Scientific Research Publishing

Open Journal of Social Sciences, 2022, 10, 34-50
https://www.scirp.org/journal/jss
ISSN Online: 2327-5960
ISSN Print: 2327-5952

Revisiting the Digital Divide in Online Teaching

—An Analysis of Urban-Rural Differences in Online Learning among Middle School Students

Haiyan Wang[1], Yunhua Song[2], Xiaoyue Zhu[1], Mei Cao[1*]

[1]School of Education Science, Nanjing Normal University, Nanjing, China
[2]Wuxi Yuqi Senior Middle School, Wuxi, China
Email: why09070205zc@163.com, *berry1999@163.com

How to cite this paper: Wang, H. Y., Song, Y. H., Zhu, X. Y., & Cao, M. (2022). Revisiting the Digital Divide in Online Teaching. *Open Journal of Social Sciences, 10,* 34-50.
https://doi.org/10.4236/jss.2022.1011004

Received: September 11, 2022
Accepted: October 9, 2022
Published: October 12, 2022

Abstract

In recent years, many studies have pointed out that the new digital divide has become an important factor affecting educational equity. This study takes the perspective of online teaching and learning to test again whether the old digital divide is really bridged and whether the new digital divide exists. Using data from a large-scale online research in a province as a carrier, 359,519 valid data were analyzed using analysis of variance and multiple regression analysis. The study found that, overall, teachers and families provide good support in online learning, and students learn better. The device divide has been basically closed. There were urban-rural differences in both teacher IT competency and family involvement. Notably, rural students have a higher rate of cell phone ownership than urban students. Rural students have significantly higher sustained willingness to learn online than urban students. However, the independent learning ability, learning psychology, and online communication learning in rural online are not as good as expected. The learning process of students in rural areas was obscured by the perceived usefulness of online learning. Therefore, the study recommends shifting from a focus on equipment in rural areas to a focus on the technological literacy of teachers and students; focusing on the learning process of rural students; and promoting parental involvement in their children's education as "media mentors".

Keywords

Digital Divide, Urban-Rural Divide, Skills Divide, Learning Process

1. Introduction

1.1. From the "Digital Divide" to the "New Digital Divide"

The definition of the digital divide can be traced back to the 1999 survey report

"Left Behind in the Web: Defining the Digital Divide" published by the National Telecommunication and Information Administration. It defines the digital divide as "the divide that exists between those who do not own the tools of the information age and those who do" (NTIA, 1999). Specifically (NTIA, 2000), the digital divide is the difference in IT ownership among different groups based on age, gender, geographic location, urban/rural, ethnicity, income, education, etc. This is the first impression that most people have when they mention the "digital divide". This inequality, which is expressed in terms of the "absence" of physical access, is often categorized by researchers as the first tier of the divide. It is also referred to as the "device divide", the "access divide" (Feng & Ren, 2018), or the "physical divide" (Wang et al., 2014). Thus, this physical digital divide is often associated with social justice, inequality, and the increasing polarization between rich and poor in the information age. It gives it a distinct sociological and economic dimension. Its findings often guide or promote the focus and giving of attention to a segment of the population in social policies and political advocacy (Jin, 2003).

The "digital divide" also exists in the field of education (Feng & Ren, 2018). The Decision of the State Council on Further Strengthening Rural Education (Cai et al., 2019) proposes the use of information technology to promote educational equity. It is mainly implemented in terms of both infrastructure and educational resources. The development of education informatization has to a certain extent alleviated the phenomenon of educational inequity. The process of education informatization has been accelerated (Lei, 2019). The proportion of multimedia classrooms in primary and secondary schools nationwide has increased from less than 40% to 91%. The Internet access rate has increased from 25% to 96%. We can see that the gap in digital devices is gradually bridging.

Many researchers (Yang & Xu, 2017; Chen & Gu, 2017) point out that the Internet on the one hand reduces the device access gap. On the other hand, Internet use and post-use impact differences may be further exacerbated. In the context of increasing Internet access and device access, are these external changes able to cause changes in student learning and development? It is worth going further and deeper to explore.

The "new digital divide" (Zhu et al., 2017) has entered the research horizon (Guo & Wan, 2022). The new digital divide does not yet have a clear and accepted definition. However, what is widely recognized by the academic community is the "skill divide" due to differences in computer and Internet access skills, (Wang et al., 2014) and the "usage divide" due to differences in the length, bandwidth, and usage of the Internet (Li et al., 2015). Zhu et al. (2017) argue that the digital divide is no longer limited to the technology level alone. Rather, it extends to the ability of individuals to use information technology to obtain valuable information. That is, the difference in the use of information technology and the difference in the result of the use. Selwyn (2004) argues that the digital divide is not a "simple dichotomy of the availability of computer equipment" but should be divided into four stages. It should be divided into four stages, which are 1) the

presence or absence of computers and network connectivity; 2) differences in the use of IT; 3) meaningful, fast and efficient use of IT; 4) differences in the impact of using IT.

The Organization for Economic Cooperation and Development (OECD, 2015) published a report showing that poor students did not change the education gap created by individuals even when they had access to the Internet in both developed and developing countries. The results of a study by Shan et al. (2021) showed that basic education equity in China generally presents well-equipped and balanced basic education facilities. However, students' learning experience is poor. Students' skills such as the use of technology need to be trained. Online learning participation also has more room for improvement. Zhang (2020) pointed out that the new digital divide has become a new worry that hinders the development of education in poor areas. Andreas Schleicher, who is the initiator of the Programme for International Student Assessment (PISA) and Minister of Education and Skills at the Organization for Economic Cooperation and Development, points out that education today is like a compass for young people. They are guided by it on their quest for knowledge. Urban children use technology for discovery and self-directed learning to explore patterns and understand knowledge on their own. Thus, a new digital divide in the use of technology has emerged.

Therefore, researchers suggest (Dijk, 2012) that the digital divide will persist for some time to come in terms of "how technology is used". Further, this means focusing on the impact of differences in the use of technology on student learning. Xue et al. (2021) found that 86.3% of scholars believed that online education promoted educational equity by combing the literature on the Internet. Others showed the opposite view. The epidemic period gives us an opportunity to examine the current state of the digital divide.

As the Internet and other information technologies continue to penetrate into our working life, the original problem about the availability of devices has been initially solved.

The fact that the "new digital divide" is gradually widening has gradually emerged.

1.2. Research Indicators for the New Digital Divide

Indicators of the first generation digital divide are more defined. Researchers use such indicators to conduct studies that are easily comparable in process and understandable in results. The research recommendations based on the findings are easily adopted. For example, the One Laptop Per Child project provides laptops to children in developing countries based on research findings. However, this digital penetration on physical devices is overemphasized. So much so that the "gaps" in attitudes, behaviors, and abilities of different groups in using technology are masked Guo (2021).

The "new" digital divide is gaining popularity to better reveal differences. The new digital divide has been studied more extensively. There is not yet a clear de-

finition of the new digital divide. Different scholars have studied the differences under the new digital divide from different perspectives. Guo (2021) divided children into different groups according to students' household registration, gender, and parents' education. He compared the mental engagement, usage behavior, and network access of different groups. Shan et al. (2021) summarized the basic elements of informatization and networking for equity in basic education. It includes hardware facilities, teaching resources, management mechanisms at the school level, information technology teaching ability at the teacher level, and information literacy at the student level. Wang et al. (2014) understood the new digital divide as skills divide and a usage divide. The skills divide refers to both media and content. It includes the manipulation of digital technology, information screening and use, communication skills, and content creation skills. The usage divide refers to the bandwidth, type, time, frequency and whether creative use of the Internet. Zhao et al. (2021) analyzed primary and secondary school students' readiness, experience, and basic online learning from the perspective of urban-rural differences. He analyzed the respective characteristics, differences, and reasons for the differences between urban and rural students. A nationwide survey in the UK (Vila, 2010) analyzed the use of the Internet by young people. The survey included five items: using the Internet to communicate, information search, entertainment activities, participation, and using the Internet to create. Peng (2015) analyzed the factors that affect the substantial equity of education in urban and rural areas: motivational access, access to use, and access to skills. Xue et al. (2021) pointed out that family involvement, readiness to learn, and equipment conditions are all important elements that affect educational equity.

In general, the digital divide has a wide range of "divides". It covers all aspects of the family, teachers, and students themselves.

1.3. Characterization of Different Groups under the New Digital Divide

Some scholars (Wang & Sui, 2014) have found that there is a time divide among the adolescent population. Teenagers are spending a steady amount of time online. And "about 2.17 days a week are spent on the Internet," according to the China Youth Internet Behavior Survey Report (Yao, 2017) from 2008 to 2015. The results of a survey in the United States showed that adolescents from low-education parents spent an hour and a half more time on the Internet each day than children from families with higher social status. This compares to a gap of only about 16 minutes in 1999 (Wang & Sui, 2014). But is the time spent on the Internet really learning? Yet it is the entertainment function and communication function that are the main motivations for this group to go online. The New York Times identifies one of the digital divides of the new era as a waste of time.

In terms of usage behavior, there is a large difference in the Internet operation behavior of adolescent Internet users in urban and rural areas. Studies by Lyu (2011) and Weining Yao (Yao, 2017) in 2011 and 2015 showed that urban ado-

lescents had significantly higher usage rates for online entertainment, information gathering, business transactions, and communication feedback than rural ones. Rural adolescent Internet users' Internet use is far from functional and biased towards entertainment. This has resulted in a higher rate of Internet addiction among rural adolescents despite the fact that their Internet usage rate is much lower than that of urban adolescents. The main reason is due to economic conditions. The place of Internet access is restricted to Internet cafes, thus lacking parental teaching and supervision.

In addition, broadband disparity becomes one of the new dividing lines of the new digital divide. In addition to the above one-dimensional temporal divide, usage divide, and broadband divide based on urban and rural areas, some scholars have also delineated more multidimensional groups. For example, four types of Internet use among adolescents were identified in a study (Vila, 2010): marginalizers, normers, all-comers, and active participants. Marginalizers are less familiar with Internet use. Their families are likely to have no access to the Internet. The normative group would use the Internet for basic operations, such as searching for information, connecting with peers, and relaxing for entertainment. The all-comers use the Internet in a comprehensive manner. In addition to basic operations, they also engage in creative activities via the Internet, such as modifying Wikipedia. Active participants are most frequently involved in online activities, not only participating in a full range of online activities, but also frequently posting podcasts via the Internet. They upload their ideas. They want to solve problems through their own skills.

This study analyzes middle school students' online learning from the perspective of urban-rural differences. The study explores the differences in online learning between urban and rural students in terms of online learning conditions, performance, teachers' information technology teaching ability, and family participation. It also explores the possible factors that affect the willingness to learn online. The analysis of the causes provides a basis for the construction of the regularization of online teaching.

2. Research Design

2.1. Data Sources

Data for this study were obtained from junior high school students in a province during the epidemic. Questionnaires were distributed through a provincial education platform. Invalid questionnaires that took less than 5 minutes to fill out, took too long to answer (more than one day), had highly consistent consecutive options, and had a high number of missing values were excluded. A total of 359,519 valid questionnaires were collected. The percentage of male students was 49.91% and the percentage of female students was 50.09%. The number of urban students accounted for 55.4% (199,238). The number of rural students accounted for 44.6% (160,281).

2.2. Research Methodologies and Tools

The questionnaire method was used in this study. The survey consisted of three main components. 1) Students' feedback on online learning process and results. The dimension includes five sub-dimensions: independent learning, online communication, learning psychology, willingness to continue online learning and relative effect assessment. The scale of self-directed learning referred to some questions of the MSQL scale (Pintrich et al., 1993). The scale for learning psychology was referenced from the Chinese Secondary School Students' Mental Health Inventory (Sun et al., 2021). Its scale reliabilities were 0.895, 0.848, 0.776, 0.869, and 0.855, respectively. 2) Teachers' information-based teaching ability. This dimension includes planning and preparation, checking and implementation, and assessment and diagnosis. The reliability was 0.780, 0.839, and 0.851, respectively. 3) Family education. The question items included the availability of a quiet online learning environment, parental companionship and supervision of children, and checking and counseling. The scale for teachers' information technology teaching ability was developed based on the criteria related to the "Standards for Information Technology Application Ability of Primary and Secondary School Teachers (for Trial Implementation)" researched and developed. Its scale reliability was 0.77. The whole scale Kronbach Alpha coefficient was 0.934. The KMO value was 0.946 using Statistical Product Service Solutions (SPSS). Bartlett's test p-value was less than 0.001. This indicates that the validity of the questionnaire is good. In addition, online learning tools used in online teaching, internet conditions, and whether the internet is smooth were also investigated.

This study mainly used difference analysis and descriptive statistics to present urban-rural differences in students' online learning situation and experience, teachers' IT application ability, and family involvement. Multiple linear regression analysis was used to explore the factors that influence students' willingness to learn online.

3. Data Analysis

3.1. Overall Level Status

This study presents educational equity in terms of *teachers' information technology teaching ability*, students' *online learning process and result feedback*, and *parental participation*, as shown in **Table 1**.

The mean value of *teachers' information technology teaching ability* was as high as 4.27. The mean values of the secondary dimensions also exceeded 4.0. This indicates that teachers' informatization level in online teaching is high. Teachers are well prepared for online teaching. For example, teachers organize online group discussions for students. They support students to conduct inquiry learning around a certain topic. They organize online reports and presentations for students. Each point of the online teaching is thoroughly explained. In the *organization and implementation* of online teaching, teachers focus on classroom

Table 1. Means and standard deviations of the elements of educational equity in online teaching.

Dimensionality	Mean value	Standard deviation
Teacher Information Technology Teaching Skills	4.27	0.84
Planning and Preparation	4.10	1.08
Organization and Implementation	4.32	0.86
Assessment and Diagnosis	4.38	0.79
process and results feedback	3.75	0.69
Online Learning Process	3.87	0.73
Self-directed Learning	4.26	0.73
Online Communication	3.69	1.09
Learning Psychology	3.29	1.21
Online learning results feedback	3.60	0.89
Continuous willingness to learn online	3.69	1.01
Perceived usefulness of online learning	3.51	0.96
Parental involvement	3.96	0.87
Quiet learning environment	4.35	0.83
Parental support and supervision	3.77	1.06

organization, student management, and motivation. For *assessment and diagnosis*, teachers will use technology to correct assignments and conduct assessments.

The overall mean value of students' *online learning process and outcome feedback* is 3.75, indicating that students are performing well. In particular, the mean value of *self-directed learning* is 4.26, indicating that junior high school students have a certain degree of self-management ability. They are able to observe the discipline of online learning. The study time and study tasks are reasonably arranged. The mean value of the online communication dimension is 3.69, indicating that peer and teacher-student communication is more frequent. The mean value of online learning psychology (3.29) is slightly lower. The psychological condition of students in online learning needs to be paid attention to. *Students' perceived usefulness* and *willingness to continue learning online* are also high in terms of *results feedback*.

Parents play an important role during online teaching. Parents provide a quiet learning environment for their children. And most parents spare no effort in accompanying and supervising, checking and tutoring. They play an irreplaceable role in the effectiveness of online teaching.

Overall, online teaching performed better overall, especially for teachers. This is followed by the cooperation of parents. Students also performed well in dealing with the sudden change in learning environment and change in teaching style.

3.2. Urban-Rural Differences in the Status of Online Teaching during the Epidemic

3.2.1. Urban-Rural Differences in Online Learning Conditions

The research results show that there are differences in equipment, network conditions and network fluency in the online learning process for urban and rural students. However, the differences are small.

In terms of terminal device use (Table 2), urban students mainly used computers (67.60%) for online learning. Rural students mainly used their parents' smartphones (62.60%). The use of their own smartphones for learning was higher among rural students than urban students. The use of TVs and printers was lower than that of urban students. The proportion of borrowed devices was higher than urban students. Overall, the percentage of urban students using teaching devices (including laptops, desktop computers, and tablets), communication devices (cable TV), and communication devices (cell phones) for online learning was 99.00%. The percentage of use among rural students was 98.40%. In terms of network conditions (Table 3), the proportion of rural students using home broadband network and cell phone traffic is smaller than that of urban students. The proportion of "dabbling" in the Internet is significantly urban students. In terms of network fluency (Table 4), the network is relatively smooth in all regions. The proportion of very stuck network is less than 1%. There was no statistically significant difference between urban and rural areas in terms of network fluency.

Table 2. Terminal equipment.

Area	Computer (including laptop, tablet)	Parent's smartphone	My smartphone	TV	Use at least one (computer, cell phone, TV)	Printer	Borrowed cell phone or computer
Urban	67.60%	55.10%	31.60%	11.60%	99.00%	31.40%	2.00%
Rural	43.30%	62.60%	35.90%	10.50%	98.40%	12.30%	2.40%

Table 3. Network conditions.

Urban and Rural Type	Home Broadband Network	Cell phone traffic	Scuffle
Urban	60.20%	17.60%	1.50%
Rural	53.00%	15.30%	2.50%

Table 4. Variance analysis of network fluency.

Region	Total number	Very smooth	A little bit stuck	Very stuck	Mean value	Standard deviation	t value
Urban	199,238	101,331 (50.9%)	96,458 (48.4%)	1449 (0.7%)	1.5	0.514	t = −0.69
Rural	160,281	81,411 (50.8%)	77,620 (48.4%)	1250 (0.8%)	1.5	0.515	

3.2.2. Urban-Rural Differences among Teachers, Students and Parents in Online Learning

There were some differences in the *teacher information technology teaching skills* of urban and rural teachers (Table 5). In general, both urban and rural teachers had a higher level of information-based teaching ability (mean value greater than 4.0). The level of information technology teaching ability of urban teachers was better than that of rural teachers. In terms of sub-dimensions, urban teachers' *planning and preparation*, *organization and implementation*, and *assessment and diagnosis* were all better than rural teachers.

In terms of students' online learning process, urban students were significantly better than rural students in terms of independent learning, *online communication*, and *learning psychology*.

3.2.3. Urban-Rural Differences in Online Learning Performance

1) Differences in the line learning process.

The online learning process mainly refers to the *self-directed learning*, communication, and psychological situation of learning in online learning. The results of the study (Table 5) showed that urban students outperformed rural students in terms of process performance. The difference in learning engagement and each sub-dimension was significant ($p < 0.001$). The urban students ensured that they had time to study online and were able to take notes. They promptly

Table 5. Urban-rural differences in teachers' IT teaching ability.

	Dimension	Urban		Rural		T value
		Mean value	Standard deviation	Mean value	Standard deviation	
Faculty Level	Information-based teaching and learning capabilities	4.28	0.83	4.25	0.85	13.07***
	Planning and Preparation	4.11	1.08	4.08	1.09	8.373***
	Organization and Implementation	4.34	0.85	4.30	0.86	15.121***
	Assessment and Diagnosis	4.40	0.78	4.36	0.80	13.841***
Individual level	Online Learning Process and Results Feedback	3.75	0.70	3.76	0.67	−6.417***
	Learning Process	3.90	0.73	3.83	0.73	28.339***
	Self-directed Learning	4.29	0.72	4.22	0.73	26.605***
	Online Communication	3.72	1.09	3.66	1.09	14.34***
	Learning Psychology	3.34	1.20	3.23	1.22	25.155***
	Feedback on learning outcomes	3.54	0.91	3.67	0.85	−44.001***
	Willingness to continue	3.62	1.04	3.77	0.96	−44.889***
	Perceived usefulness	3.46	0.98	3.57	0.92	−34.067***
Family level	Family involvement	4.03	0.84	3.88	0.91	49.772***
	Quiet learning environment	4.42	0.79	4.27	0.88	53.116***
	Parental support and supervision	3.83	1.03	3.69	1.10	40.397***

discussed with teachers and classmates when they encountered problems. Online learning was more psychologically grounded. Learning pressure was relatively low.

2) Differences in online learning outcomes.

The online learning outcomes include the *willingness to continue learning online*, and *perceived usefulness*. The results of the study (Table 5) show that rural students are better than urban students. Students in urban and rural areas differed significantly ($p < 0.001$) in their ability to learn independently and in each sub-dimension. Thus, it seems that although rural students are not as good as urban students in terms of learning process, they have a higher level of agreement with online learning. Rural students agreed that "I would be willing to participate in online learning even if there was no epidemic" and "I agreed that some online teaching activities should be incorporated into the regular school teaching". They also believed that "the effect of online learning was as good as or better than normal learning".

3.2.4. Urban-Rural Differences in Family Participation

The results of the study (Table 5) show that parents of urban students are more involved in their children's online education. There is a significant difference in family involvement between urban and rural students ($p < 0.001$). Urban parents were more likely to "accompany and supervise" and "check and tutor" their children's homework. They also provided a quieter environment for their children to study online.

3.3. Analysis of Factors Influencing Willingness to Learn Online

This study investigated the willingness of urban and rural students to participate in online learning after the epidemic. It was found that while rural students' willingness to learn was significantly lower than urban students, rural students' willingness to learn was significantly higher than urban. The study compared the factors influencing urban and rural students' willingness to learn online. The study conducted correlation analysis (as shown in Table 6) and multiple linear regression analysis (as shown in Table 7). Willingness to learn online was used as the dependent variable, and teacher, family, and student-level factors and demographic variables were used as independent variables.

As can be seen from the table, the urban students' willingness to continue online learning was explained by 40.5% of the variance explained by these independent variables of teachers, individuals, and families. Rural students' willingness to continue online learning was explained by 39.3% of the variance explained by the independent variables of teachers, individuals, and families. Among them, students' perceived usefulness of online learning was the most influential coefficient. The coefficient of influence was 0.569 ($t = 272.733$, $p = 0.000$) and 0.536 ($t = 231.719$, $p = 0.000$) for urban and rural areas, respectively.

Among other factors, the stronger the teachers' IT application skills, the higher the students' willingness to learn online. The higher the individual's ability to

Table 6. Correlation analysis of factors affecting students' willingness to learn online.

	Continuing willingness	Teacher information teaching ability	Parental Accompaniment and supervision	Parental checkups and tutoring	Self-directed learning	Online communication	Perceived usefulness
Continuing willingness	1						
Teacher information teaching ability	0.279**	1					
Parental Accompaniment and supervision	0.220**	0.302**	1				
Parental checkups and tutoring	0.267**	0.345**	0.719**	1			
Self-directed learning	0.367**	0.422**	0.362**	0.398**	1		
Online communication	0.381**	0.550**	0.361**	0.427**	0.670**	1	
Perceived usefulness	0.625**	0.367**	0.285**	0.349**	0.472**	0.484**	1

**Significant correlation at the 0.01 level (two-tailed).

Table 7. Results of the analysis of factors affecting students' willingness to learn online in different regions.

Independent variable	Region			
	Urban		Rural	
	β	t	β	t
Gender	0.02	11.545***	0.032	16.015***
Nature of school	−0.016	−9.418***	0.004	1.949
Section	−0.009	−4.989***	−0.001	−0.567
Information Technology Application Skills for Teachers	0.007	3.219**	0.021	8.745***
Parental Accompaniment and Supervision	0.002	0.617	0.01	3.429**
Parental inspection and tutoring	0.02	7.775***	0.033	10.96***
Self-directed learning ability	0.04	16.513***	0.05	18.252***
Online communication	0.063	24.311***	0.068	23.14***
Perceived usefulness	0.569	272.733***	0.536	231.719***
R^2 correction value	0.405		0.393	
F	15087.294		11542.021	
P	0.000		0.000	

**$p < 0.01$, ***$p < 0.001$.

learn independently, the higher the continuous willingness to learn online. Family-level factors are also important influencing factors. The more parents are involved, the higher the students' willingness to learn online.

Among both urban and rural students, behavioral willingness to learn online is higher among female students than among male students. The behavioral wil-

lingness of rural students is not affected by the nature of schooling and school segment. Among urban students, behavioral intentions are worse in private than in public schools. The higher the school segment, the lower the behavioral willingness.

4. Findings and Discussions

4.1. Research Findings

4.1.1. Overall, Teachers and Families Provide Good Support in Online Learning, and Students Learn Better

Teachers' IT teaching skills in online teaching were overall at a high level. This is consistent with the findings of Sun et al. (Sun et al., 2021). The teachers' own evaluations of planning and preparation, organization and implementation, and assessment and diagnosis were generally positive. This indicates the teachers' confidence in using IT. Parental involvement was also high. A quiet learning environment was provided for the children. And there was some supervision of the child's learning. Students were also more satisfied with the process and results of online learning, but the psychological aspects of online learning were slightly less so. The massive outbreak of the epidemic caused extraordinary distance learning. Students inevitably experience mood swings (Li & Zhu, 2020), isolation anxiety, and discomfort with cross-media learning.

4.1.2. The Urban-Rural Device Divide in Online Learning Is Largely Bridged

The results of the study showed that the vast majority of students in both urban and rural areas had terminal devices. The differences in network conditions were small. There is no statistical difference in network fluency. It indicates that the device divide between urban and rural areas has been gradually reduced. This is consistent with the findings of Peng (2015). To a certain extent, the information construction has solved the problem of "physical access". It can also be said that the physical divide has been gradually bridged. The difference was that the most used terminal device of urban students was computer. Rural students' most used devices are their parents' smartphones. The percentage of rural students with their own smartphones was higher than that of urban students.

In previous investigations, it was found that smartphones are a double-edged sword (Wu et al., 2022). Many countries have stricter regulations on the use of cell phones on campus. Countries such as France and Canada have enacted cell phone bans. Regulations on the use of cell phones by adolescents are also gradually introduced in China. Although it seems that the device divide is gradually bridging, vigilance should not be relaxed. The way students use them is even more critical under the device bridge.

4.1.3. Access Divide Exists between Urban and Rural Students in Online Teaching

The survey of the learning process shows that urban students were more comfortable using online devices to communicate and learn in their studies. And they were able to manage and control their behavior in online learning. The dig-

ital divide is presented in a more implicit way. The ability to use technology becomes a concern that is obscured underneath the devices (van de Werfhorst et al., 2020). The "new digital divide" beyond devices is becoming a factor that affects the educational equity of urban and rural students (Guo, 2021).

Self-directed learning is a key factor affecting the quality of online learning (Huang & Zhang, 2018). In the more liberal online learning environment, a new usage divide emerges. It is expressed in 1) whether learners are able to manage their own learning behavior; 2) whether they consciously comply with the discipline and requirements of the online classroom; 3) whether they organize their learning time and tasks better; 4) whether they use technology to take notes, etc. This was also pointed out by the scholar Hong Zhao.

It is worth noting that although students in rural areas did not perform as well as students in urban areas in the learning process, the opposite was true in terms of their agreement with online learning. Rural students were also more likely to want to incorporate some online learning activities into their regular teaching in the future. In other words, despite the "access gap," rural students do feel that online learning is useful to them. The perceived usefulness influences the willingness to continue learning online. As a result, rural students' willingness to continue learning online is even higher than urban students' willingness to continue learning online.

4.1.4. Differences in Teachers' IT Skills between Urban and Rural Areas in Online Teaching

Teachers in urban areas significantly outperformed rural teachers in their use of technology. This is consistent with previous research findings. The "knowledge gap" hypothesis in the field of communication (Ge & Zhang, 2021) assumes that the better-off group has better access to information than the less well-off group. Therefore, while the equipment gap decreases, the knowledge gap between the two groups may tend to widen rather than narrow in realistic and complex contexts. Many rural teachers' IT application skills are limited to basic computer operation skills. And there is a lack of certain training and application for information acquisition, processing and reprocessing. Therefore, they cannot integrate a large number of network resources into their teaching. This has created a situation of "saturated resources, lack of applications". Rural teachers also lack the ability to manage their teaching by using QQ, nails, Tencent meetings and so on. For example, some teachers cannot check students' online learning status well, such as requiring students to make video appearances, punching cards and taking roll call frequently. These operations play a necessary role of discipline and supervision for students who lack self-discipline. If teachers can apply it well, it can play an important role in creating classroom atmosphere and disciplining students' behavior in regular teaching.

4.1.5. Differences in Family Engagement between Urban and Rural Areas in Online Teaching

The uneven development of family education is more prominent in online edu-

cation. Parents have a great influence on their children and can often affect a person's life. The shift of the educational base in online education makes the family play a more important role (Zhu et al., 2021). The results of the study indicate that parents in urban areas are more involved in the education of their children. The digital divide is exacerbated by disparities in parenting styles, educational attitudes, the importance given to children's education, and educational ability across different levels of economic development and family types. It has been shown that parents with higher family economic status guide their children to convert their online time into study time (Xue et al., 2021).

4.2. Research Recommendations

Based on the above findings, this study proposes the following research recommendations.

4.2.1. Focus on the Technological Literacy of Teachers in Rural Areas

The gap between equipment in urban and rural areas is gradually narrowing. Differences in students' ability to use technology for independent learning are exposed. It is what lies behind the hidden equipment that is most thought-provoking and difficult to overcome. For rural teachers' ability to use information technology, one-to-one support can be used. Let the teachers in urban areas drive the teachers in rural areas. Young teachers drive older teachers. In addition, we can also carry out information technology cutting-edge lectures, which make relevant micro-lessons and record classroom videos. This will gradually help teachers in rural areas to improve their IT application ability.

Prior to the launch of large-scale online education, little attention was paid to the IT literacy of students. When online education is really launched, the difference in technology literacy reflected to learning is revealed. Zhang et al. (2018) mentioned that the middle school level is a critical stage for technology literacy formation. In addition to IT classes, emphasis should be placed on strengthening the organic integration of technology education content with other subjects, such as carrying out STAM education. Carrying out STAM education to enrich students' practical activities, so that they can identify problems in practice and use technology to solve them. Developing the ability to use information technology to collect information, process information and apply information.

4.2.2. Focus on the Learning Process of Rural Students

Students in rural areas believe that the results of online learning meet or exceed those of conventional teaching. Excluding the factor of subjective feelings, we should see the online learning process performance of students in rural areas, such as the independent learning ability, learning psychology, and online communication learning in the middle. Focusing on and respecting the learning process is a respect for the human development process (Wu, 2015). The possible reason for the difference in the learning process is the lack of proficiency in the operation of technology urban and rural students. Traced to a deeper level,

the differences may be due to learning attitudes, learning habits, and independent learning abilities. The learning abilities that learners demonstrate in a classroom setting may not be the abilities they truly possess. It is the act of taking control of independent learning demonstrated in an unsupervised environment that is valid evidence of their self-management (Liu & Wu, 2015). Teachers should cultivate habits such as using the Internet to find resources, trying to connect life to learning, and self-testing the effectiveness of learning in their daily teaching. A conscious effort is made to develop learners' self-directed learning skills (Huang & Zhang, 2018).

4.2.3. Parental Role as a "Media Mentor" for Your Child

The family is the first school for your child. Especially in the online learning environment, parents directly influence the effect of online learning. If parents guide their children to develop good online learning habits in online learning (Hu, 2020), it will make students use their online learning time effectively and improve their information literacy. Schools, communities, and others (Xue et al., 2021) can should collaborate with each other and provide service training to parents for online education support. It is also possible to enhance parents' awareness of online education through live broadcasts on platforms such as Weibo and Jitterbug, etc.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

Cai, M. J., Wei, Y. Y., & Cheng, Y. Z. (2019). Research on Information Technology for Basic Education Equity Policy—An Analytical Perspective Based on Policy Tools. *Electrochemical Education Research, 40,* 48-55.

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

Dijk, V. (2012). The Evolution of the Digital Divide—The Digital Divide Turns to Inequality of Skills and Usage. *Digital Enlightenment Yearbook, 767,* 57-78.

Feng, Y. C., & Ren, Y. Q. (2018). Education Informatization 2.0 Era of Education to Help the Wisdom: Eliminating the Three-Layer Divide and Blocking the Transmission of Poverty-Interpretation of the Education Informatization 2.0 Action Plan No. 3. *Journal of Distance Education, 36,* 20-26.

Ge, X. B., & Zhang, L. (2021). An Analysis of the Causes of the "New Digital Divide" between Urban and Rural Teachers and the Path of Bridging It—From the Theoretical Perspective of the "Knowledge Gap". *Journal of South China Normal University (Social Science Edition), No. 4,* 42-51+205.

Guo, C., & Wan, B. (2022). The Digital Divide in Online Learning in China during the COVID-19 Pandemic. *Technology in Society, 71,* Article ID: 102122. https://doi.org/10.1016/j.techsoc.2022.102122

Guo, J. (2021). The Evolution of Digital Divide: From Network Access to Mental Engage-

ment—An Investigation Based on Online Learning of College Students during the Epidemic. *Journal of East China Normal University (Education Science Edition), 39,* 16-26.

Hu, Y. (2020). The New Digital Divide You Can't Imagine. *News Front, 19,* 60-62.

Huang, Z. Z., & Zhang, X. L. (2018). Exploring the Influence Mechanism of Self-Directed Learning Ability on online Learning Effect—And the Mediating Role of Online Learning Interactive Experience. *Modern Educational Technology, 28,* 66-72.

Jin, J. B. (2003). The Concept of Digital Divide. *Journalism and Communication Research, No. 1,* 75-79+95.

Lei, C. Z. (2019).Promoting Education Modernization Comprehensively with Education Informatization to Open a New Journey of Education in the Age of Intelligence. *People's Education, No. 2,* 40-43.

Li, W. H., & Zhu, Z. T. (2020). Improving Emotional Experience: A Remedy to Alleviate Emotional Problems of Online Learning in Times of Mass Epidemics. *Chinese e-Learning, No. 5,* 22-26+79.

Li, Y., Yan, X. Y., & Wu, T. (2015). Gender, Ethnicity, and Learning Style of Teacher-free Master's Students on the Effectiveness of Online Learning from the Perspective of "Digital Divide": A Review of Online Distance Education Equity and Countermeasures. *Journal of Distance Education, 33,* 98-105.

Liu, Z. X., & Wu, Q. H. (2015). Cultivation of College Students' Independent Learning Ability from the Perspective of Flipped Classroom. *Modern Educational Technology, 25,* 67-72.

Lyu, Y. F. (2011). A Comparative Study on the Internet Information Behavior of Urban and Rural Teenagers in China. *Modern Intelligence, 31,* 79-81.

NTIA [National Telecommunications and Information Administration] (1999). *Falling Through the Net: Defining the Digital Divide*. Government Printing Office USA.

NTIA [National Telecommunications and Information Administration] (2000). *Falling through the Net: Toward Digital Inclusion. A Report on Americans' Access to Technology Tools*. US Department of Commerce.

OECD [Organization for Economic Co-Operation and Development] (2015). *Students, Computers and Learning. Making the Connection*. Organization for Economic Co-Operation and Development. https://doi.org/10.1787/9789264239555-en

Peng, T. (2015). "The New Digital Divide" in Urban-Rural Education: An Investigation of Substantive Equity. *Educational Theory and Practice, 35,* 16-19.

Pintrich, P. R., Smith, Da. A. F., Garcia, T., & Mckeachie, W. J. (1993). Reliability and Predictive Validity of the Motivated Strategies for Learning Questionnaire (MSLQ). *Educational and Psychological Measurement, 53,* 801-813. https://doi.org/10.1177/0013164493053003024

Selwyn, N. (2004). Reconsidering Political and Popular Understandings of the Digital Divide. *New Media & Society, 6,* 341-362. https://doi.org/10.1177/1461444804042519

Shan, J. H. et al. (2021). A Study on the Current Situation of Information Technology for Fair Development of Basic Education in China—An Analysis of a Survey Based on Nearly 420,000 Students' Online Learning Experiences. *Education Development Research, 41,* 1-9.

Sun, Y.Y. et al. (2021). A Study of Primary and Secondary School Teachers' Information-Based Teaching Ability. *Open Education Research, 27,* 84-93.

van de Werfhorst, H., Kessenich, E., & Geven, S. (2020). *The Digital Divide in Online Education. Inequality in Digital Preparedness of Students and Schools before the Start of the COVID-19 Pandemic*. SocArXiv. https://doi.org/10.31235/osf.io/58d6p

Vila, B. (2010). A General Paradigm for Understanding Criminal Behavior: Extending Evolutionary Ecological Theory. *Criminology, 32,* 311-360. https://doi.org/10.1111/j.1745-9125.1994.tb01157.x

Wang M, Xu, G. T., & Ren, Y. Q. (2014). Information Technology for Educational Equity: A Remedy or a Double-Edged Sword. *Global Education Outlook, No. 2,* 39-49.

Wang, M., & Sui, X. X. (2014). The New Digital Divide: New Challenges of Information Technology for Educational Equity. *Modern Distance Education Research, No. 4,* 97-103.

Wu, Y. Y. (2015). Obscuration and Clarification: Regurgitation of the Process Properties of Learning. *Educational Development Research, 35,* 95-99.

Wu, Y., Yang, G. F., & Zhang, C. Y. (2022). The Current Situation, Hazards and Control Measures of Smartphone Use among Foreign Adolescents. *Journal of Comparative Education, No. 1,* 94-107.

Xue, E. Y., Fu, W. Q., & Li, J. (2021). On the Fairness of Online Education Development. *China E-Learning, No. 3,* 1-7+70.

Yang, P., & Xu, Y. (2017). The Digital Divide and Inequality of Investment in Family Education. *Peking University Education Review, 15,* 126-154+188.

Yao, W. N. (2017). Dynamic Changes in the Characteristics and Online Behaviors of Teenagers' Internet Users—An Analysis of the Survey Report of Chinese Teenagers' online Behaviors over the Years. *China Youth Research, No. 2,* 90-97.

Zhang, J. F. (2020). The New Digital Divide: A New Worry Blocking the Development of Education in Poor Areas: Thoughts on the Survey of Satisfaction with Education Informatization in "Three Regions and Three States". *Primary and Secondary School Management, No. 12,* 20-23.

Zhang, Y. Y., Gu, J. J., Xu, W. J., & Lu, Y. F. (2018). Investigation and Research on Students' Technological Literacy in Compulsory Education in Eight Provinces and Urban Areas of China. *Journal of East China Normal University (Education Science Edition), 36,* 29-41+154-155.

Zhao, H. et al. (2021). Online Education: Digital Divide or Digital Opportunity?—Based on the Analysis of Urban-Rural Differences in Online Learning during the Epidemic. *Open Education Research, 27,* 62-68.

Zhu, S., Yang, H., & Feng, L. (2017). The Current Situation, Hot Spots and Frontier Analysis of International Research on "Digital Divide"—And the Implications for Education Informatization and Balanced Development of Education. *Journal of Distance Education, 35,* 82-93.

Zhu, X. Y., Cao, M., & Li, H. (2021). The Impact of Parental Education Involvement in Online Learning and Its Interaction Effect. *Modern Distance Education, No. 6,* 47-55.