet impact on academic performance of rural students, we also conduct the baseline regression for a sample of 1,469 urban students. The regression results in column (4) show that, after controlling for other factors, the regression coefficient is negative but not statistically significant. This indicates that the negative impact of the internet on academic performance is more significant in rural areas, supporting our first hypothesis.

Table 2: Baseline Regression Results

Variables	（1）	（2）	（3）	(4)	（5）	（6）	（7）
	ClassGrade				SchoolGrade		
Phone	-0.396***	-0.309***	-0.232**	-0.0728	-0.352***	-0.262***	-0.226**
	(0.082)	(0.085)	(0.092)	(0.119)	(0.088)	(0.091)	(0.098)
Constant	2.856***	2.403***	4.101***	3.706***	3.317***	2.871***	3.679***
	(0.420)	(0.451)	(0.667)	(0.905)	(0.339)	(0.393)	(0.679)
P_Controls	No	No	Yes	Yes	No	No	Yes
FS_Controls	No	Yes	Yes	Yes	No	Yes	Yes
R_Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	1979	1973	1,973	1,469	1,947	1,942	1,942
R2	0.121	0.130	0.141	0.210	0.119	0.130	0.136

Note: *p<0.10, **p<0.05, ***p<0.01. Robust standard errors in parentheses.

4.2 Robustness Check

We conduct a robustness check on the baseline regression results, as shown in Table 3. First, both smartphone use and computer use are important ways for rural students to access the internet. While smartphones are often used for communication, computers are generally used for more direct internet access. To further test the robustness of the results, we replace the *Phone* with the *Computer* and re-run the regression. The results are reported in columns (1) and (2) of Table 3. The estimates show that, when using the *ClassGrade* as the dependent variable, the coefficient is significantly negative at the 10% level when class rank is used as the dependent variable. However, when *SchoolGrade* is the dependent variable, the coefficient is negative but not statistically significant. The regression results suggest that using computers also has a negative impact on rural students' academic performance, but the effect is less pronounced compared to smartphone usage. This may be due to the greater portability of smartphones, which leads to more frequent internet use, whereas computer usage is more constrained by time and space.

Second, since the dependent variable is a discrete, ordered variable, it does not fully meet the assumptions of linear regression. Using a standard linear regression model may cause estimation errors. Therefore, we perform a robustness check using an ordered logit model, which is better suited for capturing the order and differences in student rankings without requiring assumptions about the data. The results from this check are reported in column (3) of Table 3, and the conclusions remain robust.

Table 3: Robustness Check

Variables	(1) ClassGrade	(2) SchoolGrade	(3) ClassGrade
Computer	-0.143*	-0.085	
	(0.086)	(0.102)	
Phone			-0.240**
			(0.106)
Constant	4.128***	3.710***	
	(0.657)	(0.683)	
Controls	Yes	Yes	Yes
N	1,973	1,942	1973
R2	0.139	0.133	0.044

Note: *p<0.10, **p<0.05, ***p<0.01. Robust standard errors in parentheses.

4.3 Heterogeneity Analysis

First, considering the economic and social development differences between the central and western regions and the eastern regions, we divide the sample into two groups based on geographical location: central and western provinces and eastern provinces. The regression results are reported in columns (1) and (2) of Table 4. The results show that the estimated coefficient for the central and western regions is significantly negative, while the regression result for the eastern regions is not statistically significant. This suggests that internet usage has a more pronounced negative impact on rural students in the central and western regions, but not in the eastern regions. This is likely due to the combined effects of regional differences in internet development and educational levels, which is consistent with the differing impacts of internet use on student academic performance in urban and rural areas. This is another reflection of the "digital divide" at the regional level. According to the 51st Statistical Report on the Development of the Internet in China, published by the China Internet Network Information Center (CNNIC) in March 2023, the construction of internet infrastructure in China is still characterized by a hierarchical development pattern. The concentration of IPv4 addresses and ".CN" domain names is higher in eastern regions, accounting for 63.36% and 46.20%, respectively. Due to the Matthew effect, the regional internet development differences in China largely coincide with the differences in educational levels, meaning that rural students in central and western regions are more likely to experience negative impacts from internet usage due to their relatively lower levels of internet exposure and information disadvantages.

Second, internet usage among different age groups varies. Therefore, we divide the rural student sample into two groups: primary school students (aged 12 and below) and secondary school students (aged above 12). The regression results are reported in columns (3) and (4) of Table 4. The results show that the estimated coefficient for primary school students is significantly negative, while the coefficient for secondary school students is negative but not statistically significant. This indicates that the negative impact of the internet on academic performance is more severe for primary school students, while the impact is relatively weaker for secondary school students. This is consistent with our expectations. Specifically, several factors may explain why primary school students are more susceptible to the negative impacts of internet usage:

Distraction: Primary school students may become easily distracted when using the internet, leading to a decrease in learning efficiency. They are more likely to be tempted by online games, short videos, and social media, which may divert their attention away from completing educational tasks.

Vulnerability to Harmful Information: Primary school students lack the ability to discern the content on the internet and are more likely to be influenced by harmful information, including violent, pornographic, or frightening content. This can have a negative impact on their psychological well-being and academic performance.

Lack of Self-Control: Primary school students have not fully developed self-control abilities and may find it difficult to regulate their internet usage. In contrast, secondary school students tend to be more rational and mature in their internet usage, having developed better self-control skills. They are more capable of distinguishing between useful and non-useful internet content, and are better able to balance their use of the internet for educational purposes.

These differences in internet usage between primary and secondary school students are also evident in both rural and urban contexts. However, rural primary school students, who have less exposure to the internet in their daily lives, are more likely to form poor internet habits due to a lack of guidance. This explains why the negative impact of internet usage is more pronounced among rural primary school students, supporting our second hypothesis.

Table 4: Heterogeneity Analysis

Variables	(1) Central & Western	(2) Eastern	(3) Primary School	(4) Secondary School
Phone	-0.200*	-0.279	-0.391**	-0.0797
	(0.109)	(0.194)	(0.170)	(0.113)
Constant	4.285***	2.528**	4.845***	2.922***
	(0.721)	(1.043)	(1.316)	(0.784)
Controls	Yes	Yes	Yes	Yes
N	1,427	417	742	1,231
R^2	0.110	0.230	0.237	0.158

Note: *p<0.10, **p<0.05, ***p<0.01. Robust standard errors in parentheses.

4.4 Mediation Effect Analysis

The existing literature has extensively discussed the mechanisms through which the internet influences academic performance of students. Common mechanisms include:

Lifestyle and Health: Students with weaker self-control may not regulate their internet usage properly, which can impact their sleep quality and lead to unhealthy lifestyles. This, in turn, affects their attention, mental state, and learning efficiency (Ning Ke, 2018).

Attention and Focus: The internet can distract students, making it difficult for them to focus and study effectively. For example, students who use their phones or watch videos during class may miss important content, and internet addiction can also make it more difficult for students to concentrate on their studies (Yang Yonghong, 2017; Wang Junxia et al., 2021).

Learning Motivation and Methods: Excessive use of smartphones can also affect students' motivation and learning methods. If students spend too much time on mobile games or social media, their motivation to learn may decline, and they may lose interest in their studies. Additionally, the internet may make students more dependent on search engines and answer databases, diminishing their ability to understand knowledge in-depth and think critically (Zhi Tingjin et al., 2019).

Given that these mechanisms are complex, this paper focuses on analyzing the mediation effects from two aspects: learning time and learning efficiency.

First, we use "frequency of using the internet for learning (*InterStudy*)" as a mediator and investigate how smartphone use affects learning time. The two-stage regression results are reported in columns (1) and (2) of Table 5. The first-stage regression shows that smartphone use significantly reduces the frequency of internet-based learning at the 10% level. In the second-stage regression, the estimated coefficient is significantly positive, showing a positive correlation with academic performance. This indicates that smartphone use reduces the frequency of internet learning, which in turn leads to decreased academic performance. Although it may seem intuitive that using a smartphone would increase the frequency of learning through the internet, a more plausible explanation is that rural students spend more time on social media and entertainment after using their smartphones, which not only takes away from their learning time but also reduces their use of the internet for educational purposes. This is consistent with the literature and our hypotheses.

Similarly, we use "participation in after-school tutoring (*Cram*)" as a mediator to reflect the students' reliance on external tutoring, indirectly showing the impact of smartphone use on learning efficiency. The two-stage regression results are reported in columns (3) and (4) of Table 5. The first-stage regression shows that smartphone use increases the reliance on after-school tutoring. In the second-stage regression, the estimated coefficient is significantly negative, indicating that the increased reliance on tutoring negatively correlates with academic performance. This suggests that the greater dependence on tutoring due to smartphone use leads to decreased academic performance, as motivation and ability to learn independently are weakened. The interrelationship between reliance on tutoring and smartphone use further reduces learning efficiency of rural students.

Table 5: Mediation Effect Analysis

Variables	(1) InterStudy	(2) ClassGrade	(3) Cram	(4) ClassGrade
Phone	-0.249* (0.149)	-0.324* (0.194)	0.032* (0.017)	-0.226** (0.097)
InterStudy		0.081*** (0.027)		
Cram				-0.203* (0.112)
Controls	Yes	Yes	Yes	Yes
N	1,323	1,224	1,991	1,973
R^2	0.208	0.187	0.183	0.143

Note: *p<0.10, **p<0.05, ***p<0.01. Robust standard errors in parentheses.

5. Conclusion and Recommendations

The development of internet technology has provided educational opportunities for rural areas, enhancing educational equity. As Premier Li once stated: "The greatest fairness in education is fairness of opportunity." The internet has brought information resources to rural education, providing rural students with access to educational opportunities and partially alleviating the urban-rural educational gap. It promotes educational equity of opportunities. However, focusing solely on opportunity fairness in education and ignoring the digital divide brought about by internet technology upgrades will not foster substantial educational fairness between urban and rural areas.

This paper empirically analyzes the impact of internet use on rural students' academic performance and confirms that the use of smartphones, computers, and other internet tools significantly negatively affects the academic performance of rural students. This negative impact, however, is not as pronounced for urban students. Furthermore, the heterogeneity analysis reveals that the negative effect of the digital divide is more pronounced in rural areas of central and western China, where the development of internet infrastructure is relatively underdeveloped. Additionally, the paper finds that the negative impact of the internet on the education of school-age children in rural areas is more significant compared to secondary school students. Furthermore, this paper also investigates the mediation mechanisms of the internet impact, identifying that smartphone use reduces the frequency of internet-based learning and increases reliance on after-school tutoring, which ultimately results in a decline in academic performance.

Based on these findings, the following recommendations are made to mitigate the negative impact of the internet on rural education:

Leverage the Rational Use of Internet Technology: Continue to improve the quality of internet education and address the gap in computer and internet penetration between urban and rural students. Expanding rural students' access to educational information on the internet and promoting educational equity is essential. It is crucial to emphasize the guiding role of internet information education for rural students and avoid superficial internet education projects, ensuring a truly open internet education environment.

Promote Family-School Cooperation: Guide rural students to develop scientific and healthy internet usage habits, and help them correctly use internet information resources for self-education. This can achieve a more equitable investment in personal human capital. Early education on internet usage should be provided to rural students, especially when they have not yet formed proper values or self-control abilities. It is necessary to regulate the time, content, and manner of internet use. Additionally, attention should be paid to the trend of younger age groups using the internet, and protective measures should be taken for school-age children's internet exposure.

Address the Digital Divide in Internet Use: While the internet offers opportunities for educational equity, attention should also be paid to the digital divide in terms of internet usage between urban and rural students. Government and educational institutions must provide targeted policy support for children from "information disadvantaged" families, especially in central and western rural areas and for left-behind children. Addressing the challenges posed by the barriers to information access can help reduce social stratification.

It is worth noting that in the post-pandemic era, both rural and urban students have increased their internet exposure due to online courses and other digital learning tools. The deep integration of online and offline education has become a prevailing trend in the education industry. Future research should explore whether the widespread use of the internet will change the relationship between the digital divide and the urban-rural education gap. This study, based on 2018 CFPS data, has some limitations, and further research using more recent data can provide comparative analysis between rural and urban education in the post-pandemic era. Additionally, using data from other sources, such as the China Education Panel Survey (CEPS), could extend this analysis. The topic of internet development and educational equity requires further exploration.

References

Chen, C. J., & Gu, X. Q. (2017). Does the Internet Exacerbate Educational Inequality? — An Empirical Study Based on PISA Shanghai Data. Beijing University Education Review, 15(01), 140-153+191-192.

Chen, L. (2018). Educational Informatization 2.0: Trends and Directions for Educational Reform Led by the Internet. China Distance Education, No. 524(09), 6-8.

Gong, B. T. (2020). The Three-Level Digital Divide [Master's Thesis]. Nanjing Normal University.

Fang, C., & Huang, B. (2018). Has Information Technology Improved Students' Academic Performance? — An Empirical Study Based on the China Education Tracking Survey Data. Open Education Research, 24(06), 88-99.

Feng, Y. R., & Zhang, W. (2018). Analysis and Countermeasures of the Usage Status of Learning Apps. Media, No. 287(18), 75-78.

Han, S. M. (2021). Policy Evolution, Problem Analysis, and Development Suggestions for Promoting Educational Equity through Educational Informatization in China. China Distance Education, No. 563(12), 10-20+76.

He, K. K. (2019). The Major Impact of Emerging Information Technology on the Deepening Reform of Education Since the 21st Century. Journal of Educational Technology Research, 40(03), 5-12.

Huang, R. H., Liu, D. J., Liu, X. L., et al. (2017). The Basic Pattern of Internet-Promoted Educational Reform. China Educational Technology, No. 360(01), 7-16.
Liao, H. J., & Zhang, Q. W. (2018). The Transfer Logic and Value Choice of ‘Internet +’ Educational Precision Assistance — From the Perspective of Educational Equity. Journal of Educational Technology Research, 39(05), 5-11.
Ning, K. (2018). The Internet, Changes in Lifestyle, and the Physical Health of Rural Adolescents in China [Master's Thesis]. Nanjing Agricultural University.
Sun, D. T. (2015). The Development of Rural Education in the ‘Internet +’ Era. Journal of Anhui Agricultural University (Social Sciences Edition), 24(06), 15-18.
Wan, L. Y., & Xie, P. K. (2022). The Real Path for Promoting Educational Equity through Educational Informatization — A Case Study of Primary Education in Ethnic Minority Regions. Journal of Central South University for Nationalities (Humanities and Social Sciences Edition), 42(02), 166-173+188.
Wen, Z. L., & Ye, B. J. (2014). Mediation Effect Analysis: Methods and Model Development. Psychological Science Progress, 22(05), 731-745.
Wang, J. X., & Wang, Y. Q. (2021). Empirical Research on the Factors Influencing College Students’ Classroom Attention. Software Guide, 20(11), 221-228.
Xu, Y. S. (2021). The Impact of Online Computer-Assisted Learning on Students’ Academic Performance [Master's Thesis]. Shaanxi Normal University.
Xie, J. L., & Li, Q. (2015). Leading the New Trend of Educational Reform with ‘Internet +’. Journal of Chuxiong Normal University, 30(02), 85-88+108.
Yang, Y. H. (2017). Factors Affecting College Students' Attention Management in the ‘Internet +’ Environment. Journal of Guangxi Educational Institute, No. 152(06), 136-140.
Yu, M. Y., & Ye, B. (2017). Can ‘Internet +’ Promote Educational Equity? — Also Discussing the Challenges and Responses to Educational Equity in the ‘Internet +’ Era. Research in Educational Sciences, No. 265(04), 15-18+23.
Yang, P., & Xu, Y. (2017). The Digital Divide and Inequality in Family Education Investment. Beijing University Education Review, 15(04), 126-154+188.
Zhang, Y. (2016). Exploring the Concept and Model of ‘Internet + Education’. China Higher Education Research, No. 270(02), 70-73.
Zhang, J. Z., & Huang, S. G. (2018). The Hidden Reproduction: The Impact Mechanism of Educational Equity — An Empirical Study on Internet Usage Preferences of Students from Different Social Classes in Urban and Rural Areas. China Educational Technology, No. 382(11), 18-23+132.
Zhou, Y., & Hua, Y. Y. (2017). The Internet and Rural Family Entrepreneurship — An Empirical Study Based on CFPS Data. Agricultural Technology Economics, No. 265(05), 111-119.
Zhi, T. J., & Chen, C. J. (2019). The Impact of Internet Usage Time on Secondary School Students’ Subject Literacy — A Study from the Perspective of Internet Usage Motivation. Journal of East China Normal University (Education Science Edition), 37(06), 61-74.
DiMaggio, P., & Hargittai, E. (2001). From the ‘Digital Divide’ to ‘Digital Inequality’: Studying Internet Use as Penetration Increases. Princeton: Center for Arts and Cultural Policy Studies, Woodrow Wilson School, Princeton University, 4(1), 4-2.
Golder, S. A., & Macy, M. W. (2014). Digital Footprints: Opportunities and Challenges for Online Social Research. Annual Review of Sociology, 40, 129-152.
Peña-López, I. (2015). Students, Computers, and Learning: Making the Connection. UNESCO.
Xie, Y. (2012). The User's Guide of the China Family Panel Studies (2010). Beijing: Institute of Social Science Survey, Peking University, 3-29.