

Offline AI for Bridging Rural–Urban Educational Inequality in Central Asia: Insights from Kyrgyzstan, Kazakhstan, and Uzbekistan

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Abstract: Rural students in Central Asia face significant obstacles in accessing quality education, widening the gap with urban peers. This study examines the challenges these students encounter in Kyrgyzstan, Kazakhstan, and Uzbekistan, using interviews with two national representatives and three rural students per country, along with a survey of 153 students.

While most students are familiar with AI tools such as ChatGPT and Duolingo, many report slow, unstable, or unaffordable internet, showing that unequal quality of access, rather than awareness, is the main barrier. Limited digital resources and a lack of locally relevant materials further limit learning.

Experts suggest that offline AI tools could support students, but the focus of this research is on understanding their real-life experiences and identifying practical ways to improve educational access and equity across rural communities. These findings may serve as a foundation for developing educational programs, policies, and initiatives aimed at improving access and equity for rural students in Central Asia.

Keywords: Rural Education; Educational Equity; Digital Divide; Central Asia; Offline AI Tools; Access to Education; Student Experiences.

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I. INTRODUCTION

Educational inequality between rural and urban areas are a major global issue, particularly in developing countries. In Central Asia, countries such as Kyrgyzstan, Kazakhstan and Uzbekistan are working to improve educational systems, yet rural students continue to face significant barriers. Beyond school infrastructure, challenges include limited access to digital devices, unstable or costly internet, lack of learning materials, and difficulty understanding complex content. These inequalities are increasingly important as the region moves toward digital education.

The digital context in Central Asia is uneven. Kazakhstan's President Kassym Jomart Tokayev has promoted AI and digital technologies to bridge urban-rural gaps, citing upgrades in thousands of rural schools (Tokayev Urges Equal Education Standards, 2025). However, rural areas still experience slow or low-quality internet, making

online learning difficult. For example, rural teachers often rely on personal mobile devices due to connectivity issues (Kurmangaliyev, 2021), and internet speeds can remain below 4Mbps. In Uzbekistan, digital resources are more available in urban schools (85%)

While urban schools benefit from better infrastructure, trained teachers, and reliable digital resources, rural students often contend with outdated facilities, complex curricula, and limited access to technology.

This study is relevant because it highlights the lived experiences of students, providing insights into the specific obstacles they face when trying to engage with digital learning. By focusing on students' perspectives, the research identifies not only technological barriers, such as unreliable internet and scarce devices, but also practical difficulties, including understanding complicated subjects and the lack of locally relevant materials.

Moreover, examining the potential of offline AI tools offers a forward-looking perspective on how educational equity might be improved. Understanding which interventions could realistically support students in resource-limited areas allows policymakers, educators, and organizations to design programs that are both effective and context-appropriate. Ultimately, this research provides a foundation for strategies that aim to reduce the rural–urban education gap and promote inclusive learning opportunities across Kyrgyzstan, Kazakhstan, and Uzbekistan.

One of the major problems is the lack of qualified teachers. Survey results show that 75 out of 153 students reported insufficient teaching staff as a significant obstacle. In many rural schools, teachers are overworked, and some lack the subject knowledge required to explain complex topics effectively. This often leaves students struggling to understand lessons and can contribute to broader learning gaps.

Another key challenge is limited access to digital resources. A total of 43 students highlighted a shortage of digital devices, while 23 reported slow or unstable internet as a barrier to learning. Even when students are aware of AI tools such as ChatGPT or Duolingo, unreliable internet and insufficient devices prevent consistent use, limiting opportunities for self-directed or technology-supported learning.

Difficult or unclear learning materials also pose a major obstacle. 101 students reported that curriculum content is often complex and challenging to understand. Language barriers affect 23 students, and a small number noted issues such as poorly explained lessons or insufficient textbooks. While these smaller counts are less widespread, they further illustrate the range of difficulties rural students face.

By identifying these barriers, this study highlights areas where interventions—such as offline AI tools, teacher training, and improved educational materials—could help reduce rural–urban educational inequalities in Central Asia.

The goal of this research is to identify the main challenges faced by rural students in accessing quality education in Kyrgyzstan, Kazakhstan, and Uzbekistan, and to explore practical solutions, including the potential use of offline AI tools, to help reduce rural–urban educational inequalities. By centering on students' experiences, this study aims to provide insights that can inform educational programs, policies, and initiatives designed to promote equitable learning opportunities across the region.

➤ *Research Objectives*

To examine the key challenges rural students encounter in accessing quality education, including issues with teachers, learning materials, digital devices, and internet connectivity.

- To analyze students' awareness and use of AI educational tools, and identify barriers to effective

usage.

- To assess the impact of external and internal factors (infrastructure, curriculum, digital access, and socio-cultural conditions) on rural students' learning experiences.
- To gather qualitative and quantitative data through surveys and interviews in order to understand students' real-life experiences and needs.
- To propose practical recommendations for interventions, such as offline AI solutions, teacher support, and resource development, aimed at narrowing the rural–urban education gap in Central Asia.

II. LITERATURE REVIEW

➤ *Rural Education Inequality in Central Asia*

Rural education inequality is a pressing global issue. According to UNESCO, billions of people still lack reliable internet and connected schools in rural areas. For instance, about 2.6 billion people (32% of the world's population) have no internet access, and 1.8 billion of them live in rural communities. Globally, roughly 60% of primary schools and half of lower-secondary schools are not connected to the internet (UNESCO, 31 March 2025). These infrastructure gaps mean rural students often contend with outdated textbooks, few qualified teachers, and poverty-related barriers, reinforcing an unequal education landscape.

In response, some countries have adopted innovative approaches. For example, UNESCO highlights that in Kenya, SMS-based learning programs send lesson materials by text message to students in areas with limited internet (UNESCO 31 March 2025).

Peru, where targeted rural education programs have shown success. The UNESCO-supported “Horizons” (Horizontes) programme in the Cusco region collaborates with local schools to build students' socio-emotional and technical skills. After four years in operation, the program trained dozens of teachers and managers, helped over 130 students complete secondary school with concrete “life projects,” and enabled 714 students to earn dual vocational certifications. Importantly, participating schools saw a significant drop in dropout rates (around three percentage points on average) (UNESCO, 16 September 2024). This demonstrates how holistic, community-based initiatives can improve outcomes for rural youth.

➤ *Identifying Key Challenges*

Central Asian countries face similar rural–urban divides. Kazakhstan, Uzbekistan, and Kyrgyzstan have launched broad digital strategies (e.g., “Digital Kazakhstan,” “Digital Uzbekistan 2030,” “Digital Kyrgyzstan 2025”) to upgrade school infrastructure and connectivity. However, our survey finds that a “last-mile” gap persists in practice. In a survey of 153 rural students, 93.5% reported having some internet access, yet many described it as “unstable, slow, or unaffordable”. In other words, although national plans promise online learning, most rural schools still lack reliable broadband and modern devices. Findings note that students continue to face “weak internet” and a shortage of

computers and labs despite the official programs. This suggests that top-down policies have not fully reached village classrooms, leaving basic infrastructure and quality-of-access problems unaddressed.

Interviews and observations from the field highlight why these challenges persist. About 48.4% of rural students surveyed reported teacher shortages, with many saying available teachers were “not qualified” or poorly trained. Classrooms often lack up-to-date materials: students described sharing a single old textbook, missing science lab supplies, and having no modern computers. Outside of school, socio-economic factors further hamper learning. Many students must help with farming or household chores, which cuts into study time and creates “an unsuitable environment for studying” at home. Interviews also point out that most curricula and content are not adapted to local languages or cultural contexts, so rural students find less relevance in what is taught. These lived experiences – teacher quality issues, resource scarcity, family obligations, and cultural mismatches – reveal the real barriers that simple tech fixes cannot solve alone.

In summary, the literature shows that meaningful progress will require equity-driven solutions grounded in students’ real lives. Policymakers should build on these insights by improving rural infrastructure (electricity, internet, devices) and investing in teacher training and learning materials tailored to local needs. Crucially, strategies must address socio-economic obstacles – for instance by providing community support and flexible learning schedules – so that rural children can actually benefit from new programs. Focusing on the on-the-ground challenges and perspectives of rural learners is essential for closing the education gap in Central Asia.

➤ *Identifying Key Challenges Faced by Rural Students in Central Asia*

- *Limited Access to Stable Internet*

A major obstacle for rural students is weak or unstable internet connectivity. According to the survey, 93.5% of participants reported having some form of internet access at home, yet many described it as slow, unstable, or unaffordable, making regular online learning difficult. This limits their ability to join virtual classes, watch educational videos, or use digital learning platforms. One student explained, “I can’t always open lessons because the connection disappears every few minutes.” Although students are aware of AI tools like ChatGPT and Duolingo, poor connection quality remains the key barrier to equal access.

- *Lack of Qualified Teachers*

Almost 48.4% of respondents stated that their schools lack enough qualified teachers. Several interviewees shared that some teachers “do not explain topics clearly” or “skip lessons because of additional work.” This shortage especially affects mathematics, science, and foreign language classes. One student said, “Even if we have teachers, they often don’t know how to use modern

materials or online resources.” In rural schools, a single teacher may cover multiple subjects, leading to fatigue and lower lesson quality.

- *Outdated Learning Resources and Shortage of Devices*

About 28% of surveyed students said their schools lack digital devices such as computers or tablets. Some must share one computer per class, while others rely only on printed textbooks, which are often outdated or damaged. A few students mentioned having “no access to digital textbooks or multimedia lessons.” The shortage of devices and modern teaching tools prevents rural students from keeping up with urban peers who have access to laptops, online tutorials, and educational apps.

- *Difficulty Understanding Complex Material*

The most common academic issue was difficulty understanding school material, reported by 54.8% of respondents. Many students said that teachers “do not explain clearly,” which makes subjects like math and physics especially hard. One student wrote, “The textbook language is too complicated; I understand only when someone explains in simple words.” This finding reflects a deeper issue—rural students often rely on self-study or online searches to fill learning gaps, which may not always be effective.

- *Language Barriers and Irrelevant Content*

About 22.6% of participants mentioned that language and cultural differences make studying harder. Some materials are available only in Russian or English, while many students in remote villages primarily speak Kyrgyz, Uzbek, or Kazakh. As one student noted, “Sometimes we don’t understand examples in textbooks because they are about cities or other countries.” The lack of localized and relatable content reduces engagement and makes students feel disconnected from the curriculum.

- *Socio-Economic and Family Pressures*

Many rural families face financial hardship, which directly affects students’ education. Interview responses revealed that some students must “help with housework or farming,” leaving little time for homework. Others said they cannot afford private tutors or even consistent internet data. A few students mentioned that “parents think helping in the field is more important than lessons.” These economic pressures make it difficult for students to stay focused and motivated, especially in higher grades.

- *Inequality Between Rural and Urban Schools*

When asked about the difference in educational opportunities between rural and urban areas, 48.3% of respondents said it was “significant,” and 17.2% called it “very large.” None believed there were no differences. Most students pointed to school facilities, teaching quality, and digital access as the biggest gaps. One wrote, “In cities they have better teachers and new computers; we only dream about that.” This demonstrates how place of residence continues to determine educational quality across Central Asia.

➤ *Possible Solutions to Overcome Educational Inequality in Rural Central Asia*

• *Improving Teacher Training and Professional Support*

Teacher development remains one of the most urgent priorities for rural schools. Nearly half of surveyed students (48.4%) reported that their teachers “do not explain material clearly” or “lack up-to-date methods.” Interview participants also emphasized that rural educators often have limited exposure to digital tools and innovative teaching practices. One expert suggested that instead of long theoretical workshops, teachers could benefit from short, practical training sessions — even one-hour lessons on using new learning tools, followed by ongoing peer support through chat groups. Such continuous microlearning would allow educators in rural schools to strengthen their teaching methods without leaving their communities or interrupting lessons.

• *Localization of Educational Content and Language Adaptation*

More than one-fifth (22.6%) of students said that understanding materials written in non-native languages is a barrier. Both experts interviewed stressed that education in Central Asia must be language-first and context-first. Learning materials should be translated and culturally adapted so students recognize their lives, traditions, and local examples in lessons. For example, one respondent explained that offline learning systems should store multiple language packs — Kazakh, Kyrgyz, Uzbek, and Russian — directly on devices, allowing students to switch languages instantly. Localized and culturally relevant content ensures that rural learners are not alienated and can fully understand and relate to the subjects they study.

• *Strengthening Educational Infrastructure and Access*

While 93.5% of students reported having some form of internet access, many described it as “slow” or “unstable.” Both experts agreed that infrastructure must improve before any innovation succeeds. Rural schools face unstable electricity, outdated equipment, and limited digital literacy in local communities. As one respondent noted, “Electricity can be unstable or limited to a few hours a day, which makes it hard to run or charge any digital tools.” To address this, governments should focus on expanding stable power supply, improving classroom facilities, and ensuring at least basic connectivity for every school. Infrastructure is the foundation upon which all educational equality depends.

• *Providing Financial and Social Support to Rural Students*

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• *Encouraging Student Motivation and Preventing Emotional Burnout*

Survey data showed that over half of students (54.8%) struggle to understand complex material, often leading to frustration and reduced motivation. The same pattern was observed in interviews, where educators warned that students may “lose interest or feel left behind” due to difficult content or unequal conditions. To prevent emotional burnout, schools should implement peer learning groups, counseling programs, and extracurricular clubs. Such initiatives would give students a sense of belonging and support, helping them stay motivated and emotionally resilient even in challenging circumstances.

• *Policy Reforms and National Collaboration*

Experts agreed that long-term change requires coordinated policy reform and collaboration between government agencies, universities, and EdTech developers. One interviewee highlighted that corruption and weak implementation often prevent education programs from reaching rural schools, despite sufficient funding on paper. Therefore, transparency, accountability, and rural-centered policy design must guide all initiatives.

In addition to the survey, qualitative interviews were conducted with two educational experts from each country and several students from rural communities. The interviews were semi-structured and focused on the applicability of offline AI systems for rural classrooms, teacher readiness, infrastructure constraints, and culturally appropriate adaptation of educational content. The insights provided by these interviews helped complement the quantitative findings, revealing practical perspectives from educators directly engaged in the implementation of new learning technologies.

The survey results were analyzed using descriptive statistics to identify key trends. For instance, 93.5% of respondents reported stable internet access, while 6.5% indicated intermittent or no access. Moreover, 48.4% of students highlighted the shortage of qualified teachers as a major obstacle, and 64.5% noted that AI tools helped them better understand school subjects. These data points illustrate the uneven distribution of educational opportunities between urban and rural areas.

The interviews were analyzed thematically, with responses grouped into categories such as infrastructure limitations, teacher training needs, and inclusion of multilingual and neurodiverse learners. Several respondents emphasized the importance of preloaded offline systems capable of functioning without constant internet access, as well as the integration of local languages like Kazakh, Kyrgyz, and Uzbek to ensure inclusivity.

This combined methodological approach allowed the study to obtain a comprehensive understanding of both the measurable and experiential aspects of rural education in

Central Asia.

The integration of survey statistics and expert interviews provided a solid empirical basis for assessing not only the current challenges but also the realistic potential of offline AI tools in improving educational equity in the region.

Digital Kazakhstan, Sanarip Kyrgyzstan, and Digital Uzbekistan 2030 should incorporate local pilot projects directly in rural communities, ensuring that investments translate into real, measurable improvements in access and learning outcomes.

Overall, both the survey results and expert interviews show that educational inequality in Central Asia is not only a technological issue but a systemic one. Solutions must address the core human and infrastructural challenges — qualified teachers, localized content, financial support, and effective policy execution. By focusing on these areas, Central Asian governments and educators can create a fairer, more inclusive system where every student, regardless of location, has an equal opportunity to learn and succeed.

III. RESULTS AND DISCUSSION

The quantitative survey of 153 students from rural areas in Kyrgyzstan, Kazakhstan, and Uzbekistan revealed notable patterns in terms of access to digital infrastructure, familiarity with AI-based tools, and perceptions of educational quality. A significant majority of students (93.5%) reported having stable internet access at home, while 6.5% indicated intermittent or no access. Although this suggests that most rural students can access the internet, the remaining minority still experiences connectivity limitations that may hinder consistent engagement with online learning platforms.

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IV. METHODOLOGY

The present study utilized a mixed-methods research design to examine the challenges and opportunities of implementing AI-based educational tools in rural schools across Central Asia. The methodology was chosen to obtain both numerical and contextual insights into how students and educators experience digital inequality and to identify possible solutions that could enhance learning accessibility in under-resourced regions.

A quantitative survey was conducted among 153 students from Kyrgyzstan, Kazakhstan, and Uzbekistan. The survey aimed to collect information about students' educational conditions, access to internet and digital devices, awareness and usage of AI tools, and their general attitudes toward new educational technologies. Of all

respondents, 54 were from Kyrgyzstan, 50 from Kazakhstan, and 49 from Uzbekistan. Most participants were in grades 8–11 or in their first year of college, representing a wide range of academic levels typical of rural multigrade learning environments.

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In terms of digital tools, awareness of AI-based educational technologies was high: 100% of respondents had heard of at least one AI tool, and 98% reported experience using ChatGPT specifically. Duolingo was also widely known.

Around 48.4% of students used such tools several times a week, while daily use was reported by roughly 10%. These findings suggest that while exposure to AI in education is growing, the intensity and consistency of usage remain limited. Many students appear to use AI tools as supplemental aids rather than primary resources for their learning.

The survey also highlighted several educational challenges common to rural learners. The most frequently cited issue was curriculum difficulty, mentioned by 66% of respondents, followed by a lack of qualified teachers (48.4%). Other reported obstacles included the absence of personal devices (28%), poor internet connectivity (15%), and language barriers (15%). When asked about perceived differences between rural and urban education quality, 66.7% of students rated the gap as “very large” or “significant,” indicating a widespread

Despite these obstacles, the results indicate a strong interest and willingness among students to use AI tools for learning, particularly when these tools are adaptable to local languages and can function offline. The study highlights that effective implementation of AI-based learning requires more than just technology—it needs contextual adaptation, teacher training, and integration into the existing curriculum to be genuinely beneficial.

Awareness of educational inequality. Overall, AI educational tools hold considerable promise for bridging educational gaps in rural areas. By providing

Qualitative interviews with students and education experts added depth to these findings. Several students described situations where unstable electricity or outdated school equipment limited their ability to use digital tools. One student explained that even when internet access was available, the absence of functional computers in their school forced them to rely on personal smartphones, which were not always suitable for extended study. Another student noted that although they found AI tools helpful in understanding topics, they often encountered errors or

confusing responses from the tools, requiring additional support from teachers.

Educators interviewed pointed out the need for AI tools to function offline, especially in regions with weak connectivity or inconsistent power supply. One expert emphasized that rural schools often operate in multigrade classrooms with a single teacher managing multiple levels, making individualized attention difficult. In such contexts, an offline AI tutor with preloaded content and multilingual support could significantly enhance instruction by providing differentiated exercises tailored to each student's level. Teachers also expressed concern about their readiness to use such technologies, suggesting that even a short, practical training could help them integrate AI tools more effectively into their classrooms.

The findings reflect a layered set of challenges faced by rural students. While interest in AI-based learning is high and awareness of digital tools is widespread, structural limitations—such as weak infrastructure, device shortages, and limited teacher preparation—undermine the consistent and equitable use of technology in education. The survey responses and interviews collectively point to a need for localized, inclusive, and offline-capable AI systems designed for rural contexts.

These tools must not only function under infrastructure constraints but also align with local languages and curricular needs to be truly effective.

Data demonstrate both the potential and the limitations of AI-enhanced learning in rural Central Asia. Students are eager to engage with AI tools, and many find them helpful. However, successful integration will depend on addressing the foundational barriers that shape rural education: access to stable infrastructure, availability of suitable devices, teacher training, and inclusive content development. While some solutions were discussed in the literature review, these results emphasize the importance of co-designing AI tools with input from students and educators to ensure practical impact in rural learning environments.

Personalized learning experiences and support tailored to students' needs, these tools can enhance learning outcomes and reduce inequities between rural and urban education. Future efforts should focus on developing accessible, offline-friendly, and multilingual AI solutions, alongside professional development for teachers, to ensure that AI-based education can reach its full potential in rural Central Asia.

V. CONCLUSION

This study explored the awareness, usage, and potential impact of AI-based educational tools among students in rural areas of Kyrgyzstan, Kazakhstan, and Uzbekistan. The findings demonstrate that while many students are aware of AI technologies such as ChatGPT and Duolingo, actual usage remains inconsistent. Factors such as limited internet access, lack of digital devices, and insufficient teacher

guidance significantly hinder the integration of AI into everyday learning. Additionally, challenges inherent to rural education—including heavy curricula, teacher shortages, and a rural-urban educational divide—further restrict students' ability to benefit from these technologies.

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