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Rural Online Learning During COVID-19: What We Learned and What has Changed

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The fall of the 2020 school year was a unique historical moment that saw the temporary closing of many brick-and-mortar school buildings. School personnel were forced to reexamine instruction delivery due to the rapid pivot in technology use through the implementation of online learning. This article will describe the quantitative results of an online survey completed during the critical timeframe of fall 2020. Rural educational leaders who participated in the survey provided insights on access to teaching and learning technologies that affected students with and without disabilities. The impacts of the digital divide on rural schools are examined, including broadband access and reliability. The article will also provide an update on relevant changes to the digital divide that have taken place since the deployment of the survey.

***Keywords*: rural; disabilities; digital divide; broadband; educational technology; educational equity**

Few times in the history of education have yielded circumstances so unique that the impacts have the potential to resonate for years, if not decades. The fall of the 2020 school year was just such a historical moment. Due to the COVID-19 pandemic, many brick-and-mortar school buildings were closed, forcing schools and families to reexamine traditional instruction. Despite the closure of school buildings, the public schools' obligation to students remained. Students were entitled to a comprehensive education; therefore, schools substantially changed how instruction was delivered using online instructional technologies (Lai & Widmar, 2021). This article describes the quantitative results of an online study completed between August 2020 and October 2020 that investigated rural educational leaders' perceptions of using online instructional technologies before and during the COVID-19 pandemic.

The COVID-19 pandemic changed how schools delivered instruction to all students, with little time to prepare for the unexpected move to online learning. Students in rural areas were at a greater disadvantage due to the digital divide that inequitably impacted access to reliable broadband networks and technology in these remote areas compared to students in urban or suburban communities. Rural educational leaders were in a difficult position as they oversaw the pivot to online learning in their schools.

The movement to online learning disrupted the learning of most students. Yet, students with disabilities were in a unique position. By definition, students with disabilities struggle with learning in classroom settings (IDEA, 2004). However, the COVID-19 pandemic created unexpected and substantial obstacles to providing instruction and related services for students with disabilities (Young & Donovan, 2020). While face-to-face learning provides challenges for students with disabilities, online learning for this student group is challenging when classroom supports are not provided. Self-regulation, motivation, learning pace, and even physical support become problematic when learning virtually (Young & Donovan, 2020).

In the United States (U.S.), school closures forced 7.2 million students with disabilities to receive their education and special education services online (National Center for Education Statistics, 2022). However, under the Individuals with Disabilities Education Act (2004), school districts were still required to provide free and appropriate public education (FAPE), including specialized instruction and related services (U.S. Department of Education, 2020). The U.S. Department of Education did acknowledge the “unique and ever-changing environment” while cautioning school districts that FAPE was still required even if FAPE was provided through virtual or online instruction (p. 1). However, the Department did urge caution regarding delivering face-to-face or physical services such as hands-on physical or occupational therapy or sign language services. Nonetheless, schools were still required to provide accommodations such as extended time, accessible reading materials, videos with closed captioning, and other accommodations required by a child’s individual education programs (IEP) as long as schools provided appropriate instruction (U.S. Department of Education, 2020). Still, many students with disabilities had the potential to be disconnected from the regular provision of special education services that they typically received in their brick-and-mortar schools. Educational leaders needed to fulfill the requirements of the law while ensuring the safety of their students and staff.

The current study investigated educational leaders’ perceptions of their schools’ use of online learning before and during the pandemic and their shared experiences regarding access to educational technologies, providing valuable insight into schools' challenges. The effect of the pandemic has continued for years beyond the initial period of school closures, and work remains to ensure that students in rural schools can equitably access online learning technology.

Teaching and learning technologies are now essential elements in K-12 education as they have become powerful tools for transforming student learning. These technologies can help reinvent and refocus classrooms as they move to more student-centered learning to prepare students for 21st-century technology, social, and learning demands (Zhang et al., 2021). In fact, teaching and learning internet technologies are uniquely positioned to help students develop 21st-century skills. Critical 21st-century skills supported by teaching and learning technologies include collaborative learning, knowledge construction, critical thinking, problem-solving, and creative thinking (Chai & Kong, 2017). Yet, students in rural schools have consistently lacked access to reliable broadband internet (Power et al., 2020) that supports access to learning 21st-century skills. As the COVID-19 pandemic caused schools nationwide in the U.S. to pivot to online instructional delivery during the spring and fall of 2020, students in rural schools remained disadvantaged due to technology and resource-related issues (Gallegos et al., 2022).

Clearly, the use of online teaching and learning has been increasing over the last 20 years (Tonks et al., 2021). Before the COVID-19 pandemic, an estimated 1.4 million K-12 students attended online (virtual) schools in the U.S., with another 1.5 million K-12 students taking individual supplemental online high school courses for credit recovery (Digital Learning Collaborative, 2020). Yet, the proportion of students with disabilities receiving special education services attending full-time online schools (6.7%) was substantially below the national average of 13.1% (Molnar et al., 2021). Additionally, 12.4% of students enrolled in schools with programs that provided blended learning opportunities (combining online learning in a traditional classroom) were those with identified disabilities (Molnar et al., 2021).

One in five students in the U.S. attend rural schools, which equates to about 9.3 million (Showalter et al., 2023). As expected, rural schools are often quite small and have a median enrollment of only 493 students (Showalter et al., 2023). Yet, rural is not a universal term. Rural communities differ greatly, with their landscape ranging from lush, forested lands to underpopulated towns nestled deep within the Rocky Mountains. Essentially, a comprehensive and succinct definition has yet to be developed due to the great diversity of rural settings (Longhurst, 2022; Thier et al., 2021). Rural schools themselves have a variety of strengths, including strong community engagement (Johnson & Howley, 2015) and benefits derived from being smaller organizations, including smaller class sizes, students experiencing a greater sense of belonging, increased safety, easier implementation of new ideas, and higher self-efficacy among teachers (Jimerson, 2006).

Rural communities also face unique challenges that are often manifested under the common theme of economic inequality (Tieken & Montgomery, 2021). One result of economic inequality can be found in the current digital divide in rural areas. Essentially, internet broadband services and the lack of computing devices have left rural communities and schools technologically underserved compared to their suburban counterparts (Jameson et al., 2020; Riddlesden & Singleton, 2014). According to school district leaders, the greatest ongoing concern for years has been schools' ability to provide students with reliable remote instruction, a situation exacerbated during the COVID-19 pandemic (Jackson & Garet, 2020).

The current study was conducted between August 2020 and October 2020 to query rural educational leaders' perceptions of how their schools used online instructional technologies. This timeframe provides a unique insight into rural educational leaders' experiences as they attempted to provide equitable educational opportunities for all students, including those receiving special education services, in their rural districts and schools. This article also examines several technology changes and educational implications of the COVID-19 pandemic. The understanding gained from this study may help provide insights for addressing technology-related issues in rural schools and highlight the need for continued research and practice to support all students with and without disabilities. While another pandemic may not be imminent, localized short-term and longer-term school closures resulting from natural or weather-related disasters may directly affect rural schools. Rural technology-related issues persist, as exemplified by the current digital divide.

Digital Divide

There continues to be unequal access to the Internet across the U.S. (Shakina et al., 2021). As a result, issues with internet access have been encapsulated using the term *digital divide*. Internet availability and digital inequity helped to originally define the digital divide when discrepancies were first identified over twenty years ago (e.g., Dewan & Riggins, 2005; Hoffman et al., 2000). The digital divide now includes the gap between households with reliable access to broadband technology and households with poor or no broadband access (Lythreatis et al., 2022).

The definition of the digital divide has evolved to include three levels: access, skills and usage, and outcomes (Shakina et al., 2021; Wei et al., 2011). Level 1 is access to information and communication technology (ICT), Level 2 is variability in digital skills and usage, and Level 3 is achieving beneficial outcomes using the internet (e.g., Shakina et al., 2021.; Wei et al., 2011). The definition of the digital divide is hierarchical, with each level encompassing the lower level. Level 3 is the highest level, including ICT access, skills and usage, and outcomes.

The digital divide itself is influenced by several factors, including geographic settings (i.e., rural, urban, or suburban), the cost and deployment of technology infrastructure, and socio-economic factors (Reddick et al., 2020). Rural settings often experience digital inequities more readily than suburban or urban settings since the cost of installing broadband internet infrastructure is more costly, making it less profitable for internet service providers to provide services for rural locations (Obermier, 2018; Riddlesden & Singleton, 2014). Schneir and Xiong (2016) developed a cost model indicating that deployment costs in rural areas are 80% higher than in most urban areas. Rural areas require more infrastructure investment to run the broadband to homes (i.e., longer distributions, feeders, and drop segments). The exorbitant deployment costs for areas with reduced population density and reduced profit potential for service providers make it less likely that those in rural areas will have access to the internet.

The speed of the broadband network further impacts the digital divide. For this article, broadband connectivity is defined as the speed of data transfer that is available when using the internet. Broadband speed impacts the number of devices that can access the internet simultaneously and the quality of the internet. A broadband speed of 250/25 megabits per second is reasonable for operating four devices (e.g., phones, computers, laptops, digital televisions, etc.) in a household (Federal Communications Commission, 2020). For homes with multiple school-aged children, broadband speed is important for equitable access to online instructional technologies. Unfortunately, broadband speeds are slower in rural settings and come at a higher cost than in urban or suburban areas (Obermier, 2018; Riddlesden & Singleton, 2014). The outcome is that rural areas likely have lower broadband service levels and higher access costs, furthering digital inequities.

Socio-economic factors amplify digital inequities in rural areas. A major contributing factor to the digital divide in rural areas is related to the poverty rate in rural areas (Kormos, 2018). The U.S. Department of Agriculture (2019) has reported that high poverty rates in isolated rural areas are especially persistent. Thus, accessing broadband internet and internet-connected computing devices is more difficult in rural areas, worsening the digital divide (Jameson et al., 2020; Riddlesden & Singleton, 2014). Only about 72% of rural Americans have access to broadband internet in their homes, and they are less likely to have multiple internet-capable devices than urban or suburban families (Vogels, 2021). Access to education relied heavily on connectivity and internet-capable devices throughout the COVID-19 pandemic, especially during times when brick-and-mortar schools were closed.

Digital Divide in Schools

Issues related to technology funding have exacerbated the digital divide in many rural schools, as witnessed during the COVID-19 pandemic. Yet, rural schools have been employing distance learning and online instructional technologies for a number of years (Hannum et al., 2009). In a national survey of rural school systems, Hannum and colleagues (2009) found that 85% of rural districts participating in their study used some distance education at some point, and 69.3% were currently using distance learning technologies. Currently, technology use in rural schools has increased, with 93% of teachers having access to computers for student use and access to the Internet (National Center for Education Statistics, 2023a). These technologies have helped reduce the geographic isolation that is often prevalent in remote towns and schools. When available, broadband internet has also provided opportunities for rural students to develop their 21st-century skills (Power et al., 2020). Yet, 11% of rural students who access the internet from home for studying and homework purposes need to use mobile broadband subscriptions, generally their mobile phones (National Center for Education Statistics, 2023a). The National Center for Education Statistics also found that students in remote rural areas had the lowest access to fixed broadband internet access (69%) of any locale (e.g., towns, cities, suburban, urban).

Theoretical Framework

Inequities prevalent in rural settings continue to exacerbate the digital divide. Despite advances in high-speed internet and improvements in infrastructure and hardware, access remains a core hardship for rural families. Inequitable access to technology also disadvantages rural students and families compared to urban or suburban students and families. The lack of access is an equity issue. The term equity has been used in the literature for many years; however, there is no consensus regarding the meaning of equity (e.g., Adams, 1963; Bolino & Turnley, 2008; Pick & Sarkar, 2016). The most appropriate application of equity for the current study revolves around technology access.

Van Dijk (2017) proposed the Resources and Appropriation Theory, the current study's theoretical framework. The Resources and Appropriation Theory posits that societal inequalities produce an unequal distribution of resources, leading to unequal access to digital technologies, which in turn contributes to unequal participation in society (Van Dijk, 2017). Unequal participation reinforces categorical inequalities and unequal distribution of resources (Van Dijk, 2017). The cyclical nature of the Resources and Appropriation Theory explains how the digital divide perpetuates inequality in rural settings.

Van Dijk’s (2017) Resources and Appropriation Theory provided the appropriate foundation for quantitatively examining participant responses because of the underlying focus on access. While the digital divide has persisted for over 20 years (Dewan & Riggins, 2005; Hoffman et al., 2000), the COVID-19 pandemic thrust it to the forefront of education as rural schools were greatly impacted by issues of equitable access to instructional technologies (Kormos, 2018). Van Dijk’s (2017) theory positing that societal inequalities form the foundation for the pervasive inequalities that persist in the distribution of resources, access to digital technologies, and participation in society provided an appropriate theoretical lens through which to examine participant responses. This theoretical framework supported our data analysis by providing the specific lens through which we viewed the internet teaching and learning technology inequities identified by our participants. The theoretical framework also gave us a better perspective of how participants perceived differences in access to teaching and learning technologies, technical support, and access to special education services before and during the COVID-19 pandemic.

Online Teaching and Learning Technologies

The COVID-19 pandemic forced schools to quickly close and pivot to online learning in the spring and fall of 2020. With little time to prepare, educators, students, and families were thrust into online instructional technologies regardless of a student's age or ability. With minimal time to convert face-to-face lessons to online instruction, teachers rushed to redesign lessons and learn new technology alongside their students. The success of online learning depended heavily on the quality of the internet connection and the availability of devices needed to access learning materials.

The expression "teaching and learning technologies" encompasses several terms. These include web-based classroom technology, remote learning, mobile learning environments, digital learning, educational technology, e-learning, instructional technology, online learning, distance education, and e-learning technologies. For the purpose of this study, we used the operational definition of teaching and learning technologies that were developed by the Association for Educational Communications and Technology (AECT), which defined educational technology as "the study and ethical practice of facilitating learning and improving performance by creating, using, and managing appropriate technological processes and resources" (Januszewski & Molenda, 2013, p. 1). Teaching and learning technologies provide opportunities for a more student-centered learning environment that de-emphasizes lectures and other teacher-centered approaches (Kormos & Julio, 2020).

Method

The current study was developed due to the impacts of the COVID-19 pandemic, which caused schools to quickly pivot to using various online teaching and learning technologies. This study investigates the perceptions of rural educational leaders in school districts across six central U.S. states regarding school technology, technical support, the abilities of students with disabilities to learn online, and special education service delivery. The current study used the National Center for Educational Statistics (NCES) (2024) levels of rurality to define rural settings. Rural areas that are five miles or less from an urban area are considered Fringe. Rural areas between five and 25 miles from an urban area are identified as Distant. Rural areas located over 25 miles from an urban area are labeled Remote. For data analysis purposes, the NCES rurality levels were broken into more granular levels that included six levels rather than three. Rural educational leaders were operationally defined for this study as district-level special education directors, district administrators (not special education directors), and school principals. The study addressed the following research questions:

1. What do rural educational leaders perceive as the differences in access to internet teaching and learning technologies for delivering instruction in rural districts *before* and *during* the COVID-19 pandemic?

2. How do rural educational leaders perceive the effectiveness of technical support for online teaching and learning technologies *during* the COVID-19 pandemic?
3. How do rural educational leaders perceive how special education services are provided and monitored *during* the COVID-19 pandemic?
4. How do rural educational leaders perceive the abilities of students with disabilities to learn online *during* the COVID-19 pandemic?

Participants

Invitations to take the online survey were emailed to individuals using the Qualtrics survey service. Questionnaires were distributed to rural educational leaders in six states, including Colorado, Nebraska, North Dakota, South Dakota, Missouri, and Wyoming, in early August 2020. The email lists were compiled by contacting the state departments of education, which granted permission to use their email lists. 4,649 email invitations were first sent. Three reminder emails were sent to non-respondents between August and late October 2020. One hundred sixty-seven respondents completed surveys for a response rate of 3.6%, with a survey completion rate of 62%. We felt that the low response rate could be attributed to the demands on rural educational leaders resulting from the COVID-19 pandemic. Table 1 describes the characteristics of study participants.

Table 1
Participant Characteristics

Characteristic	n	%
Participant		
Role		
Principal	63	44.4
District-level Administrator (not Special Education Director)	63	44.4
Special Education Director	16	11.2
Years		
1-5 years	39	27.7
6-10 years	20	14.2
11-15 years	35	24.8
16-20 years	29	20.6
More than 20 years	18	12.8
District Size		
Less than 500 students	57	40.4
501-750 students	15	10.6
751-999 students	9	6.4
More than 1,000 students	60	42.6
Rurality – Miles from an urban or suburban area		
1-10 miles	28	19.9
11-20 miles	12	8.5

21-30 miles	23	16.3
31-40 miles	15	10.6
41-50 miles	19	13.5
More than 50 miles	44	31.2
School Size		
Less than 50 students	9	6.6
51-200 students	57	41.9
201-350 students	23	16.9
351-500 students	26	19.1
501-650 students	6	4.4
651-800 students	1	0.7
801-950 students	4	2.9
More than 950 students	10	7.4
Free/Reduced Lunch		
1-25 %	16	11.8
26-50 %	43	31.6
51-75 %	58	42.6
76-100 %	19	14

Instrument

The survey instrument was developed based on the limited relevant research available during the beginning of the COVID-19 pandemic. So, the research questions guided the development of the survey instrument. The instrument itself was divided into two main sections: quantitative and qualitative open-ended questions. Due to the depth of data derived from the survey instrument, the qualitative data analysis was published separately in a prior article (Sundeen & Kalos, 2022). The current article provides a data analysis of the quantitative elements of the survey instrument.

The quantitative section of the questionnaire was developed to assess the perceptions of rural educational leaders regarding differences in access to Internet teaching and learning technologies before and during the COVID-19 pandemic. A five-level Likert scale ranging from excellent to not acceptable was used for most questions. Questions were also formulated to understand how effectively technical support was provided in rural schools and districts since modern technology must be properly and consistently maintained to be effective. The questionnaire also included questions to help determine how IDEA (2004) special education services were provided, given the quick transition to online learning in many schools. Rural educational leaders were also queried on their perceptions of how well students in specific IDEA (2004) disability categories could learn using internet-based learning technologies. The final section of the questionnaire included several demographic questions that categorized the role of respondents (principal, district-level administrator [not special education director], and special education director) and their years as rural educational leaders. Distance in miles from a suburban or urban center was also determined, as was district size based on number of students and the number of schools in the district. Rural educational leaders were also asked to rank the average school size in their district based on number of students attending. The percentage of students receiving free and reduced lunch was also queried.

Data Analysis and Findings

Differences in access to internet teaching and learning technologies for delivering instruction in rural districts *before and during the COVID-19 pandemic, variable frequency, and relationships between variables were explored using* descriptive and statistical analysis. Frequency analysis was completed for commonly used teaching and learning technology variables (see Table 2).

Table 2
Teaching and Learning Technologies: Prior and During COVID-19

Technology	Prior		During	
	n	%	n	%
Computers	154	91.70	154	91.70
Tablets	103	61.30	104	61.90
Cell Phones	58	34.50	105	62.50
Virtual Reality	15	8.90	13	7.70
Augmented Reality	4	2.4	2	1.20
Other	10	6.00	11	6.50

Overall Teaching and Learning Technology

Inferential statistical analysis was used to examine the relationships between several variables, including overall teaching and learning technology status, specific teaching and learning technology usage, and service provision for students with disabilities. Independent t-tests were performed to examine the relationships between educational leaders' perceptions of differences in conditions prior to versus during the COVID-19 pandemic. Note that the study respondents answered the questionnaire only once. So, when asked about *prior* to and *during* conditions, they recalled these conditions on the same survey during the early school year in the fall of 2020.

The two variables representing overall teaching and learning technology status *were examined before and during the COVID-19 pandemic*. Based on Levene's Test for Equality of Variances, equal variances were assumed. Results indicated statistically significant mean differences between the *prior* (*M* = 2.38, *SD* = .85) and *during* (*M* = 2.73, *SD* = .96; t (334) = -3.60, *p*=.000, two-tailed) conditions with a 95% confidence interval ranging from -.55 to -.16. The magnitude of the differences in the means (mean difference

= -.36) was small (eta squared = .038). In other words, 38% of the variance in overall technology status is explained by differences in the *prior* and *during* conditions.

Nonetheless, there *was* a significant difference in how rural educational leaders perceived the changes in their overall technology status when asked to compare *prior* to the COVID-19 pandemic and *during* the early school year 2020. In fact, descriptive variables showed that of the rural educational leader respondents, 56% rated the Overall teaching and learning technology status before the COVID-19 pandemic as excellent or good, while only 43% rated the status as excellent or good during the COVID-19 pandemic.

Multiple linear regression analyses were used to develop a model to predict possible influences on the *Overall teaching and learning* variable during the COVID-19 pandemic. Preliminary analyses were conducted to ensure no violation of the assumptions of normality, linearity, multicollinearity, and homoscedasticity were present. The model evaluation indicated that 57.6% of the variance in *Overall teaching and learning* during the COVID-19 pandemic was attributed to seven variables: broadband reliability, broadband service meets demands, gaps in broadband internet coverage, overall broadband internet coverage, cell phone service coverage gaps, technology support overall, and time for technology problem resolution $F(7, 153) = 10.83$, $p < .001$, $R^2 = .331$ (see Table 3). Three model variables were statistically significant. The variables included gaps in broadband internet coverage, overall broadband internet coverage, and technology support overall. The strongest unique contribution was provided by the technology support overall variable (β=.486).

Table 3
Multiple Regression of Overall Teaching & Learning Technology Status During the Pandemic

Variable	*B*	95% CI for *B*		SE *B*	β
		LL	*UL*		
Overall Status – During					
Broadband Reliability	-.058	-.298	.183	.122	-.064
Broadband Meets Demand	-.066	-.324	.192	.131	-.069
Broadband Gaps	.172*	.013	.331	.080	.206*
Broadband Coverage	-.214*	-.417	-.010	.103	-.201*
Cellphone Service Gaps	-.084	-.209	.042	.064	-.093
Technology Support Overall	.506*	.306	.705	.101	.486*
Technology Issue Resolution Time	-.115	-.282	.051	.084	-.128
R^2	.331				
Adjusted R^2	.301				
F	10.83*				

Note: CI = confidence interval; *LL* = lower limit; *UL* = lower limit; *p < .001.

Technology Support

Technology support was examined through three questions. Most rural educational leaders reported that their technology support was provided at the district level (86.3%; n=145) rather than at the school level (13.7%; *n*=23). Providing support from a more centralized location makes sense from funding and resource availability standpoints. Rural districts often struggle with overall school funding and resource access (Kormos & Wisdom, 2021; Showalter et al., 2023).

Technology support is time-sensitive when large numbers of students depend on access to online learning technologies. Rural educational leaders reported that most technology problems were solved in one day or less (69.7%; *n*=142). Some technology issues were resolved in two to three days, as reported by 21.6% (n=35) of respondents. Other rural educational leaders indicated that technology-related issues were not solved until four to seven days after being reported (8.7%; *n*=14).

The current study also addressed the question of overall technology support satisfaction. Results indicated that 38.7% (*n*=63) of respondents felt the overall technology support was *excellent*. Additionally, support was rated as *good* or *average* at 41.7% (*n*=68) and 13.5% (*n*=22), respectively. Ten responses indicated that overall technology support was *poor* (4.9%; *n*=8) or *unacceptable* (1.2%; *n*=2). Generally, overall technology support for rural districts was regarded positively.

A multiple linear regression model was used to examine the ability of two variables to predict rural leaders' perception of *Overall teaching and learning status during the pandemic*. The two predictor variables included *overall technology support* and *time to solve technology problems*. The model provided significant results $F(2, 159) = 19.20$, $p < .001$, $R^2 = .199$ (see Table 4). *Technology support* and *time to solve technology problems* explained 44.6% of the total variance. So, during the COVID-19 pandemic, the perception of overall teaching and learning status was significantly affected by how technology support was provided and the time it took to receive it.

Table 4
Multiple Regression of Overall Teaching & Learning Technology Status During the Pandemic; Technology Support Variables Only

Variable	*B*	95% CI for *B*		SE *B*	β
		LL	*UL*		
Overall Status – During					
Technology Support Overall	.559*	.357	.761	.102	.537*
Technology Issue Resolution Time	-.147	-.231	.028	.088	-.163
R^2	.194				
Adjusted R^2	.184				
F	19.20*				

Note: CI = confidence interval; *LL* = lower limit; *UL* = lower limit; $^*p < .001$.

Broadband

A dichotomous (yes/no) variable was used to examine districts' broadband availability. Of the 167 respondents, 78% (*n*=130) of rural educational leaders estimated that broadband coverage was available for their districts. Nonetheless, 22% (*n*=37) of rural leaders expressed that broadband internet was unavailable in their district—the potential impacts of a 22% gap in school district coverage loom. Students may struggle with learning in a typical setting and miss substantial learning opportunities due to a lack of broadband internet access.

Broadband reliability and the ability of broadband to meet the demands of schools were also queried. Table 5 shows the results of both variables. Note that 8% of rural leaders indicated that broadband reliability (*n*=14) was either *poor* or *not acceptable*. Similarly, 8% also indicated that their available broadband was *poor* or *not acceptable* at meeting their demands (*n*=12). Yet, when asked about broadband gaps, 70% (*n*=114) of rural educational leaders indicated that their districts had *some, quite a few,* or *many gaps.* Any gaps in broadband coverage meant that children in those areas could not use the internet for learning.

Table 5

Broadband Reliability and Broadband Meeting Demands

Scale	*Broadband Reliability*		*Broadband Meets Demands*	
	n	%	*n*	%
Excellent	54	32	57	35
Good	60	36	56	34
Average	35	21	23	23
Poor	7	4	9	6
Not Acceptable	7	4	3	2

A multiple linear regression analysis was conducted to examine the effects of broadband variables on the overall teaching and learning status during the pandemic. The model evaluation revealed that the four broadband independent variables (reliability, meets demands, coverage, gaps) could predict rural educational leaders' satisfaction with the *Overall teaching and learning technology* during the COVID-19 pandemic. The four-predictor model accounted for 44.60% of the variance in Overall satisfaction with teaching and learning technologies during the COVID-19 pandemic, $F(4, 157) = 9.74$, $p < .05$, $R^2 = .199$ (see Table 6). These results indicate that broadband-related issues did indeed affect how rural educational leaders felt about the overall teaching and learning status during the fall of 2020.

Table 6
Multiple Regression of Overall Teaching & Learning Technology Status During the Pandemic; Broadband Variables Only

Variable	*B*	95% CI for *B*		SE *B*	β
		LL	*UL*		
Overall Status – During					
Broadband Reliability	.031	-.226	.288	.130	.034
Broadband Meets Demand	.007	-.263	.278	.137	.008
Broadband Gaps	.183*	.012	.355	.087	.220*
Broadband Coverage	-.257*	-4.71	-.044	.108	-.242*
R^2	.199				
Adjusted R^2	.178				
F	9.74*				

Note: CI = confidence interval; *LL* = lower limit; *UL* = lower limit; *p < .001.

Cell Phone

A multiple linear regression model was developed to isolate the influence of cell phone service gaps and coverage on *Overall teaching and learning status* during the pandemic. However, no significance was found for this model, $F(2, 160) = 2.55$, $p < .001$, $R^2 = .031$. Thus, rural educational leaders were less concerned about cell phone issues than broadband issues during the COVID-19 pandemic.

Specific Teaching and Learning Technologies

To better understand the degree to which teaching and learning technologies were accessed *prior* to and *during* the pandemic, independent t-tests were used to examine specific internet technologies. The technologies examined included computers, tablets, cell phones, virtual reality, and augmented reality. Cell phone usage *prior* to and *during* were the only variables observed with statistically significant differences among the five technologies examined prior to ($M = .35$, $SD = .48$) and during ($M = .63$, $SD = .49$; t (334) = -5.33, $p = .000$, two-tailed).

Frequency analysis indicated that in 31% of schools and districts, cell phones were used for lessons *prior* to the pandemic, while 74% used cell phones for lessons *during* the pandemic. Since more students were using cell phones for learning, this was a crucial contributor to students' success in rural settings.

Yet, gaps in cell phone coverage were noted by rural educational leaders. Their response to the survey question regarding cell phone service coverage indicated that 76% (*n*=123) of their districts had 51% to 100% cell phone service coverage, leaving an estimated 24% (*n*=40) of their districts with coverage gaps. Surprisingly, 14% (*n*=24) of their districts had 0% to 25% cell phone coverage (see Table 7). This level of coverage gaps in cell phone service indicates that the potential for students using phones to keep up with classwork was limited. Students in limited or no cell phone service coverage areas were bound to struggle with their learning.

Table 7

Cell Phone Service Coverage

	Frequency	%
76 - 100% coverage	65	40
51 - 75% coverage	58	36
26 - 50% coverage	16	10
0 - 25% coverage	24	14

Perceived Ability to Learn Online

Rural educational leaders were also asked about their perceptions regarding the ability of students identified with IDEA (2004) disability categories to learn online. Overall, leaders rated the online learning acumen of students with disabilities as *Excellent, Good,* or *Average* (37.5%; *n*=53). In contrast, 62.4% (*n*=88) of rural educational leaders rated their perception of the online learning abilities of their students with disabilities as *Fair* or *Poor*. Clearly, rural educational leaders found that students with disabilities struggled with online learning.

A follow-up question asked rural educational leaders to rate learners with disabilities by IDEA (2004) category (see Table 8). Results indicated that students identified with orthopedic impairment (10.2%; *n*=14), speech-language impairment (7.3%; *n*=10), and autism spectrum disorder (5.1%; *n*=7) were identified as *Excellent* online learners among students with disabilities. Conversely, students identified with multiple disabilities (34.1%; *n*=47), autism spectrum disorder (33.6%; *n*=46), and emotional and behavioral disorders (32.4%; *n*=45) were recognized as students who struggle most with online learning. Note that autism spectrum disorder appeared at both ends of the online learning ability spectrum, perhaps indicating the wide variations in the severity of how this disability affects learners.

Table 8

University of Northern Colorado

	Excellent		Good		Average		Fair		Poor		NA	
Disability Category	n	%	n	%	n	%	n	%	n	%	n	%
Specific Learning Disability	3	1.8	31	22.3	37	26.6	41	29.5	25	18.0	2	1.2
Other Health Impairment	2	1.5	33	24.1	46	33.6	32	23.4	16	11.7	8	5.8
Autism Spectrum Disorder	7	5.1	13	9.5	27	19.7	33	24.1	46	33.6	11	8.0

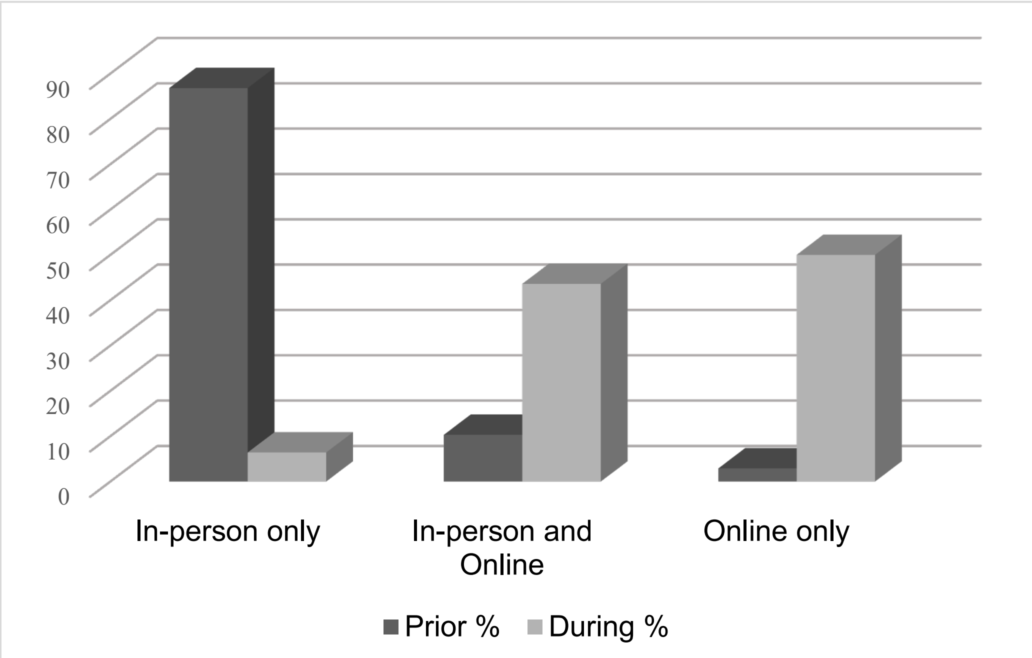
Emotional and Behavioral Disorders	5	3.6	10	7.2	33	23.7	39	28.1	45	32.4	7	5.0
Speech Language Impairment	10	7.3	33	24.1	42	30.7	28	20.4	17	12.4	7	5.1
Visual Impairment, including Blindness	2	1.5	7	5.1	7	5.1	20	14.6	39	28.5	62	45.3
Hearing Impairment	4	2.9	20	14.4	19	13.7	25	18.0	29	20.9	42	30.2
Deafness	1	0.7	10	7.5	11	8.2	23	17.2	23	17.2	66	49.3
Deaf-Blindness	2	1.5	3	2.2	2	1.5	15	11.1	30	22.2	83	61.5
Orthopedic Impairment	14	10.2	19	13.9	31	22.6	12	8.8	14	10.2	47	34.3
Intellectual Disability	1	0.7	12	8.7	29	21.0	38	27.5	42	30.4	16	11.6
Traumatic Brain Injury	3	2.2	5	3.6	14	10.2	23	16.8	35	25.5	57	41.6
Multiple Disabilities	2	1.4	10	7.2	19	13.8	29	21.0	47	34.1	31	22.5

Note. NA indicates that the disability category was not represented in rural districts.

Service Provision for Students with Disabilities

A critical element of IEPs are the related services provided for students with disabilities. Examples of related services include physical therapy, occupational therapy, audiology services, orientation and mobility services, and interpreting services. Since many brick-and-mortar schools were closed or only partially open during the COVID-19 pandemic (Young & Donovan, 2020), it was important to determine how IEP-related services were being provided. The service delivery survey question provided three options to respondents: *in-person only, in-person and online*, and *online only*. Results showed that prior to the COVID-19 pandemic, services were being provided to students with disabilities primarily in-person (86.8%), with only 2.9% being provided strictly online. During the COVID-19 pandemic, only 6.4% of students received in-person services, and 43.6% of services were provided utilizing in-person and online modalities (See Figure 1). Online-only services were reported as being provided 50% of the time *during* the COVID-19 pandemic.

Figure 1
Related Services Prior and During the Pandemic



Discussion

The purpose of this quantitative study was to explore questions related to rural educational leaders' perceptions of the differences in access and student use of internet teaching and learning technologies in rural districts *prior* to and *during* the COVID-19 pandemic. Four salient questions were examined related to the perceptions of rural educational leaders regarding internet technology access, technical support, student online learning abilities, and provision of special education services *prior* to and *during* the COVID-19 pandemic. Students receiving special education services were required, along with their non-disabled peers, to quickly shift to online learning in the fall of 2020. Yet, it soon became apparent that many students in rural areas were at a disadvantage regarding their ability to access online instruction. Students with disabilities were at risk of falling behind while they may not have been receiving all their legally mandated support and services.

Rural areas across the U.S. have typically had poorer broadband internet access than suburban or urban areas. In the most recent broadband deployment report, the Federal Communications Commission (FCC) acknowledges the service gaps in rural schools compared to suburban and urban schools (Federal Communications Commission, 2021). The digital divide has persisted for rural communities for decades, yet it became a fundamental issue for school districts as they worked to provide meaningful instruction for students during the COVID-19 pandemic. The inequities in broadband access for rural school districts limited consistent internet access for student instruction. Participant responses in the current study indicated a statistically significant difference in the overall teaching and learning technology status before and during the pandemic. A surprising 70% of rural education leaders indicated that there were substantial gaps in broadband coverage in their districts. The implication of the prevalence of broadband gaps is that students in areas without coverage likely had gaps in their learning, too.

Surprisingly, rural educational leaders reported being quite satisfied with their technical support during the COVID-19 pandemic. In fact, positive experiences with technical support response times contributed significantly to leaders' perceptions of the overall teaching and learning status during the COVID-19 pandemic.

We know that students have embraced the use of cell phones for their social interactions. However, the COVID-19 pandemic motivated students to turn to their cell phones for online learning, too (Owen et al., 2023). In fact, 29% of parents reported that their children likely used their cell phones for completing schoolwork (Vogels et al., 2020). Accordingly, the current study found that rural educational leaders reported a significant increase in student cell phone usage for learning, from 34.50% to 62.50%, during the COVID-19 pandemic. Yet, leaders also reported substantial gaps in cell phone coverage in their rural school districts. The implications of this discrepancy for student learning are substantial. Students living and learning in rural settings were at a distinct disadvantage when online learning became essential.

We did not know enough about *how* K-12 students with disabilities learned online prior to the COVID-19 pandemic (Averett, 2021; Kennedy & Ferdig, 2018). For instance, Vasquez and Straub (2012) examined online instruction for students with disabilities in K-12 settings. Their comprehensive review of the literature identified only six studies, of which only one described the use of synchronous technology for teaching. One reason for the dearth of representative synchronous online learning studies is that, prior to the COVID-19 pandemic, online learning options were generally self-selected. In other words, parents chose online instruction for their children with the thought that their children could learn more effectively online than in-person (Schuck & Lambert, 2020). One example was parents enrolling their children in online programs for credit recovery and dropout prevention through online schools (Cavanaugh et al., 2013). More research is required to better understand how students with disabilities learn using online technologies.

Online Learning for Students with Disabilities

Rural educational leaders indicated that students with identified disabilities struggled when they were required to learn using internet technologies, with some disability groups experiencing greater difficulties than others (e.g., multiple disabilities, autism spectrum disorder, and emotional and behavioral disorders). There may never be a complete school shutdown again, as there was during the 2020-2021 school year. Yet, as more teaching and learning is likely to take place online in the coming years, it will be necessary to understand better how students with disabilities can best be supported to better learn using internet technologies. It is also important to note that studies completed with data from during the COVID-19 pandemic will not be synonymous with studies preceding or following the COVID-19 pandemic.

Complicating our understanding of how students with disabilities learn online is the fact that much of the research completed during and since the COVID-19 pandemic examined students with disabilities as a homogeneous group relative to their online learning experiences. Based on the results from the current study, there is a range of differences in student aptitude for learning virtually.

Research providing a better understanding of online learning habits for students with disabilities will be helpful. One such habit is self-regulation. Studies have shown that successful online learners with disabilities can practice self-regulation based on intrinsic and extrinsic motivation (Lambert & Schuck, 2021; Mohtar & Yunus, 2022). Yet, staying focused for many hours while learning online can be difficult for students who also struggle with brick-and-mortar classroom learning (Rice & Allen, 2016; Young & Donovan, 2020). Additional research related to specific disability categories and unique learning needs will be necessary to better understand how to best support these learner groups in their online learning efforts.

Related Services for Students with Disabilities

An area of substantial concern for students with disabilities during the COVID-19 pandemic lockdown and pivot to online learning was the ability of schools to provide a free and appropriate public education (FAPE) during the COVID-19 lockdown. The Individuals with Disabilities Education Act (IDEA, 2004) mandates that children with disabilities receive educational services described in students' IEPs at no cost to families. So, even when brick-and-mortar schools closed, schools were charged with meeting the legal requirements in each child's IEP. Even prior to the COVID-19 pandemic school closures, schools have not always met the requirements of the law relative to providing educational services for students with disabilities (Yell & Bateman, 2022). The COVID-19 pandemic exacerbated a problem that had already existed. School personnel struggled during the COVID-19 pandemic with fully implementing each student's IEP and providing services that meet the needs of each student with disabilities. The results from the current study indicated that most IEP-related services were provided in person prior to the COVID-19 pandemic. During the COVID-19 pandemic, rural educational leaders reported that few (6.4%) IEP-related services were being provided in person.

Nonetheless, responsibility for providing FAPE during the COVID-19 pandemic did not diminish; school districts were still responsible for implementing all elements of student IEPs as described under IDEA (U.S. Department of Education, 2020). It was acknowledged that IEP implementation and related service delivery may look different during school lockdowns, but the services were still required to provide a FAPE (Yell &

Bateman, 2022). For instance, if teachers used videos for instruction, accurate captioning or embedded sign language interpreting needed to be included. IEP meetings were held using video conferencing technologies. Accommodations and modifications were adapted to meet the restrictions of online instruction (Young & Donovan, 2020). For example, some students did not have access at home to the same assistive technology that they used in school. Young and Donovan (2020) provide the example of a student who used a Braille book at school, but the correct technology to create and write in Braille was not available at home. The larger lesson for school districts is that to provide FAPE, advance planning must take place first rather than adjusting after the fact (Rice & Pazey, 2022).

What Has Changed Since the Pandemic?

Not enough has changed regarding broadband internet coverage in rural areas. In fact, the FCC reported in 2021 that 14.5 million Americans still did not have access to high-speed internet, though the metrics have been improving (Federal Communications Commission, 2021). Rural internet coverage is still at only 77.4%, while urban coverage is reported at 98.5%, though the gap has been reported to have been consistently reduced since first being measured in 2016 (Federal Communications Commission, 2021). Yet, an independent analysis of FCC documents (e.g., Form 477) revealed that the digital divide between urban and rural access to broadband is still a major issue for rural users (Busby et al., 2024). In fact, Busby and colleagues (2024, para. 3) report that “at least 42 million Americans do not have access to broadband”.

In 2019, the State of the States report boldly stated that “The classroom connectivity gap is closed” (EducationSuperHighway, 2019, p.1). Yet, much progress is still required for that statement to be fully realized. The digital chasm, masquerading as a divide, still exists for millions of students nationwide. Specifically, 46.5% of students in schools nationwide do not have access to broadband at the minimum level set by the FCC (Connect K-12, 2022). In fact, only two-thirds of school districts (67%) are meeting the minimum acceptable level for bandwidth set by the FCC (Federal Communications Commission, 2021). The Connect K-12 (2022) report also highlighted that 23.5 million students learning in 4,232 districts do not have access to the internet speeds required to support digital learning tools for classrooms.

We have learned since the COVID-19 pandemic that there are gaps in the educational progress of many students that cannot be regained. The results from the National Assessment of Educational Progress (NAEP) show that for the substantial share of students who were already behind in their learning prior, the learning deficits experienced during the COVID-19 pandemic were “crippling” (Raymond, 2023, p. 1). Between 2020 and 2022, NAEP reading scores showed the largest drop since 1990; the “first ever” drop in mathematics scores was recorded (National Center for Education

Statistics, 2023b). The greatest declines in NAEP scores were recorded for lower-performing students, including those with disabilities.

The Center for Research on Education Outcomes (CREDO) predicts that students who normally experience a slower pace of learning are more likely to experience long-term learning losses that may never be recovered (Raymond, 2023). CREDO researchers estimated post-COVID-19 pandemic achievement for students at different learning levels and used the data to predict the potential academic achievement after twelve years of schooling. Their findings indicated that if only 90 days of learning loss are accounted for, just 64% of students will meet the 12th-grade learning benchmark (i.e., expected 12th-grade average knowledge). Extrapolating further, CREDO examined the results of an additional three years of instruction and intervention after 12th grade. Results indicated that the learning gains increased by only 7%, from 64% to 71%. In other words, COVID-19 pandemic learning losses cannot be recovered for some students even with substantially increasing instructional years.

Students with disabilities have experienced the greatest magnitude of loss compared with their non-disabled peers. The percentage of students receiving special education services to reach the 12th-grade learning benchmark, even with three additional years of learning, is predicted to be only 47% (Raymond, 2023). Students in rural settings, not accounting for disabilities, would be expected to achieve the 12th grade benchmark at a rate of 72% compared with their suburban peers (74%).

Rural educational leaders identified internet access and cell phone coverage gaps as substantial challenges facing students required to learn online during the COVID-19 pandemic. Not surprisingly, students in rural settings, and especially those with disabilities, struggled to not only access reliable internet and the required online learning technologies but also experienced learning loss that cannot be recovered. Since some schools already struggled to implement IEPs as written, the COVID-19 pandemic further highlighted the challenge of providing necessary services without adequate time to transition to an online platform, necessary training for staff, and reliable internet and devices. Since the COVID-19 pandemic, limited progress has been made to address the digital divide, and educators continue to look for solutions to address learning loss.

Limitations and Future Research

The current study examined rural educational leaders' perceptions of student access to learning technologies prior to and during the COVID-19 pandemic. Leaders also shared their perceptions of the ability of students receiving special education services to learn online. This study does have several limitations. These include the surprisingly low response rate for survey respondents. We believe that educational leaders were overwhelmed by circumstances related to the COVID-19 pandemic and had little time to devote to completing surveys. Additionally, those leaders who responded were essentially self-selected rather than a random sample of participants.

Future research should more closely examine the long-term effects of the COVID-19 pandemic on the learning of students in rural settings, especially those with disabilities. A better understanding of *how* students with disabilities learn online will also help to create more equity as schools employ more digital learning tools in classrooms. Understanding how to best serve specific disability groups (e.g., multiple disabilities, autism spectrum disorder, and emotional and behavioral disorders) in online settings will also be important. Additionally, we need to better understand how to remediate long and short-term gaps in learning caused by unforeseen circumstances.

Additionally, it is clear that students receiving special education services experienced a loss of services during the pandemic. Examining the potential long-term implications of those service losses will be helpful to better provide appropriate interventions for students with disabilities and strive to reduce the effects of the COVID-19 pandemic. It will also be necessary to understand more deeply how differences in learning settings, such as rural, suburban, and urban settings, affect student outcomes, especially in unique and unexpected conditions.

Conclusions

The purpose of this quantitative study was to explore questions related to rural educational leaders' perceptions of the differences in access to internet teaching and learning technologies for delivering instruction in rural districts *prior* to and *during* the COVID-19 pandemic and examine leaders' perceptions of the online learning potential of students with disabilities. The COVID-19 pandemic caught the educational community off-guard. School closures, lack of rural broadband infrastructure, poor rural cell phone connectivity, lack of internet-capable devices in schools, and a host of issues related to supporting students with and without disabilities caused losses in learning for many students. Progress in learning the 21st-century skills we value for student learning (e.g., collaborative learning, knowledge construction, critical thinking, problem-solving, and creative thinking) was compromised. To better prepare, equitable student opportunities must exist in every area of our country, including rural, suburban, and urban settings.

An important finding from this study was the rural educational leaders' satisfaction with technology support in their schools and districts. Having trained technology support personnel, post-COVID-19 pandemic is critical to the effective operation of schools. The use of online learning technology has increased dramatically because of the COVID-19 pandemic, and many schools are continuing to supplement their in-person instruction with these online learning resources. As the additional funding received because of the COVID-19 pandemic winds down, school districts must ensure they have plans to keep devices updated and technology departments staffed with trained support personnel.

While the shift to online learning and partial school closures that persisted throughout the 2020-2021 school year was difficult for many students and families, students with disabilities and their special education teachers and related service providers were underprepared to meet the needs of all students with IEPs. The COVID-19 pandemic brought to light the challenges of providing related services online, especially without the use of adequate online platforms to allow appropriate interaction and accommodations for students. Now that providers have lived through this experience, they can work with their educational leaders to identify those challenges as well the strategies that were effective.

The COVID-19 pandemic was an extreme example of school closure. Yet, other circumstances, including natural and man-made disasters, will continue to interrupt normal access to brick-and-mortar schools. We need to be prepared to ensure that students do not lose valuable learning opportunities during any long—or short-term school closings.

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