



Digital Inequality and Socio-Cultural Barriers in Distance Learning in Kazakhstan: Urban-Rural Perspectives

Albina Sariyeva^{*a}, Azhar Zholdubayeva^a, Ainura Kurmanaliyeva^a & Elmira Gerfanova^b

* Corresponding author:

Email: albin.sariyeva@gmail.com

a. Faculty of Philosophy and Political Science, Al-Farabi Kazakh National University, Almaty, Kazakhstan.

b. Department of General Education Disciplines, Astana IT University, Astana, Kazakhstan

Article Info

Received: October 07, 2025

Accepted: January 22, 2026

Published: February 16, 2026



[10.46303/jcve.2026.3](https://doi.org/10.46303/jcve.2026.3)

How to cite

Sariyeva, A., Zholdubayeva, A., & Kurmanaliyeva, A., & Gerfanova, E. (2026). Digital Inequality and Socio-Cultural Barriers in Distance Learning in Kazakhstan: Urban-Rural Perspectives. *Journal of Culture and Values in Education*, 9(1), 59-85.

<https://doi.org/10.46303/jcve.2026.3>

Copyright license

This is an Open Access article distributed under the terms of the Creative Commons Attribution 4.0 International license.

ABSTRACT

This study aims to examine how digital inequality shaped students' distance learning experiences during COVID-19 in Kazakhstan by identifying infrastructural and socio-cultural barriers to equitable online education. Using a mixed-methods design, data were collected from 540 secondary and university students through a structured 29-item questionnaire assessing digital access, satisfaction, engagement, and socio-cultural factors, with participants retrospectively reflecting on their distance learning experiences between November 2024 and February 2025. The sample included 247 secondary school students and 293 university students with balanced urban-rural representation. Urban-rural differences were analysed using Welch's t-tests, χ^2 tests, and regression analyses, while qualitative responses were examined through thematic analysis. Results show that rural students reported significantly lower digital access, reduced satisfaction with distance learning, and less willingness to continue online education compared to urban peers. However, rural students with stable internet connectivity, personal devices, and adequate home study spaces reported satisfaction levels comparable to urban students, highlighting key infrastructure thresholds for equity. Qualitative findings further revealed that socio-cultural barriers, concerns about academic integrity, isolation, and loss of peer support gradually shifted toward acceptance when institutional support improved. Overall, the findings underscore the need for targeted broadband expansion, device provision, multilingual e-learning platforms, and community engagement strategies to promote equitable and resilient digital education in Kazakhstan.

KEYWORDS

Distance learning; digital inequality; inclusivity; Kazakhstan; urban-rural disparities; e-learning platforms.

INTRODUCTION

The COVID-19 pandemic in 2020 triggered an unprecedented global shift from traditional classroom instruction to distance learning (Alismaiel et al., 2022; Mathrani et al., 2023; Miao et al., 2022; Oyedotun, 2020). In Kazakhstan, nationwide closures affected approximately 3 million school students and nearly 500,000 university students, placing significant strain on the country's readiness for digital education (Nurgaliyeva et al., 2024). Distance learning, defined as instruction mediated by technology across spatial and temporal separation, was rapidly implemented at scale (Costa et al., 2021; Keegan, 2013; Turnbull et al., 2021). Educators acknowledged that Kazakhstan was largely unprepared for this transition, citing inadequate infrastructure, limited digital content, and insufficient teacher training as key obstacles (Bokayev et al., 2021; Burakanova et al., 2021; Seilkhan et al., 2022). It is noteworthy that schools in Kazakhstan operated major challenges. Schools remained in distance mode for extended periods across two academic years. As a post-Soviet, upper-middle-income country situated between Eastern and Western traditions, Kazakhstan offers insights with broader relevance, sharing characteristics with many Global North systems such as near-universal enrolment, a predominantly female teaching workforce, and centralised reform (Imanova et al., 2025). At the same time, uneven regional connectivity and rapid policy-driven digital adoption often outpaced local capacity, creating a distinctive context in which national mandates intersected with classroom realities.

Connectivity emerged as a critical challenge, particularly in rural areas where limited internet access and device shortages intensified pre-existing educational inequalities. Moreover, some parents and communities expressed scepticism about the quality of emergency online instruction, questioning whether rapidly implemented virtual classes could provide meaningful learning experiences. Research from both the region and global contexts reflects similar concerns, showing that parents and learners often doubt the legitimacy and effectiveness of hastily deployed online formats, especially when quality assurance mechanisms and levels of teacher engagement are unclear or inconsistent (Ajani et al., 2025; Baytak, 2022; Hove & Dube, 2021).

Contemporary studies (Hove & Dube, 2021; Mapisa & Makena, 2024) show that the challenges arising from the abrupt transition to online learning extended well beyond technical connectivity. Hove and Dube (2021) claim that the pandemic exposed and intensified existing digital stratification between economically advantaged and disadvantaged learners, effectively creating a 'virtual elite' in which only materially privileged students could sustain educational continuity while marginalised groups were excluded. Although this pattern was documented in Zimbabwe, it reflects a broader trend across many developing education systems, where rapid digitalisation intended to preserve learning has in practice reinforced inequalities in access and opportunity. Supporting this view, empirical research with health sciences students in Turkey found that 77.4% experienced significant technological barriers to participating in online courses, and students without personal computers or stable internet connections reported

substantially lower satisfaction with remote instruction. Those relying solely on mobile phones tended to view online learning more negatively, highlighting the strong relationship between material access to technology and the quality of learning experiences (Baytak, 2022).

This broader concept of 'digital inequality' extends far beyond a simple binary of access and non-access, representing a multidimensional phenomenon closely linked to socioeconomic status (Dyanti & Mkabile-Masebe, 2025; Mathrani et al., 2023). Research syntheses from low- and middle-income contexts show that internet and mobile connectivity are unevenly distributed, and that online learning disproportionately benefits students who already possess greater family resources, cultural capital, and digital literacy (Jordan et al., 2021). Evidence from secondary education further illustrates how school closures widened these gaps: a large-scale study of Chinese high school students found that stronger family investment and better home digital conditions were associated with more intensive digital learning and higher academic achievement during the pandemic, thereby amplifying disparities between advantaged and disadvantaged students (Yajie et al., 2023). Longitudinal studies suggest that without deliberate institutional adaptation and targeted infrastructure investment, unequal technological access intensifies rural–urban educational divides, transforming remote education from a potential equalizer into a mechanism that perpetuates inequality (Aruleba & Jere, 2022). In addition, research in peripheral and rural settings also highlights the loss of peer support and heightened isolation as important psychological barriers to engagement, underscoring that access must be understood to include socioemotional and relational dimensions in addition to technology (Sikhangezile & Modise, 2020). Finally, studies show that when students perceive their courses as poorly suited to online delivery, motivation declines even when technical access is available (Baytak, 2022).

These layered inequalities shape learners' intentions to continue using online and blended learning formats. Students who experienced low-quality remote instruction during the pandemic are less likely to voluntarily adopt digital learning in the future, increasing the risk of continued exclusion from emerging digital opportunities. This has important policy implications, as pedagogical quality and institutional capacity often stronger in urban than rural institutions shape how students perceive and experience online education. Evidence indicates that educators and institutions can either reduce or reinforce exclusion depending on the level of resources, instructional quality, and support they provide. Consequently, improving students' satisfaction with and willingness to engage in online learning requires coordinated efforts that integrate infrastructure development, pedagogical improvement, and culturally responsive adaptation (Aruleba & Jere, 2022; Baytak, 2022).

Despite the expanding international and regional literature on digital inequality during COVID-19, empirical research in Kazakhstan remains limited. Existing national studies document implementation challenges and rural–urban disparities, but do not quantify access thresholds required for equivalence or examine how location-linked socio-cultural factors contribute beyond basic connectivity. For example, a large national survey of students (N = 3,670) found

that rural learners were less satisfied with online learning and faced greater difficulties than their urban peers, yet it did not estimate the levels of bandwidth, device access, or school support needed to close these gaps (Nurgaliyeva et al., 2024). Similarly, a university-focused SWOT analysis identified low internet speed and fragmented platforms as major barriers without modelling conditions for rural–urban parity (Seilkhan et al., 2022). At the system level, a quantitative study of 1,299 school leaders showed that limited teacher internet access predicted lower leader well-being during closures, highlighting organisational impacts of connectivity constraints, but it did not address parity thresholds or students’ willingness to continue online learning (Durrani & Makhmetova, 2024). Collectively, these studies describe the scope of the problem without identifying the conditions under which digital inequality can be reduced; the present study addresses this gap by systematically evaluating Kazakhstan’s distance learning experience.

The following research questions guide this study:

RQ1: What differences exist between urban and rural students in digital access, satisfaction with distance learning, and willingness to continue with online or blended learning in Kazakhstan?

RQ2: How does the urban–rural gap in digital access predict differences in students’ satisfaction and willingness to continue with online or blended learning?

RQ3: How do socio-cultural factors help explain urban–rural differences in satisfaction and willingness to continue with online or blended learning?

The study’s main contribution lies in its theoretically grounded application within the under-researched Kazakhstani context (Creswell & Clark, 2017; Greene, 2007). By identifying specific infrastructural and sociocultural thresholds at which rural learners achieve parity with urban peers, it provides an empirically based framework that other post-Soviet and developing education systems can adapt to address similar forms of digital inequality. Insights from Kazakhstan’s experience are relevant to broader contexts where many countries face challenges related to unequal digital access and cultural acceptance of e-learning, yet where detailed evidence from non-Western perspectives remains limited.

MATERIALS AND METHODS

Research Design

This study employed an explanatory mixed-methods design, in which quantitative data were collected and analysed in the first phase, followed by qualitative data used to explain and elaborate the statistical results, as recommended by Creswell and Clark’s (2017) framework for mixed-methods research. According to this approach, a structured online survey provided numeric indicators of digital access, satisfaction, and willingness to continue distance learning, while open-ended responses supplied narrative accounts that helped interpret and contextualise these quantitative patterns in students’ distance learning experiences in Kazakhstan.

Participants

The study used a stratified sampling strategy to ensure that both urban and rural students, as well as secondary school and university students, were properly represented in the sample. Of these participants, 247 (45.7%) were secondary school students and 293 (54.3%) were university students. The sample included 278 females (51.5%) and 262 males (48.5%), with a mean age of 21.7 years (range 15–22). Urban–rural representation was intentionally balanced, with 300 respondents (55.6%) enrolled in urban institutions and 240 (44.4%) studying in rural schools or universities (Table 1).

Table 1.

Sample characteristics.

Variable	Category	n	%
Educational level	Secondary schools	247	45.7
	Universities	293	54.3
Location	Urban	300	55.6
	Rural	240	44.4
Gender	Female	278	51.5
	Male	262	48.5
Age (years)	Mean (M)	21.7	-
	Range	15-22	-

Instrument

Data were collected using a structured 29-item questionnaire, the Digital Access and Socio-Cultural Barriers in Distance Learning Scale, organised into six sections (Appendix A). The instrument was theoretically informed by Van Dijk’s multilevel model of digital inequality and the Technology Acceptance Model. Section 2 operationalises material access (internet connectivity and device availability), Sections 3 and 4 capture perceived usefulness and ease of use (satisfaction, engagement, and communication), and Section 5 addresses skills and outcome access (digital competence, inclusion, and isolation). Together, these sections reflect the dimensions identified by both models as jointly shaping technology acceptance and learning outcomes (Davis, 1989; van Dijk, 2002).

The questionnaire consisted of six sections:

Section 1: Background information (five items) – gender, age, educational level, school location (urban/rural), and language of instruction.

Section 2: Digital access (3-point ordinal scale; six items) – perceived limitations related to internet connectivity and stability, device availability, access to a quiet study space at home, access to digital platforms, and perceptions of widening educational inequalities during distance learning.

Section 3: Distance learning experience (5-point Likert scale; five items) – overall satisfaction, perceived effectiveness of distance learning, preference for blended formats, willingness to continue online learning, and readiness to recommend it to others.

Section 4: Engagement and support (5-point Likert scale; five items) – ability to maintain focus during online classes, perceived instructor effectiveness, ease of communication, adequacy of language support, and perceived equivalence between online and face-to-face learning.

Section 5: Social and inclusivity factors (5-point Likert scale; five items) – digital skills, sense of inclusion, peer interaction, feelings of isolation, and motivational aspects of online learning.

Section 6: Open-ended questions (three items) – perceived challenges during distance learning, coping strategies, and views on satisfaction and support in online or blended formats.

The items were informed by prior research on digital inequality and online learning adoption and adapted to the Kazakhstani context (Keegan, 2013; Nurgaliyeva et al., 2024). The questionnaire was administered in both Kazakh and Russian to ensure accessibility for students from different linguistic backgrounds.

Instrument Validity and Reliability

The questionnaire was designed to measure four constructs related to students' distance learning experiences: digital access, distance learning experience, engagement and support, and social and inclusivity factors. Digital access captured key infrastructural conditions such as internet quality, device availability, quiet study space, and access to digital platforms, as well as perceptions of widening inequalities. Distance learning experience reflected overall satisfaction, perceived effectiveness, preference for blended formats, and willingness to continue or recommend online learning. Engagement and support focused on students' ability to concentrate, perceived instructor effectiveness, communication with teachers, and perceived equivalence between online and face-to-face learning. Social and inclusivity factors assessed students' digital skills, perceived family and community support, scepticism toward online learning, growing confidence over time, and perceptions of inclusivity in the online learning environment. The open-ended questions were designed to elaborate these key quantitative constructs, providing richer explanations of urban–rural differences in digital access, learning satisfaction, and social support.

Content validity was supported by a blueprint (table of specification) linking each item to the core constructs of digital access, engagement, satisfaction, and socio-cultural attitudes, and by review from three faculty experts (digital education and cultural studies), who confirmed adequate coverage of these domains and suggested minor wording refinements (Zhang & Aryadoust, 2022). Construct validity was further indicated by convergence between quantitative scale scores and qualitative themes from the open-ended responses, which aligned with patterns reported in prior studies on digital inequality and online learning.

Internal consistency reliability was satisfactory across the multi-item sections of the questionnaire: Cronbach's $\alpha = 0.82$ for Section 2: Digital access, $\alpha = 0.88$ for Section 3: Distance learning experience, $\alpha = 0.84$ for Section 4: Engagement and support, and $\alpha = 0.81$ for Section

5: Social and inclusivity factors, all exceeding commonly recommended thresholds for educational research (Edelsbrunner et al., 2025).

Data Collection

Data were collected through an online questionnaire administered via Microsoft Forms between November 2024 and February 2025. Participants were asked to retrospectively evaluate their distance learning experiences during the COVID-19 pandemic. To ensure representation from both urban and rural contexts, a multi-channel recruitment strategy was employed, involving regional education departments, school and university networks, mailing lists, social media platforms, and professional communities. Participation was voluntary and anonymous, and no incentives were provided. A total of 540 valid responses were collected from students across multiple regions, yielding a diverse and well-balanced dataset in terms of geographic location, educational level, and socioeconomic background.

Data Analysis

To analyse the survey data, descriptive statistics were computed to summarise key indicators, including overall satisfaction, access to digital platforms, and willingness to continue distance learning. Urban–rural comparisons were conducted using two-tailed independent-samples t-tests for continuous outcomes and χ^2 tests for categorical outcomes. Continuous measures included the Digital Access Index (0–4), calculated as the sum of four binary indicators (adequate internet, personal device, stable connectivity during classes, and a dedicated study space), and Satisfaction measured on a 5-point Likert scale. Mean differences were reported with 95% confidence intervals and Cohen’s *d* as an effect size indicator (small ≈ 0.20 , medium ≈ 0.50 , large ≈ 0.80), with Welch’s t-test applied when Levene’s test indicated unequal variances. Categorical outcomes included satisfaction (≥ 4 vs. < 4) and willingness to continue (Yes, Maybe, No), with results reported using χ^2 statistics, ϕ for 2×2 tables, and Cramér’s *V* for 2×3 tables (small ≈ 0.10 , medium ≈ 0.30). Distributional assumptions were checked using histograms and Q–Q plots, all expected cell counts met minimum requirements, and all tests were two-tailed with $\alpha = 0.05$.

To examine the association between satisfaction and willingness to continue, Spearman’s r_s was calculated and interpreted using the Chaddock classification at $p = 0.05$. Additionally, hierarchical regression analyses were conducted to identify the predictors of satisfaction and willingness to continue. Location was entered in Step 1, followed by digital access and support variables in Step 2, to test whether infrastructural conditions accounted for urban–rural disparities.

Qualitative data from the three open-ended questions were summarised to illustrate and explain the quantitative patterns observed in the survey results. The analysis was conducted independently by two researchers with expertise in online education, who reviewed all responses and identified recurring patterns related to connectivity, engagement and motivation, assessment integrity, changes in daily routines, and emotional well-being (Naeem et al., 2023). Through iterative comparison and discussion, the researchers agreed on a set of

common themes and selected representative quotations that best captured these patterns and clarified how students experienced distance learning in different urban and rural contexts.

Ethical Considerations

Confidentiality was rigorously maintained by protecting participants' identities and ensuring secure data handling throughout the study. Participants' fundamental rights, including the right to privacy, were fully respected in accordance with relevant national legislation. Informed consent was obtained from all participants prior to their involvement. The research protocol was reviewed and approved by the university ethics committee (protocol № IRB-A899), ensuring compliance with internationally recognised ethical standards.

RESULTS

RQ1: What differences exist between urban and rural students in digital access, satisfaction with distance learning, and willingness to continue with online or blended learning in Kazakhstan?

We first quantified urban–rural differences in digital access, satisfaction with distance learning, and willingness to continue with online or blended learning, as the primary aim of this study was to assess disparities between urban and rural students. Table 2 presents descriptive statistics and Welch's t-tests for urban–rural differences in the Digital Access Index and satisfaction scores. Table 3 summarises the corresponding categorical comparisons for satisfaction and willingness to continue online or blended learning. The results provide clear evidence of an urban–rural digital divide, with urban students reporting significantly better digital access, slightly higher satisfaction with distance learning, and greater willingness to continue in online or blended formats compared to their rural counterparts.

Table 2.

Urban-rural comparisons: descriptive and inferential tests (Welch's t) with effect sizes

Outcome	Urban	Rural	Welch's t	p	Cohen's d
Digital Access Index (0–4)	3.2 ± 0.8	2.4 ± 0.9	t = 10.78	< 0.001	0.95 (large)
Satisfaction (1–5)	3.6 ± 0.9	3.2 ± 0.9	t = 5.13	< 0.001	0.44 (medium)

Note: Higher Digital Access Index indicates better access (0-4: adequate internet, personal device, stable in-class connectivity, quiet study space). Group sizes: Urban $n = 300$; Rural $n = 240$.

Table 3.

Urban-rural comparisons: percentages and inferential tests (χ^2) with effect sizes

Outcome	Urban	Rural	χ^2	p	Effect size
Satisfied (≥ 4)	57.0%	40.0%	15.42	< 0.001	$\phi = 0.17$
Willingness (Yes/Maybe/No)	40% / 30% / 30%	25% / 30% / 45%	17.18	< 0.001	Cramér's V = 0.18

As shown in Table 2, urban respondents reported a substantially higher average Digital Access Index ($M = 3.2$ out of 4) than rural respondents ($M = 2.4$). This composite index captured access to four key resources: adequate internet bandwidth, personal one to one device

availability, stable connectivity for at least five days per week, and a quiet study space at home. An average score of 3.2 suggests that most urban students had access to the majority of these resources, whereas rural students, on average, lacked one or two. These access disparities were reflected in learning experiences, as urban students reported slightly higher satisfaction with online learning ($M = 3.6$ out of 5) compared to rural students ($M = 3.2$). Consistent with this pattern, 57.0 percent of urban respondents reported being satisfied or very satisfied with online learning, while only 40.0 percent of rural respondents reported the same.

Formal analyses confirmed that urban–rural differences were both statistically and practically significant. On the Digital Access Index, urban students scored 0.80 points higher than rural students (95% CI = 0.65–0.95), Welch’s t (≈ 483) = 10.78, $p < .001$ representing a large effect (Cohen’s $d = 0.95$). Satisfaction with distance learning also favoured urban students, with a moderate mean difference ($\Delta M = 0.40$, 95% CI = 0.25–0.55; Welch’s t (≈ 512) = 5.13, $p < .001$; $d = 0.44$). Categorical analyses showed that a greater proportion of urban students reported being satisfied or very satisfied (57.0% vs. 40.0%), and this association with location was significant ($\chi^2(1) = 15.42$, $p < .001$; $\phi = 0.17$), with urban students having nearly twice the odds of satisfaction (OR = 1.99, 95% CI = 1.41–2.81).

Illustrative qualitative findings

The following narratives address RQ1 by clarifying mechanisms that emerged from the quantitative findings. Qualitative responses clarified the mechanisms underlying these patterns, as students frequently attributed satisfaction to stable internet access, exclusive use of personal devices, and supportive home learning environments often emphasising the flexibility and availability of recorded. One university student noted, *“I could follow lectures from home without worrying about missing content, and I liked having recordings to review.”* In contrast, dissatisfaction was closely linked to frequent connectivity disruptions and limited interaction, with rural students describing repeated internet outages and feelings of isolation that hindered participation; as one school student explained, *“Sometimes the internet would cut out three or four times during one class; it was impossible to follow the lesson,”* while another added, *“I felt isolated and could not ask questions when I needed help.”* Together, these qualitative accounts reinforce the quantitative results by highlighting how access and interaction conditions played a decisive role in shaping students’ learning experiences and satisfaction. Willingness to continue with online learning exhibited an even sharper urban–rural contrast. Among urban students, 40% reported being willing to continue with online or blended learning, compared with only 25% of rural students, while opposition was more prevalent among rural respondents (45%) than urban respondents (30%). The remaining students in both groups selected the conditional response ‘Maybe’. This distribution indicated a small to moderate association between location and future learning preferences ($\chi^2(2) = 17.18$, $p < .001$; Cramér’s $V = 0.18$) and, when considered alongside the satisfaction gap, suggests that limited access and weaker learning experiences in rural contexts reduce students’ willingness to adopt digital learning modalities in the future.

In summary, rural learners were less satisfied with their pandemic distance education experiences and less willing to continue with online learning in the future, indicating a gap not only in current experiences but also in attitudes toward e-learning. This pattern aligns with prior research, as a comparative study in Indonesia similarly found lower levels of satisfaction, participation, and willingness to engage in online learning among rural students compared to their urban counterparts during the pandemic (Safiah et al., 2023).

Analysis of specific infrastructural conditions reveals clear thresholds at which rural learners' outcomes begin to resemble those of their urban peers. Rural students who reported that internet connectivity, device access, and quiet study space were not limiting factors exhibited satisfaction levels and willingness to continue online learning that were much closer to urban students' outcomes than those of rural students facing substantial constraints in any of these areas. These findings indicate that parity depends on the simultaneous provision of stable connectivity, personal device access, and a supportive home study environment, rather than improvements in any single condition alone.

RQ2: How does the urban–rural gap in digital access predict differences in students' satisfaction and willingness to continue with online or blended learning?

To identify the infrastructural conditions predicting satisfaction and willingness to continue, we conducted hierarchical regression analyses (Table 4). In Step 1, location alone significantly predicted satisfaction ($\beta = 0.21$, $p < .001$, $R^2 = 0.04$) and willingness to continue (OR = 1.99, 95% CI [1.41, 2.81], $p < .001$). In Step 2, after accounting for the Digital Access Index and school platform support, the effect of location was substantially reduced and became non-significant for satisfaction ($\beta = 0.06$, $p = .18$) and marginal for willingness (OR = 1.32, 95% CI [0.96, 1.82], $p = .08$). Digital access emerged as the strongest predictor of both satisfaction ($\beta = 0.45$, $p < .001$) and willingness to continue (OR = 2.34, 95% CI [1.78, 3.08], $p < .001$), followed by school platform support (satisfaction: $\beta = 0.28$, $p < .001$; willingness: OR = 1.67, 95% CI [1.21, 2.31], $p < .01$). The full model explained 38 percent of the variance in satisfaction ($R^2 = 0.38$, $\Delta R^2 = 0.34$, $p < .001$) and correctly classified 72 percent of willingness outcomes (Pseudo- $R^2 = 0.21$), indicating that when rural students have access to stable connectivity, personal devices, and adequate institutional support comparable to urban students, the urban–rural gap in satisfaction and willingness largely disappears, confirming that these disparities are driven by modifiable infrastructural and support conditions rather than location itself.

To further clarify the sources of these disparities, we analysed specific dimensions of digital access and perceived obstacles. Table 5 presents a detailed comparison of urban and rural students' self-reported limitations, including internet availability, connection stability, device access, quiet study space, and access to school-provided digital learning platforms, as well as the proportion of students who perceived educational inequality to have increased during remote instruction.

Table 4.*Hierarchical regression analysis predicting satisfaction and willingness to continue*

Predictor	Satisfaction Step 1	Satisfaction Step 2	Willingness Step 1 (OR)	Willingness Step 2 (OR)
Location (Urban)	$\beta = 0.21$ (SE = 0.05)	$\beta = 0.06$ (SE = 0.04)	OR = 1.99 [1.41, 2.81]	OR = 1.32 [0.96, 1.82]
Digital Access Index	—	$\beta = 0.45$ (SE = 0.04)	—	OR = 2.34 [1.78, 3.08]
School Platform Support	—	$\beta = 0.28$ (SE = 0.05)	—	OR = 1.67 [1.21, 2.31]
R ² / Pseudo-R ²	0.04	0.38	0.03	0.21
ΔR^2 / Δ Pseudo-R ²	—	0.34	—	0.18

Table 5.*Perceived limitations and inequality signals by location (Urban n = 300; Rural n = 240)*

Item	Category	Urban n (%)	Rural n (%)
Students' internet connectivity	Not a limitation	246 (82.0%)	139 (57.9%)
	Minor limitation	36 (12.0%)	58 (24.2%)
	Major limitation	18 (6.0%)	43 (17.9%)
Students' connection stability (drops, lag)	Not a limitation	243 (81.0%)	144 (60.0%)
	Minor limitation	39 (13.0%)	60 (25.0%)
	Major limitation	18 (6.0%)	36 (15.0%)
Students' access to digital devices (1:1 availability)	Not a limitation	237 (79.0%)	149 (62.1%)
	Minor limitation	45 (15.0%)	58 (24.2%)
	Major limitation	18 (6.0%)	33 (13.8%)
Quiet study space at home	Not a limitation	234 (78.0%)	144 (60.0%)
	Minor limitation	48 (16.0%)	60 (25.0%)
	Major limitation	18 (6.0%)	36 (15.0%)
School's access to digital platforms	Not a limitation	216 (72.0%)	139 (57.9%)
	Minor limitation	60 (20.0%)	67 (27.9%)
	Major limitation	24 (8.0%)	34 (14.2%)
Widening inequality (during distance learning)	Yes	144 (48.0%)	158 (65.8%)
	No	156 (52.0%)	82 (34.2%)

Several clear patterns emerge from Table 5, with rural students reporting greater challenges than urban peers across all indicators. For basic internet connectivity, 82.0% of urban students reported that personal internet access was not a limitation, compared with only 57.9% of rural students, while 17.9% of rural students described connectivity as a major limitation,

nearly three times the urban rate (6.0%). This highlights a substantial gap in internet availability and quality between urban and rural areas.

Illustrative qualitative findings

The following qualitative findings address RQ2 by showing how access constraints and support conditions shape urban–rural differences in satisfaction and willingness to continue online learning. Qualitative responses further illustrate these disparities, as rural students described having to search for a signal outdoors, experiencing frequent disconnections, or sharing a single device among multiple siblings, which limited regular participation. As one rural student explained, *“I had to walk outside or even climb on the roof to catch a signal, also often I missed half the lesson because the internet kept dropping,”* while another noted, *“Sometimes three siblings had to share one phone, so I could not join classes regularly.”* In contrast, urban students emphasised stable connections and personal device access that allowed uninterrupted attendance and use of recorded materials; one university student wrote, *“Our Wi-Fi was stable, and I could focus on learning without interruptions.”* Another urban respondent emphasised convenience, saying, *“Having my own laptop meant I could join every class and replay recorded lectures when needed.”* Together, these narratives reinforce the quantitative results by showing how connectivity and device constraints directly shaped everyday distance learning experiences, with additional subgroup patterns summarised in Appendix B. A comparable disparity is evident in connection stability. Even when internet access was available, rural students experienced more frequent disconnections and lag, with 15.0 percent reporting unstable connections as a major problem compared to only 6.0 percent of urban students. Consistently, 60.0% of rural students reported no significant stability issues, whereas more than 80 percent of urban students enjoyed stable connections throughout online learning. Qualitative comments mirror this divide; as one rural student described, *“The video would freeze every few minutes, and I had to reconnect again and again, it was exhausting,”* while another noted, *“Sometimes I only heard the teacher’s voice without seeing the slides because of weak internet,”* in contrast to an urban student who emphasised that *“Classes on Zoom were smooth; I never worried about the signal,”* and another who wrote, *“Even if my camera was on for two hours, the connection stayed strong, so I could participate fully.”* These accounts confirm that differences in connection stability directly affected the quality of students’ learning experiences.

Device access exhibits a similar pattern. Nearly four out of five urban students (79.0%) reported having personal device access with no limitations, compared with only 62.1% of rural students. The remaining rural learners often shared devices or relied on inadequate equipment, with 13.8% identifying device access as a major limitation, more than double the proportion reported by urban students (6.0%).

Limited access to a quiet study space was another challenge more commonly reported by rural students, with 15.0% indicating the absence of a suitable space as a major limitation, double the proportion reported by urban students (6.0%). This likely reflects differences in household conditions, as rural learners often had fewer private or quiet areas for focused study

during lockdowns. Qualitative accounts support this pattern, with rural students describing shared devices and studying in noisy common spaces, while urban students more frequently reported having personal devices and dedicated rooms that enabled concentration. Together, these experiences illustrate how both home environments and resource availability shaped learning opportunities during distance education.

RQ3: How do socio-cultural factors help explain urban–rural differences in satisfaction and willingness to continue with online or blended learning?

Qualitative analysis of 540 open-ended responses revealed recurrent socio-cultural themes that help explain the quantitative disparities, with eight categories summarized in Appendix B (Table 6). Internet connectivity emerged as the most critical challenge, reported by about 60% of rural secondary students and 55% of rural university students, compared with only 10–15% of urban students, while stability problems such as lag and dropped connections affected 40–50% of rural respondents versus fewer than 20% of urban students. Device access gaps were also pronounced, as roughly 35–40% of rural students lacked personal or adequate devices, whereas 75–85% of urban students reported having their own laptops or tablets, and limited home study space affected 30–35% of rural students compared with 75–80% of urban students who had dedicated areas. Platform access further differentiated experiences, with 30–40 percent of rural students relying on basic tools such as WhatsApp, while 70–80% of urban students used formal learning management systems. These constraints translated into lower perceived quality, as only 35–40 percent of rural students reported satisfaction despite difficulties, compared with 55–65% of urban students. Socio-cultural factors reinforced these patterns: around 45–50 percent of rural students reported family scepticism toward online learning, compared with 65–70% of urban students who experienced supportive environments, and perceptions of worsening inequality were more prevalent among rural students (60–65 percent versus 45–50 percent urban). Together, these findings indicate that scepticism about the legitimacy of online learning, social isolation, and limited family support were more acute in rural contexts and interacted with infrastructural deficits to suppress satisfaction and willingness to continue, whereas urban students more often viewed online learning as a manageable adaptation, with 40–45 percent open to future hybrid formats compared with only 25–30 percent of rural students.

DISCUSSION

The central finding of this study is that the rapid shift to online education during the COVID-19 pandemic exposed and intensified existing digital inequalities between urban and rural learners in Kazakhstan, revealing a clear divide in both technological access and educational experiences. This section discusses the findings in relation to the research questions and situates them within the broader Kazakhstani and international literature, with a focus on digital inequality and urban–rural disparities as well as infrastructural challenges, which together highlight key challenges and lessons from Kazakhstan’s pandemic education response.

Urban–rural differences in digital access, satisfaction, and willingness

The findings underscore a pronounced urban–rural disparity in digital access, confirming that rural students were disproportionately affected by the abrupt shift to distance learning. The digital gap was substantial, indicating that rural students, on average, lacked at least one of four critical resources adequate internet, personal devices, stable connectivity, or a suitable study space that were generally available to urban students. This pattern aligns with prior research in Kazakhstan and internationally. Teacher-reported evidence shows that rural location and slow internet limited the use of synchronous instructional tools during school closures, while school-provided ICT access helped mitigate these constraints. Student-focused studies likewise report lower satisfaction and greater challenges among rural learners (Nurgaliyeva et al., 2024), and our study extends this work by estimating the level of infrastructure improvement required for rural students to reach parity. Consistent with international findings, rural learners often experience lower satisfaction in online contexts due to structural disadvantages (Mathrani et al., 2023). Importantly, the study results show that rural students with full access to digital resources reported satisfaction levels comparable to urban peers, suggesting that the digital divide reflects unequal resource distribution rather than inherent rural–urban differences. Similar conclusions have been drawn in multi-country studies documenting greater technological barriers and learning difficulties among rural students during COVID-19 (Mathrani et al., 2023), particularly for marginalised groups, and our findings mirror this global evidence of compounded disadvantage linked to connectivity and unequal access to digital skills and resources (Aissaoui, 2022; Salemink et al., 2017; Van Deursen & Van Dijk, 2019). These results directly address RQ1 by showing that urban–rural differences in satisfaction and willingness to continue online learning are closely aligned with measured disparities in digital access. Qualitative accounts of repeated disconnections, shared devices, and noisy study environments in rural areas provide concrete explanations for the lower satisfaction scores and weaker willingness observed among rural students.

It is important to note that urban–rural gaps are not unique to Kazakhstan but are especially pronounced in post-Soviet and other developing contexts with centralised education systems. Kazakhstan is a particularly illustrative case because, despite relatively high national connectivity levels, substantial internal disparities persist. Urban students in cities such as Almaty and Astana often have high-speed internet and multiple devices at home, whereas rural students may depend on a single smartphone with limited data, a contrast that became especially visible and consequential during the pandemic. By identifying the conditions under which rural learners reported higher satisfaction, this study highlights potential thresholds for narrowing the urban–rural divide, with stable internet access and personal device availability emerging as especially influential. These findings align with national evidence, as UNICEF Kazakhstan’s 2024 learning-loss briefs document similar challenges in under-resourced schools, including weak connectivity, limited devices, and reliance on smartphones (UNICEF, 2024). Although these results should be interpreted cautiously, they suggest that improving basic

digital infrastructure could substantially reduce observed differences in satisfaction between urban and rural learners.

Another disparity emerged in students' willingness to continue with e-learning. Even after accounting for access constraints, rural students remained more hesitant than urban students to pursue future online or blended education, likely reflecting their poorer prior experiences. This pattern raises the risk of a new form of inequality: as digital and hybrid learning models expand globally, rural students may disengage or be excluded due to negative experiences during the pandemic. Ensuring that rural schools can deliver effective and positive e-learning experiences is therefore essential to prevent a scenario in which urban students benefit from the flexibility, resources, and connectivity of digital education while rural students are confined to traditional modes. Ultimately, narrowing the urban–rural digital divide is not only about improving current access but also about safeguarding equitable participation in future education systems. This pattern responds to RQ1 by indicating that willingness to continue is not uniformly low but systematically stratified by prior learning conditions, with qualitative narratives of frustration and disengagement among rural students helping to explain the higher proportion of “No” responses in this group. The quantitative evidence clearly indicates that infrastructure deficits were the primary barrier to equitable distance education in Kazakhstan. Reliable electricity, internet connectivity, and access to appropriate hardware and software form the basic foundation of online learning, yet students in rural areas faced challenges across nearly all of these components, a pattern widely documented during the pandemic. For example, Seilkhan et al. (2022) identified limited access to mobile internet in most villages as a central problem, with even some suburban areas experiencing low connection speeds. When students are unable to connect consistently to online classes, the potential benefits of digital education cannot be realised.

Digital access and support as predictors of urban–rural differences

A central infrastructure challenge identified by respondents was inadequate connectivity, as both bandwidth and stability were often insufficient in rural areas. Rural participants described having to go outside or climb onto rooftops to obtain a usable signal and missing classes due to frequent outages, reflecting broader reports that students in remote parts of Kazakhstan relied on hilltops or minimal village broadband simply to download assignments (Seilkhan et al., 2022). This problem extended beyond students, as Durrani and Makhmetova (2024) found that more than two thirds of Kazakhstani school leaders reported poor internet access for teachers as a major constraint, which was statistically associated with lower leadership well-being. Together, these findings indicate that weak connectivity not only disrupted students' learning but also placed substantial strain on educators and administrators, making internet access a critical weak link in the distance education system, particularly outside urban centres.

In 2020–2021, Kazakhstan had 7,550 schools, of which 96.4% were state funded, 3.4% private, and 0.3% undisclosed (Bureau of National Statistics, 2022), with approximately 71% located in rural areas, reflecting the country's large territory and low population density outside

major cities. Rural schools tend to be small, whereas urban schools are generally larger and often operate in multiple shifts (Durrani et al., 2023), structural features that make rural institutions particularly vulnerable to connectivity problems and shortages of digital resources. Device availability represents another key infrastructural constraint. Although mobile phone penetration in Kazakhstan is high, many students, particularly in multi-child households, lacked exclusive access to a computer or tablet for online learning, and even when devices were available, they were often unsuitable for sustained educational use. Several rural students reported relying on outdated phones that could not support newer educational applications or video streaming. While the government and schools distributed laptops and tablets to some students during the pandemic, this support was often insufficient or delayed in many communities. These quantitative gaps in device access and the reported reliance on outdated phones in rural households clarify why digital access emerged as the strongest predictor of satisfaction and willingness in the regression models, providing a mechanism for the urban–rural differences identified in RQ1 and RQ2. Our parity analysis suggests that implementing a 1:1 device initiative in rural areas, combined with reliable broadband access, would substantially reduce gaps in learning outcomes. This conclusion aligns with international recommendations emphasising the provision of standardised home learning equipment and high-quality internet for rural students (Mathrani et al., 2023) and national calls for affordable high-speed connectivity and a unified e-learning platform in Kazakhstan (Seilkhan et al., 2022).

Platform performance and access to digital content constituted another important infrastructural challenge. During the early stages of the pandemic, many Kazakhstani schools lacked established LMS, relying instead on temporary solutions such as WhatsApp, Telegram, or emailed PDF assignments, which limited instructional effectiveness. Although platforms such as Kundelik and Daryn Online were later expanded, rural schools frequently faced server overloads, limited technical support, and incomplete availability of Kazakh-language content. University students generally reported more robust systems such as Moodle or Microsoft Teams, yet still experienced outages and the burden of navigating multiple platforms. Consistent with Seilkhan et al. (2022), these findings indicate that fragmented platforms and inconsistent tool adoption hindered effective distance education, as the absence of a centralised and reliable system increased technical friction for both teachers and students. Qualitative responses from students who had to rely on WhatsApp or Telegram instead of structured LMS further illuminate how limited platform support translated into lower engagement and weaker perceptions of online learning quality, thereby contributing to lower satisfaction and willingness among rural learners.

Our findings suggest that standardising a stable, scalable, and multilingual e-learning platform is essential for strengthening future educational resilience. Many survey respondents expressed a preference for a single system that integrates lessons, assignments, and communication and is accessible in both Kazakh and Russian, underscoring that infrastructure challenges extend beyond hardware to include the software ecosystem. The positive references to open-source platforms such as Moodle suggest a viable strategy of investing in systems that

can be localised and sustainably maintained at the national level rather than relying on fragmented, ad hoc solutions.

Socio-cultural factors in distance learning

Socio-cultural attitudes influenced not only the implementation of distance learning but also how students and families experienced it. Qualitative responses revealed early scepticism about the legitimacy of online education, with concerns about fairness, academic rigor, grade inflation, and weakened credibility. These views reflect longstanding cultural expectations in which face-to-face supervision is closely associated with ‘real learning’, making the sudden absence of physical oversight disruptive to shared norms of discipline and achievement. Over time, however, some respondents described a gradual shift in attitudes, as increased familiarity with digital tools reduced resistance and normalised online learning as a workable, though imperfect, educational mode. This progression aligns with broader theories of technological adoption, which suggest that repeated exposure can mitigate initial cultural barriers. These themes directly address RQ3 by showing that urban–rural differences in satisfaction and willingness are also shaped by socio-cultural perceptions of legitimacy, fairness, and teacher presence, not just by technical access. The qualitative evidence suggests that these socio-cultural attitudes emerged in response to concrete features of the emergency transition to distance learning rather than in isolation. Initial scepticism was closely linked to perceptions of weak assessment integrity and reduced teacher presence, leading many students and families to question whether grades and learning outcomes in online settings were comparable to those in face-to-face education. Over time, however, continued exposure to digital platforms, the establishment of more structured online routines, and clearer assessment practices fostered a shift from outright distrust toward more conditional acceptance, particularly among students who reported stable access and consistent instructional support. This pattern suggests that socio-cultural barriers are shaped by the interaction between infrastructure and institutional practice rather than by cultural conservatism alone. This mixed-methods integration indicates that the same infrastructural variables identified in the quantitative models (connectivity, platforms, support) also structure students’ beliefs about whether online formats constitute “real education,” helping to explain why some rural students remain reluctant to continue with e-learning even when basic access is available. Rural learners who faced frequent connectivity failures and relied on informal messaging tools instead of structured platforms were more likely to view online learning as ‘not real education’, while urban learners with reliable systems and transparent assessment practices more often considered online formats a legitimate complement to face-to-face instruction. This is consistent with Table 4, which shows that rural students reporting major platform limitations were more likely to question the legitimacy of online learning. Overall, attitudes appear to have evolved in response to the quality and reliability of students’ lived experiences, indicating that improvements in technical conditions and institutional support can gradually shift perceptions from scepticism toward acceptance. Furthermore, the interaction between social isolation and self-regulation appears to be a key

mechanism underlying these attitudinal differences. Students who emphasised the loss of peer interaction and classroom community often reported reduced motivation and a stronger preference for a full return to in-person learning, even when technical access was adequate. In contrast, a subset of respondents, more commonly from urban universities, noted that once infrastructure and communication stabilised, online learning fostered greater autonomy, improved time-management skills, and access to additional digital resources. This divergence suggests that socio-cultural acceptance of online learning is uneven and depends on the balance between perceived losses in social support and perceived gains in flexibility and agency, which vary systematically by location and institutional capacity.

The open-ended responses also highlighted the social dimension of education, as students often linked online learning to feelings of isolation and reduced motivation, underscoring the cultural importance of collective learning environments. Rural respondents in particular described difficulties maintaining focus without their usual peer and teacher support, suggesting that while infrastructure was essential, cultural adaptation and social trust were equally influential in shaping learning outcomes. At the same time, not all experiences were negative, as some students reported developing stronger self-regulation, greater independence, and increased use of supplementary resources. These reflections suggest the possibility of a gradual cultural shift in which digital tools move beyond mere acceptance and become integrated into everyday learning practices.

Educational and policy implications

The findings of the study point to several educational and policy implications for reducing digital inequality among urban and rural students in Kazakhstan. In summary, infrastructure challenges in Kazakhstan's COVID-19 distance education were multifaceted and interconnected, as weak internet connectivity, device shortages, and fragmented platforms collectively produced unequal and often ineffective learning experiences, particularly for rural students, as reflected in lower satisfaction scores and reduced willingness to continue with online learning. These patterns mirror findings from other countries, ranging from developing contexts with uneven internet access to developed regions where sudden demand overwhelmed existing systems (Mathrani et al., 2023; Aruleba & Jere, 2022; Baytak, 2022).

For education systems, the findings imply the need to redesign distance learning provision so that rural and under-resourced schools can offer online instruction that is comparable in quality and support to that of urban institutions. The policy implication is clear: closing the digital divide must be a priority, and these gaps are addressable through targeted investments such as expanding rural broadband, subsidising devices for low-income families, and strengthening electrical and network reliability – measures that directly respond to the documented deficits in connectivity, device access, and quiet study spaces that distinguished rural from urban students in this study. This recommendation is consistent with international research showing that reliable internet, adequate devices, and supportive home environments

are foundational for equitable participation in online learning (Mathrani et al., 2023; Jordan et al., 2021; Van Deursen & Van Dijk, 2019).

In parallel, education systems should invest in teacher training for online instruction, develop clear standards for digital assessment, and support schools in creating online peer-support mechanisms, thereby addressing the qualitative evidence of weak teacher presence, concerns about assessment integrity, and feelings of isolation that contributed to lower satisfaction and greater reluctance to continue with online learning, especially among rural respondents. Previous studies similarly emphasise that teacher readiness, clear assessment practices, and social interaction are critical for sustaining engagement and trust in online education (Turnbull et al., 2021; Hove & Dube, 2021; Sikhangezile & Modise, 2020). Our findings support and reinforce ongoing national efforts to improve rural connectivity and suggest the need for faster and broader implementation.

At the same time, qualitative evidence shows that socio-cultural barriers were dynamic rather than fixed, evolving from scepticism toward cautious acceptance and, in some cases, recognition of new opportunities. This finding aligns with research indicating that perceptions of legitimacy, fairness, and autonomy in online learning shift over time as students gain experience with digital platforms and as institutions refine their practices (Davis, 1989; van Dijk, 2002; Naeem et al., 2023). Placed within Kazakhstan's broader educational culture, these results suggest that effective distance learning depends not only on technical infrastructure but also on reshaping shared attitudes and trust in digital education, indicating that sustainable progress requires simultaneous attention to both material access and social legitimacy. Previous research likewise argues that without parallel efforts to strengthen institutional support and cultural acceptance, expansion of digital technologies can deepen existing inequalities rather than resolve them (Salemink et al., 2017; Van Deursen & Van Dijk, 2019; Aruleba & Jere, 2022)

CONCLUSION

Kazakhstan's shift to distance learning during the COVID-19 pandemic exposed enduring urban-rural disparities in digital access. Although overall satisfaction with online education was moderate, rural students consistently experienced weaker connectivity, limited access to personal devices, and less supportive study environments, which in turn reduced both their satisfaction and willingness to continue. The findings identify clear thresholds for narrowing this gap, showing that reliable broadband, one-to-one device provision, and stable study conditions substantially improve learning experiences and bring rural students closer to parity with their urban peers. For policymakers, the implications are clear. Reducing digital inequality requires sustained investment in rural broadband and affordable devices, the development of a unified multilingual e-learning platform, and continuous training for teachers and students to strengthen digital competencies. Community engagement is equally important to build trust and address scepticism toward online education. Beyond infrastructure, this study shows that socio-cultural barriers, including concerns about academic integrity, doubts about the value of

online learning, and experiences of social isolation, also shaped student outcomes. Importantly, these barriers proved dynamic rather than fixed, as greater familiarity with digital tools and supportive institutional narratives fostered increased acceptance. By integrating technical improvements with cultural adaptation, Kazakhstan can move toward an inclusive blended education model that promotes regional equity and strengthens system resilience against future disruptions. At the same time, this study has several limitations. Because data were collected online, students with the poorest connectivity may be underrepresented, and the use of self-reported measures introduces the possibility of response bias. In addition, the analysis focused primarily on students' perspectives, and incorporating the views of teachers and parents could provide a more comprehensive understanding. Future research should employ mixed sampling strategies, longitudinal designs, and intervention-based approaches to examine how improvements such as broadband expansion, device provision, and digital skills training can effectively reduce educational inequalities.

REFERENCES

- Ajani, O., Govender, S., & Gamede, B. (2025). Investigating Emerging Technologies for Curriculum Delivery in a Rural South African University through the Lens of Diffusion of Innovation. *Journal of Curriculum Studies Research*, 7(2), 394-411. <https://doi.org/10.46303/jcsr.2025.27>
- Aissaoui, N. (2022). The digital divide: A literature review and some directions for future research in light of COVID-19. *Global Knowledge, Memory and Communication*, 71(8/9), 686–708.
- Alismaiel, O. A., Cifuentes-Faura, J., & Al-Rahmi, W. M. (2022). Online learning, mobile learning, and social media technologies: An empirical study on constructivism theory during the COVID-19 pandemic. *Sustainability*, 14(18), 11134.
- Aruleba, K., & Jere, N. (2022). Exploring digital transforming challenges in rural areas of South Africa through a systematic review of empirical studies. *Scientific African*, 16, e01190.
- Baytak, A. (2022). The Health Students' Perception of Online Education Amid the COVID-19 Pandemic. *Research in Social Sciences and Technology*, 7(2), 49–65.
- Bokayev, B., Torebekova, Z., Abdykalikova, M., & Davletbayeva, Z. (2021). Exposing policy gaps: The experience of Kazakhstan in implementing distance learning during the COVID-19 pandemic. *Transforming Government: People, Process and Policy*, 15(2), 275–290.
- Burakanova, G. M., Orazgaliyeva, A. G., & Pinaev, S. M. (2021). Psychological, pedagogical, and digital aspects of distance learning in Kazakhstan in the context of the COVID-19 pandemic. *SHS Web of Conferences*, 113, 21.
- Bureau of National Statistics. (2022). In Available online. <https://bala.stat.gov.kz/en/obscheobrazovatelnye-shkoly-po-tipu-mestnosti/>

- Costa, S. A., Kavouras, I., Cohen, N., & Huang, T. T. K. (2021). Moving education online during the COVID-19 pandemic: Thinking back and looking ahead. *Frontiers in Public Health, 9*, 751685.
- Creswell, J. W., & Clark, V. L. P. (2017). *Designing and conducting mixed methods research*. Sage publications.
- Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly, 319–340*.
- Durrani, N., Qanay, G., Mir, G., Helmer, J., Polat, F., Karimova, N., & Temirbekova, A. (2023). Achieving SDG 4, Equitable quality education after COVID-19: Global evidence and a case study of Kazakhstan. *Sustainability, 15(20)*, 14725.
- Dyantyi, N., & Mkabile-Masebe, B. (2025). Closing the Digital Divide: Strategies for Addressing Inequalities in Technology Access in Higher Education Institutions. *Research in Social Sciences and Technology, 10(1)*, 412-425. <https://doi.org/10.46303/ressat.2025.22>
- Edelsbrunner, P. A., Simonsmeier, B. A., & Schneider, M. (2025). The Cronbach's alpha of domain-specific knowledge tests before and after learning: A meta-analysis of published studies. *Educational Psychology Review, 37(1)*, 4.
- Greene, J. C. (2007). *Mixed methods in social inquiry*. John Wiley & Sons.
- Hove, B., & Dube, B. (2021). Covid-19 and the entrenchment of a virtual Elite private school: Rethinking education policies in Zimbabwe. *Journal of Culture and Values in Education, 4(2)*, 84–94. <https://doi.org/10.46303/jcve.2021.5>
- Imanova, D., Akzhigitova, A., & Zabrodskaja, A. (2025). Language-in-Education Policy for English Language Teaching in Public Schools of Kazakhstan: Top-Down vs. Bottom-Up Approaches. *Education Sciences, 15(1)*, 1–27. <https://doi.org/10.3390/educsci15010066>
- Jordan, K., David, R., Phillips, T., & Pellini, A. (2021). Education during the COVID-19: Crisis Opportunities and constraints of using EdTech in low-income countries. *Revista de Educación a Distancia (RED), 21(65)*.
- Keegan, D. (2013). *Foundations of distance education*. Routledge.
- Mapisa, B., & Makena, B. (2024). The Impact of ICT Adoption in Enhancing Teaching and Learning in Primary Schools of Amathole East District, Eastern Cape. *Research in Social Sciences and Technology, 9(1)*, 213-231. <https://doi.org/10.46303/ressat.2024.12>
- Mathrani, A., Umer, R., Sarvesh, T., & Adhikari, J. (2023). Rural–urban, gender, and digital divides during the COVID-19 lockdown: A multi-layered study. *Societies, 13(5)*, 122.
- Miao, F., Huang, R., Liu, D., & Zhuang, R. (2022). *Ensuring effective distance learning during COVID-19 disruption: Guidance for teachers (PES)*.
- Naeem, M., Ozuem, W., Howell, K., & Ranfagni, S. (2023). A step-by-step process of thematic analysis to develop a conceptual model in qualitative research. *International Journal of Qualitative Methods, 22*, 16094069231205789.

- Nurgaliyeva, S., Bolatov, A., Abildina, S., Zeinolla, S., Kurbonova, B., & Kyyakbayeva, U. (2024). COVID-19 online learning challenges: Kazakhstan secondary schools case study. *Frontiers in Education, 9*, 1448594.
- Oyedotun, T. D. (2020). Sudden change of pedagogy in education driven by COVID-19: Perspectives and evaluation from a developing country. *Research in Globalization, 2*, 100029.
- Safiah, I., Yunus, M., Suartama, I. K., Solehudin, M., & Hastuti, W. D. (2023). Different Domiciles in Online Learning during the COVID-19 Pandemic. *Journal of Education and E-Learning Research, 10*(3), 380–388.
- Salemink, K., Strijker, D., & Bosworth, G. (2017). Rural development in the digital age: A systematic literature review on unequal ICT availability, adoption, and use in rural areas. *Journal of Rural Studies, 54*, 360–371.
- Seilkhan, A., Abdrassulova, Z., Erkaebaeva, M., Soltan, R., Makhambetov, M., & Ydyrys, A. (2022). Problems of Distance Education in Kazakhstan during the COVID-19 Pandemic. *World Journal on Educational Technology: Current Issues, 14*(2), 380–389.
- Sikhangezile, N., & Modise, M. A. (2020). Social distancing, cultural and psychological effects on learners in a rural setting in Zimbabwe. *Journal of Ethnic and Cultural Studies, 7*(3), 200–209.
- Turnbull, D., Chugh, R., & Luck, J. (2021). Transitioning to E-Learning during the COVID-19 pandemic: How have Higher Education Institutions responded to the challenge? *Education and Information Technologies, 26*(5), 6401–6419.
- UNICEF. (2024). *Learning loss and digital access in Kazakhstan*. UNICEF Kazakhstan. <https://www.unicef.org/kazakhstan/>
- Van Deursen, A. J. A. M., & Van Dijk, J. A. G. M. (2019). The first-level digital divide shifts from inequalities in physical access to inequalities in material access. *New Media & Society, 21*(2), 354–375.
- van Dijk, J. A. (2002). A framework for digital divide research. *Electronic Journal of Communication, 12*(1).
- Yajie, L., Liu, H., & Gaoming, M. (2023). Widening digital divide: Family investment, digital learning, and educational performance of Chinese high school students during the COVID-19 pandemic school closures. *Applied Research in Quality of Life, 18*(5), 2397–2413.
- Zhang, Y., & Aryadoust, V. (2022). A Systematic Review of the Validity of Questionnaires in Second Language Research. In *Education Sciences* (Vol. 12, Issue 10). <https://doi.org/10.3390/educsci12100723>

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Data cannot be shared publicly because the authors' Ethics Committee has prohibited the public availability of data.

Conflicts of Interest: The authors declare no conflicts of interest.

APPENDIX

Appendix A. Questionnaire

Section 1. Background Information

1. Your gender
 - Male
 - Female
2. How old are you?
 - < 18
 - 18–24
 - 25–35
 - 36–50
 - 51>
3. Your educational level:
 - Secondary school
 - University
4. Please indicate the location of your school:
 - Urban (located within a city)
 - Rural (located in a village more than one hour's drive from the nearest city)
5. The language of instruction at your school is
 - Kazakh-medium
 - Russian-medium
 - Mixed (both Kazakh and Russian)
 - Other

Section 2. Digital Access (3-point ordinal scale)

6. During the period of distance learning, how would you describe the quality of your internet connectivity?
 - Not a limitation
 - Minor limitation
 - Major limitation
7. How would you evaluate the stability of your internet connection?
 - Not a limitation
 - Minor limitation

- Major limitation
8. Did you have personal access to a digital device (computer, laptop, or tablet) for your learning activities?
- Not a limitation (always had my own device)
 - Minor limitation (sometimes had to share or use less suitable devices)
 - Major limitation (often lacked a personal device for classes)
9. Did you have access to a quiet study space at home suitable for online learning?
- Not a limitation (always had a quiet space)
 - Minor limitation (sometimes had difficulty finding a quiet place)
 - Major limitation (rarely or never had a suitable study space)
10. How would you assess your school's or university's access to digital learning platforms?
- Not a limitation
 - Minor limitation
 - Major limitation
11. In your view, did the transition to distance learning widen educational inequalities among students in Kazakhstan?
- Yes
 - No

Section 3. Distance Learning Experience (5-point Likert scale)

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
12. I was satisfied with the overall experience of distance learning					
13. Distance learning was an effective way for me to learn.					
14. I would like my future education to include a mix of online and face-to-face learning.					
15. I am willing to continue with online learning (fully or partially) in the future.					
16. I would recommend distance/online learning to others based on my experience.					

Section 4. Engagement and Support (5-point Likert scale)

Item	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
17. I was able to stay focused and attentive during online classes					
18. My instructors delivered lessons effectively in the online format.					
19. I could easily communicate with instructors during online learning.					
20. The platform provided support in my preferred language (Kazakh and/or Russian) when needed.					
21. I feel I learned as much online as in traditional in-person classes.					

Section 5. Social and Inclusivity Factors (5-point Likert scale)

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
22. I had the necessary digital skills to effectively participate in online learning.					
23. My family/household supported my online learning.					
24. At the beginning, people in my family or community were skeptical about online learning.					
25. Over time, I became more confident and comfortable with the online format.					
26. The online environment was inclusive and accommodated different needs.					

Section 6. Open-Ended Questions

27. Can you describe any specific difficulties you experienced with internet connectivity or device availability during online learning? How did these issues affect your ability to attend classes, complete assignments, or participate in discussions?

28. What aspects of online learning contributed most to your satisfaction or dissatisfaction?

29. How did your family, household members, or local community support or influence your online learning experience?

Appendix B.**Table 6.** Qualitative patterns with approximate percentages (%), supported by illustrative quotes.

Category	Rural students - Secondary School	Rural students - University	Urban students - Secondary School	Urban students - University
Internet connectivity	≈ 60% reported regular struggles; ≈ 20% severe disruptions. "Had to go outside or climb on the roof to catch a signal."	≈ 55% noted frequent disconnections; ≈ 15% severe. "Internet cut out three or four times during one lecture."	≈ 80% stable, <10% major issues. "Our Wi-Fi was stable, I could focus on learning."	≈ 85% stable, few concerns. "I could follow lectures without problems."
Connection stability	≈ 40% described lag and drops as tiring; ≈ 15% constant barrier. "Video froze every few minutes, exhausting."	≈ 50% occasional freezes; ≈ 10% serious disruption. "Sometimes I only heard the teacher's voice without slides."	≈ 80% smooth, rare issues. "Zoom classes were smooth."	≈ 85% smooth, reliable. "Even with my camera on for two hours, the signal stayed strong."
Device access	≈ 40% lacked personal devices; ≈ 15% critical shortage. "Three siblings had to share one phone."	≈ 35% used outdated/shared devices. "Old phone couldn't run Zoom."	≈ 75–80% had own device. "I had my own laptop."	≈ 85% had laptops/tablets. "I could rewatch recorded lectures anytime."
Home study space	≈ 35% lacked quiet place; ≈ 15% said impossible to concentrate. "Studied in the kitchen, impossible to concentrate."	≈ 30% no proper room. "Had to study with siblings around."	≈ 75–80% had quiet/private room. "Had my own room."	≈ 80% had stable study space. "Parents made sure I had a quiet study space."
Platform access	≈ 40% said schools relied only on WhatsApp/basic tools; ≈ 15% saw	≈ 30% said Zoom/Moodle worked poorly. "No unified	≈ 70% satisfied with Kundelik/Daryn. "We used Kundelik/Daryn."	≈ 80% had full access to LMS (Teams/Moodle). "Everything in one place."

	as major barrier. "School had no proper platform, only WhatsApp."	system, often unstable."		
Perceived quality	≈ 40% satisfied; many frustrated. "Felt isolated, could not ask questions."	≈ 35% dissatisfied due to disconnections.	≈ 55–60% satisfied. "Lessons were recorded, I could rewatch."	≈ 60% satisfied. "Flexibility and recordings were helpful."
Socio-cultural factors / support	≈ 50% said family skeptical, saw online as "not real"; ≈ 20% no help with devices. "Parents thought it was fake learning."	≈ 45% reported limited family support, weak digital skills.	≈ 65% felt families were supportive. "Parents encouraged participation."	≈ 70% supportive environment. "Family helped create good conditions, positive attitude."
Perceived inequality	≈ 65% felt inequality worsened. "We felt forgotten; city schools had Moodle, we only had WhatsApp."	≈ 60% echoed same concern. "Urban universities had better platforms."	≈ 45–50% acknowledged inequality. "We had proper systems."	≈ 50% agreed inequality existed but less severe. "Always had access to Teams and Moodle."
Attitudes toward future online learning	≈ 45% refused; ≈ 30% conditional; ≈ 25% open. "Do not want online again."	≈ Similar: majority reluctant.	≈ 30% refused; ≈ 30% conditional; ≈ 40% open. "Maybe if blended."	≈ 40–45% open to hybrid. "Ready to continue in hybrid format."

Note: Translated from Kazakh/Russian