

ISSN: 1991-3494 (Print)
ISSN: 2518-1467 (Online)

**SCIENTIFIC JOURNAL OF
PEDAGOGY AND ECONOMICS**

**№5
2026**



ISSN 2518-1467 (Online),
ISSN 1991-3494 (Print)



SCIENTIFIC JOURNAL OF PEDAGOGY AND ECONOMICS

PUBLISHED SINCE 1944

5 (423)

September – October 2026

ALMATY, 2026

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Scientific Journal of Pedagogy and Economics

ISSN 2518-1467 (Online),

ISSN 1991-3494 (Print).

Owner: «Central Asian Academic Research Center» LLP (Almaty).

The certificate of registration of a periodical printed publication in the Committee of information of the Ministry of Information and Communications of the Republic of Kazakhstan

№ KZ50VPY00121155, issued on 05.06.2025

Thematic focus: «*publication of the results of new achievements in the field of fundamental sciences*»

Periodicity: 6 times a year.

<http://www.bulletin-science.kz/index.php/en/>

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Scientific Journal of Pedagogy and Economics

ISSN 2518-1467 (Online),

ISSN 1991-3494 (Print).

Меншіктенуші: «Орталық Азия академиялық ғылыми орталығы» ЖШС (Алматы қ.).

Қазақстан Республикасының Ақпарат және коммуникациялар министрлігінің Ақпарат комитетінде 05.06.2025 ж. берілген № **KZ50VPY00121155** мерзімдік басылым тіркеуіне қойылу туралы куәлік.

Тақырыптық бағыты: *«іргелі ғылым салалары бойынша жаңа жетістіктердің нәтижелерін жариялау»*

Мерзімділігі: жылына 6 рет.

<http://www.bulletin-science.kz/index.php/en/>

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Scientific Journal of Pedagogy and Economics

ISSN 2518-1467 (Online),

ISSN 1991-3494 (Print).

Собственник: ТОО «Центрально-азиатский академический научный центр» (г. Алматы).

Свидетельство о постановке на учет периодического печатного издания в Комитете информации Министерства информации и коммуникаций и Республики Казахстан

№ KZ50VPY00121155 выданное 05.06.2025 г.

Тематическая направленность: «публикация результатов новых достижений в области фундаментальных наук».

Периодичность: 6 раз в год.

<http://www.bulletin-science.kz/index.php/en/>

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SCIENTIFIC JOURNAL OF PEDAGOGY AND ECONOMICS

ISSN 1991-3494

Volume 5.

Number 423 (2026), 554-574

<https://doi.org/10.32014/2026.2518-1467.1304>

IRSTI: 06.77.59

UDC: 331.5:004(574)

JEL Classification: J16, J21, J24, O33

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GENDER INEQUALITY IN ACCESS TO DIGITAL TECHNOLOGIES AND ITS IMPACT ON WOMEN'S EMPLOYMENT IN KAZAKHSTAN

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Annotation. The digital transformation of the labour market expands employment opportunities, professional mobility and entrepreneurial activity, while simultaneously creating new forms of socio-economic inequality. Of particular importance is the digital gender gap, which manifests itself not only in the differences in physical access of men and women to the Internet and digital devices, but also in the different levels of digital competencies, the intensity of technology use, access to vocational training and opportunities for converting digital skills into high-quality employment. The study aims to assess the relationship between women's access to digital technologies and employment outcomes in Kazakhstan, and to identify the main mechanisms limiting the use of digitalisation to reduce gender disparities in the labour market. The study's information base was compiled from the Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan, gender Statistics of Kazakhstan, the World Bank, UNDP, ITU, and other international organisations. The study uses comparative and dynamic analysis, structural analysis, and systematisation of the factors of digital inequality. The results show that Kazakhstan has approached gender parity in basic Internet access indicators, but closing the quantitative connectivity gap

does not eliminate the qualitative digital divide. Differences remain in the use of digital technologies, professional digital competencies, access to STEM and ICT professions, and opportunities to gain economic benefits from digitalisation. In 2025, women made up 48.3% of Kazakhstan's workforce, but the ratio of women's workforce participation to that of men was 85.4%. There is also a significant wage gap: the average salary of women in 2025 was 372.2 thousand tenge, compared with 518.3 thousand tenge for men. The study concludes that Kazakhstan needs to shift from providing formal digital access to a model of productive digital inclusion for women, combining the development of advanced digital skills, professional retraining, support for women's transition into high-performance digital employment, and the elimination of institutional barriers.

Keywords: gender inequality, digital divide, digital technologies, women, employment, labour market, digital skills, ICT, Kazakhstan

Financing: The study was carried out as part of the scientific project IRN AP26195827, "Strategic directions for reducing gender gaps in the labour market of Kazakhstan and expanding opportunities for women in the ICT sector."

For citations: Nurbatsin A., Lodhi R.N., Karacsony P. Gender inequality in access to digital technologies and its impact on women's employment in Kazakhstan. Scientific Journal of Pedagogy and Economics, 2026. — No. 5. — P. 554-574. DOI: <https://doi.org/10.32014/2026.2518-1467.1304>.

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ЦИФРЛЫҚ ТЕХНОЛОГИЯЛАРҒА ҚОЛ ЖЕТКІЗУДЕГІ ГЕНДЕРЛІК ТЕҢСІЗДІК ЖӘНЕ ОНЫҢ ҚАЗАҚСТАНДАҒЫ ӘЙЕЛДЕРДІҢ ЖҰМЫСПЕН ҚАМТЫЛУЫНА ӘСЕРІ

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Аннотация. Еңбек нарығының цифрлық трансформациясы әлеуметтік-экономикалық теңсіздіктің жаңанысандарын жасай отырып, жұмысқа орналасу, кәсіби ұтқырлық және кәсіпкерлік белсенділік мүмкіндіктерін кеңейтеді. Гендерлік цифрлық алшақтық ерекше маңызға ие, ол ерлер мен әйелдердің Интернетке және цифрлық құрылғыларға физикалық қол жетімділігінің айырмашылықтарында ғана емес, сонымен қатар цифрлық құзыреттіліктің тең емес деңгейінде, технологияны пайдалану қарқындылығында, кәсіптік оқытуға қол жетімділікте және цифрлық дағдыларды сапалы жұмыспен қамтуға айналдыру мүмкіндіктерінде көрінеді. Зерттеудің мақсаты әйелдердің цифрлық технологияларға қол жеткізуі мен оларды Қазақстанда жұмыспен қамту параметрлері арасындағы өзара байланысты бағалау, сондай-ақ цифрландыруды еңбек нарығындағы гендерлік диспропорцияларды қысқарту құралы ретінде пайдалануды шектейтін негізгі тетіктерді анықтау болып табылады. Зерттеудің ақпараттық базасын Қазақстан Республикасы Стратегиялық жоспарлау және реформалар агенттігінің ұлттық статистика бюросы, Қазақстанның гендерлік статистикасы, World Bank, UNDP, ITU және басқа да халықаралық ұйымдардың деректері құрады. Сандық теңсіздік факторларын салыстырмалы және динамикалық талдау, құрылымдық талдау және жүйелеу әдістері қолданылды. Нәтижелер Қазақстанның интернетке қол жеткізудің базалық көрсеткіштері бойынша гендерлік паритетке жақындағанын көрсетеді, алайда қосылудағы сандық алшақтықты жою сапалы цифрлық теңсіздікті жоюды білдірмейді. Цифрлық технологияларды пайдалану бағыттарында, кәсіби цифрлық құзыреттерде, STEM және АКТ - кәсіптеріне қолжетімділікте және цифрландырудан экономикалық қайтарым алу мүмкіндіктерінде айырмашылықтар сақталады. 2025 жылы әйелдер Қазақстанның жұмыс күшінің 48,3%-құрады, алайда әйелдердің жұмыс күшіне қатысу деңгейінің мужчин тиісті көрсеткішіне қатынасы 85,4%-құрады. Сондай-ақ, еңбекақыда айтарлықтай алшақтық сақталуда: 2025 жылы әйелдердің орташа жалақысы ерлердегі 518,3 мың теңгеге қарағанда 372,2 мың теңгені құрады. Озық цифрлық дағдыларды дамытуды, кәсіптік қайта даярлауды, әйелдердің жоғары өнімді цифрлық жұмыспен қамту түрлеріне көшуін қолдауды және институционалдық кедергілерді жоюды біріктіретін әйелдердің өнімді цифрлық инклюзиясының моделіне ресми цифрлық қолжетімділікті қамтамасыз ету саясатынан көшу қажеттілігі туралы қорытынды жасалды.

Түйін сөздер: гендерлік теңсіздік, цифрлық алшақтық, цифрлық технологиялар, әйелдер, жұмыспен қамту, еңбек нарығы, цифрлық дағдылар, акт, Қазақстан

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ГЕНДЕРНОЕ НЕРАВЕНСТВО В ДОСТУПЕ К ЦИФРОВЫМ ТЕХНОЛОГИЯМ И ЕГО ВЛИЯНИЕ НА ЗАНЯТОСТЬ ЖЕНЩИН В КАЗАХСТАНЕ

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Аннотация. Цифровая трансформация рынка труда расширяет возможности трудоустройства, профессиональной мобильности и предпринимательской активности, одновременно создавая новые формы социально-экономического неравенства. Особое значение приобретает гендерный цифровой разрыв, который проявляется не только в различиях физического доступа мужчин и женщин к Интернету и цифровым устройствам, но и в неодинаковом уровне цифровых компетенций, интенсивности использования технологий, доступе к профессиональному обучению и возможностях преобразования цифровых навыков в качественную занятость. Цель исследования заключается в оценке взаимосвязи между доступом женщин к цифровым технологиям и параметрами их занятости в Казахстане, а также в выявлении основных механизмов, ограничивающих использование цифровизации как инструмента сокращения гендерных диспропорций на рынке труда. Информационную базу исследования составили данные Бюро национальной статистики Агентства по стратегическому планированию и реформам Республики Казахстан, гендерной статистики Казахстана, World Bank, UNDP, ITU и других международных организаций. Использованы методы сравнительного и динамического анализа, структурного анализа и систематизации факторов цифрового неравенства. Результаты показывают, что Казахстан приблизился к гендерному паритету по базовым показателям доступа к Интернету, однако ликвидация количественного разрыва в подключении не означает устранения качественного цифрового неравенства. Сохраняются различия в направлениях использования цифровых технологий, профессиональных цифровых

компетенциях, доступе к STEM- и ИКТ-профессиям и возможностях получения экономической отдачи от цифровизации. В 2025 г. женщины составляли 48,3% рабочей силы Казахстана, однако отношение уровня участия женщин в рабочей силе к соответствующему показателю мужчин составляло 85,4%. Сохраняется также значительный разрыв в оплате труда: средняя заработная плата женщин в 2025 г. составила 372,2 тыс. тенге против 518,3 тыс. тенге у мужчин. Сделан вывод о необходимости перехода от политики обеспечения формального цифрового доступа к модели продуктивной цифровой инклюзии женщин, объединяющей развитие продвинутых цифровых навыков, профессиональную переподготовку, поддержку перехода женщин в высокопроизводительные цифровые виды занятости и устранение институциональных барьеров.

Ключевые слова: гендерное неравенство, цифровой разрыв, цифровые технологии, женщины, занятость, рынок труда, цифровые навыки, ИКТ, Казахстан

Introduction. The rapid spread of digital technologies is becoming one of the most significant factors transforming the modern labour market. Artificial intelligence, platform-based employment, remote work arrangements, digital financial services, e-commerce, and the automation of production processes are changing the structure of demand for human capital and simultaneously creating new requirements for workers' professional competencies. Under these conditions, access to digital infrastructure and the ability to use modern technologies effectively are becoming an independent factor in a person's competitiveness in the labour market.

At the same time, digitalisation affects different socio-demographic groups unevenly. In international literature, increasing attention is being paid to the phenomenon of the gender digital divide, which is viewed as a set of differences between men and women in access to digital devices, internet connectivity, level of digital skills, nature of technology use, and ability to derive economic benefits from digitalisation (World Bank, 2024; ITU, 2024). Digital gender inequality goes far beyond internet access. Even with high Internet penetration, women may remain underrepresented in technology-related professions, use digital tools for professional development less often, and have limited access to programming, data analysis, artificial intelligence technologies, and other advanced digital competencies. Consequently, it is necessary to distinguish between access to technologies and the economic effectiveness of their use.

This approach is especially relevant for Kazakhstan. The country has developed a high level of basic digital infrastructure. In early 2025, international estimates suggest that about 19.2 million people used the Internet, and the penetration rate reached 92.9% of the population (DataReportal, 2025). Official gender statistics also indicate a virtually complete reduction in the gap between men and women in

terms of basic Internet use. In 2024, the share of Internet users among men aged 16–74 was approximately 96.6%, and among women, 95.9%.

However, this high level of connectivity coexists with persistent gender segregation in employment. Women remain concentrated primarily in education, healthcare, trade, and the service sector. At the same time, their representation in several technology-intensive and high-paying segments of the economy remains lower.

Thus, a research problem arises: why does the practically achieved gender parity in basic access to the Internet not automatically lead to gender equality in the labour market?

The research hypothesis is that the impact of digital technologies on women's employment depends less on having access to the Internet than on the quality of digital access, the level of professional digital competencies, and the ability to convert these competencies into labour and entrepreneurial income.

The article aims to determine the nature of the relationship between gender inequality in access to and use of digital technologies and women's position in Kazakhstan's labour market.

To achieve the goal, the following tasks are addressed: the dynamics of digital access among men and women are analysed; the specifics of the transformation of the gender digital divide are identified; the main parameters of women's employment are examined; the channels through which digital skills influence employment opportunities are identified; and the directions for policy aimed at the productive digital inclusion of women are formulated.

Literature Review. Scientific approaches to studying digital inequality have undergone significant evolution. At the initial stage, the digital divide was primarily associated with physical access to computers and the Internet. As digital infrastructure spread, the research focus shifted from the availability of access to differences in skills and ways of using technology.

The modern concept of digital inequality allows us to identify at least three levels. The first characterises the presence of infrastructure, devices, and Internet connectivity. The second relates to digital skills and the intensity of technology use. The third reflects the ability to derive economic, educational, and social benefits from digital activity.

The third level is especially important for analysing gender differences in the labour market. Formal equality of access does not guarantee the same economic returns from digitalisation.

Studies show that there is a bidirectional relationship between digital access and employment. On the one hand, having a job contributes to Internet use and the acquisition of digital skills. On the other hand, digital competencies expand access to information about job vacancies, distance learning, remote employment, and new professional segments. Galperin and Arcidiacono (2021), analysing the digital gender gap, found that differences in employment structure are a significant factor

in digital inequality, and that the relationship between Internet use and employment may be particularly significant for women.

Digitalisation can simultaneously reduce and reproduce existing gender inequality. The spread of remote work and online platforms reduces territorial constraints and may expand employment opportunities for women with family responsibilities. E-commerce also reduces initial barriers to entrepreneurial activity. However, the positive effect depends on education levels, digital literacy, the nature of family burdens, and the quality of the jobs created.

Analysis of the digital economy shows that technological transformation can stimulate female employment. Still, job growth does not necessarily bring higher-quality jobs. Studies of the digitalisation of labour markets show differences in effects for women with different levels of qualifications, age, and marital status.

In its Gender Strategy 2024–2030, the World Bank considers reducing the digital gender gap an independent condition for expanding women's economic opportunities. It pays special attention not only to connecting to digital technologies but also to developing artificial intelligence skills, increasing the number of women in the technology sector, and using digital platforms for employment and entrepreneurship (World Bank, 2024).

Kazakhstani studies also confirm the ambiguous impact of digitalisation on gender equality. Kireyeva, Kenzhegulova, and Seitkan (2022), based on a survey of 300 women and data from 2015–2020, showed that the spread of ICT contributed to the expansion of women's participation in the online market and e-commerce.

A later study by Nurbatsin (2025) shows that high levels of women's Internet connectivity in regions of Kazakhstan do not, by themselves, eliminate gender digital inequality. Regional differences persist in terms of the broader concept of digital readiness.

A separate area of research is related to vertical segregation in the IT sector. Seydumanova et al. (2026) highlight the impact of family responsibilities and the so-called “second shift” on women's career advancement opportunities in technology companies in Kazakhstan.

Thus, it is not enough to study the digital divide solely through Internet prevalence. Of scientific interest is the transition from digital access to digital outcomes - that is, the question of the extent to which women can convert digital access into better employment, professional mobility, and income growth.

Materials and Methods. The empirical research strategy is based on a combination of analysis of digital inclusion indicators and characteristics of women's employment.

The information base consists of data from:

- the Bureau of National Statistics of the Republic of Kazakhstan;
- the “Gender Statistics” information system;
- the World Bank Gender Data Portal;
- the International Telecommunication Union;

- the United Nations Development Programme;
- the official Skills Enbek platform;
- international databases on digital development.

The main period of analysis is 2015–2025, which allows us to compare Kazakhstan's initial acceleration in digitalisation with the current period of virtually universal Internet access.

The study uses the following groups of indicators:

digital access: the share of Internet users among women and men, access to mobile devices;

human capital: digital literacy, participation in digital learning and the development of ICT competencies;

the labour market: the level of labour force participation, women's employment, the structure of employment.

Economic results: wages of men and women and the gender pay gap.

The study uses dynamic, comparative, and structural analysis.

Conceptually, the following cause-and-effect chain is assumed: digital access → digital skills → professional opportunities → employment → quality of employment → income.

At each stage, digitalisation's impact is modified by age, place of residence, education, family responsibilities, and the sectoral structure of the regional economy.

Results. The study's findings indicate that over the past decade, Kazakhstan has made significant progress in expanding digital accessibility for the population; however, the reduction in the infrastructural digital divide has not yet been accompanied by a comparable reduction in gender disparities in the labour market. The data obtained suggest that the nature of digital inequality is gradually changing: while in the early stages of digitalisation the key factor was the presence or absence of access to the Internet and digital devices, in the current context the main issue is how capable women and men are of using digital technologies in their professional activities and converting digital skills into quality employment and income.

To verify this provision, the dynamics of the basic characteristics of digital access were initially considered. In 2015, 73.0% of men and 72.7% of women used the Internet. Consequently, at the start of the period under review, the gender gap was only 0.3 percentage points. By 2019, the figures rose to 84.3% and 84.2%, respectively, and the gap fell to 0.1 percentage points. In 2021, the share of Internet users was 93.2% among men and 92.6% among women (BNK RK, 2022).

In subsequent years, the level of digital coverage continued to increase. In 2023, approximately 95.8% of the population aged 16–74 used the Internet. In 2024, this figure rose to 96.2%, with Internet usage reaching 96.6% among men and 95.9% among women (BNK RK, 2025). Thus, the gender gap was only 0.7 percentage points.

The 2025 household survey also confirms the continued virtually universal

nature of Internet access. According to the Bureau of National Statistics, 95.6% of the population aged 16–74 used the Internet, including mobile Internet; 88.2% used a computer, laptop, or tablet; and digital literacy was 92.4% (BNS RK, 2026).

At the same time, when comparing indicators across years, it is necessary to account for changes in the age limits of individual statistical surveys. Therefore, Table 1 is used primarily to assess the direction and scale of the transformation of digital accessibility, rather than to construct an absolutely homogeneous time series for each indicator mechanically.

Table 1 — Dynamics of key indicators of digital access among the population of Kazakhstan, 2015–2025, %

Indicator	2015	2019	2021	2023	2024	2025
Internet users, men	73,0	84,3	93,2	н/д	96,6	н/д*
Internet users, women	72,7	84,2	92,6	н/д	95,9	н/д*
Gender gap, p.p.	0,3	0,1	0,6	н/д	0,7	н/д
Internet users, total	около 72,8	около 84,2	около 92,9	95,8	96,2	95,6
Level of digital literacy of the population	н/д	н/д	н/д	-	92,8	92,4
Use of a computer, laptop, or tablet	н/д	н/д	н/д	-	90,9	88,2
Source: compiled by the authors based on data from the Bureau of National Statistics of the Republic of Kazakhstan (BNS RK, 2022; BNS RK, 2025; BNS RK, 2026).						

The presented data allow us to draw several conclusions. First, during the period under review, digital accessibility shifted from a relatively high level to near-universal Internet coverage among the economically active population. In 2015, about 73% of men and women used the Internet, and by 2024–2025, the corresponding figures were around 96%.

However, the most important result is the near-complete absence of a pronounced gender gap in Internet use. In 2015, the difference between men and women was 0.3 percentage points; in 2019, 0.1 percentage points; in 2021, 0.6 percentage points; and in 2024, 0.7 percentage points.

Therefore, in Kazakhstan, it is no longer sufficient to explain gender digital inequality by a lack of physical access to the network for women. The evidence shows that the primary infrastructure barrier has been largely overcome.

However, a slight decrease in aggregated indicators between the 2024 and 2025 surveys also requires careful interpretation. The share of Internet users decreased from 96.2% to 95.6%, the level of digital literacy from 92.8% to 92.4%, and the use of computers, laptops, and tablets from 90.9% to 88.2% (BNS RK, 2025; BNS RK, 2026). Such changes should not be automatically interpreted as a steady deterioration in digital accessibility. They may reflect sample characteristics, changes in population structure, and differences in the intensity of use of certain types of devices. However, the data show that high technology penetration does not automatically mean maintaining the same intensity of use across all social groups.

More importantly, the connectivity indicator says almost nothing about the

nature of technology usage. A user who uses the Internet primarily for messaging, social media, and viewing content, and a specialist working with programming, data analysis systems, cloud technologies, or artificial intelligence, formally belong to the same category of Internet users. Meanwhile, their digital human capital and labour market opportunities differ fundamentally.

The pattern of Internet usage confirms the existence of such a problem. According to the household survey, a significant proportion of users use the Internet primarily for everyday communication and consumer purposes. In 2024, 69.6% of respondents reported messaging, 65.8% reported using social networks, and 48.1% reported downloading movies, music, and games. 28.5% of the population made purchases via the Internet (BNS RK, 2025).

These indicators suggest a high level of user digitalisation, but they do not, by themselves, characterise professional digital capital. Consequently, with near-universal Internet access, the central research question should shift from whether women have access to digital technologies to what purposes they use them and what economic benefits they can gain from this access.

This transition matters especially when comparing digital indicators with labour market outcomes. Virtually equal access to the Internet for men and women exists simultaneously with persistent differences in economic activity and employment quality.

According to international statistics, in 2025, women made up about 48.3% of Kazakhstan's total labour force. However, the female-to-male labour force participation ratio was about 85.4%, indicating a persistent gap in the intensity of economic participation (World Bank, 2025).

This result requires a distinction between two statistical characteristics. Almost half of all participants in the labour force may be women, but this does not mean that the same proportion of all men and all women of the appropriate age participate in the labour market. Consequently, women's quantitative representation does not eliminate structural differences in the likelihood of employment.

Differences remain, including in employment itself. Women are highly represented in education, healthcare, social services, trade and services, while men are more often represented in industry, construction, transport and several technical activities. Thus, gender segregation in the labour market continues to shape differences in opportunities to gain economic benefits from digitalisation.

Different industries have different requirements for digital competencies. In education or the social sphere, basic digital skills can be used primarily as an auxiliary tool, whereas in the information technology, financial technology, data analysis, or automation sectors, digital competencies directly shape employee productivity and wages.

Therefore, analysing the impact of digital transformation on women's employment requires supplementing indicators of general digital access with data on the quality of work outcomes. One of the most telling indicators is wages.

Official statistics show a steady increase in nominal wages for both men and women in 2021-2025, but at different rates. To assess these dynamics, Table 2 shows average monthly wage values by gender, as well as the authors' calculated ratio of female to male wages.

Table 2 — Dynamics of the average monthly nominal wages of men and women in Kazakhstan, 2021-2025

Indicator	2021	2022	2023	2024	2025
Men, tenge	281 239	355 072	418 788	468 914	518 259
Women, tenge	220 160	265 643	311 217	344 496	372 232
The ratio of women's wages to men's wages, %	78,3	74,8	74,3	73,5	71,8
Unadjusted gender gap, %	21,7	25,2	25,7	26,5	28,2
Absolute difference, tenge	61 079	89 429	107 571	124 418	146 027
Source: calculated by the authors according to the data of the Bureau of National Statistics of the Republic of Kazakhstan (BNS RK, 2026).					

The data in Table 2 show that over four years, the average nominal salary of men increased by 237.0 thousand tenge, or about 84.3%, while for women the increase was about 152.1 thousand tenge, or 69.1%.

As a result, the relative gap not only remained but also widened. In 2021, women's wages accounted for about 78.3% of men's wages; by 2025, this figure had fallen to 71.8%.

Accordingly, the unadjusted gender gap increased from 21.7% to 28.2%. The absolute difference increased even more noticeably: from 61.1 thousand tenge per month in 2021 to 146.0 thousand tenge in 2025. Thus, the absolute gap has more than doubled.

The result obtained is especially important in the context of the present study. During the period when the gender gap in basic Internet usage remained less than one percentage point, wage differences were measured in the tens of per cent.

This means that equality of digital connectivity and equality of economic outcomes are fundamentally different phenomena.

However, this wage indicator cannot be interpreted as a net effect of gender discrimination. It is unadjusted and reflects the cumulative impact of differences in industry, profession, job position, length of working hours, seniority, qualifications, and regional employment structure.

To further verify the sustainability of the identified difference, we considered the hourly wage indicator, which to some extent reduces the impact of differences in working hours.

Table 3 — Hourly wages of men and women in Kazakhstan, 2021-2025, tenge

Indicator	2021	2022	2023	2024	2025
Men	1 427	1 802	2 235	2 307	2 637
Women	1 179	1 486	1 800	1 871	2 046
The absolute difference	248	316	435	436	591

Women's hourly wage to men's, %	82,6	82,5	80,5	81,1	77,6
Source: calculated by the authors according to the data of the Bureau of National Statistics of the Republic of Kazakhstan (BNS RK, 2026).					

Hourly indicators confirm the general pattern. In 2021, women received about 82.6% of men's hourly wages, compared with about 77.6% in 2025.

The absolute difference over the same period increased from 248 to 591 tenge per hour. Consequently, gender differences persist not only when comparing average monthly incomes, but also after switching to hourly measurement.

At the same time, differences in hourly wages cannot be attributed to a single factor. However, the overall data show that women's and men's employment is structured differently, and high digital accessibility has not yet led to equal economic outcomes.

This contradiction is particularly evident in the ICT sector. According to educational statistics, women's interest in IT professions in Kazakhstan has increased significantly. The number of female students in information and communications has increased by about 3.4 times over several years and reached about 15.3 thousand people. At the same time, because the total number of students grew even faster, the proportion of women among IT students fell from about 31.7% to 24% (BNS RK, 2025).

Thus, the absolute increase in the number of women receiving ICT education is not accompanied by an increase in their relative representation. This fact is of fundamental importance. It shows that simply expanding educational opportunities does not automatically change the gender structure of the technology sector if men's demand for appropriate educational programs is growing faster.

A similar pattern is observed during the transition from education to employment. The proportion of women employed in the information and communications sector has remained at about 42% in recent years. This is significantly higher than the proportion of women among IT students, but still below gender parity. In addition, professional and vertical segregation persists within the technology sector itself: women may be relatively well represented in administrative, client, and support functions, but significantly less so in certain technical and managerial positions.

As a result, one of the central paradoxes of Kazakhstan's digital transformation is emerging: the gap between men and women in Internet access has virtually disappeared. In contrast, the gap in access to the most economically valuable forms of digital activity remains.

Therefore, it is necessary to distinguish between at least four levels of digital inclusion.

The first level represents infrastructural access and includes the availability of the Internet, a smartphone, a computer, or another digital device.

The second level characterises user digital inclusion: the ability to use electronic government services, Internet banking, social networks, online stores, instant messengers, and other mass services.

The third level is professional digital inclusion, which includes the use of specialised software, management systems, analytical platforms, programming, data processing, cloud technologies, and artificial intelligence.

The fourth level represents economic digital inclusion - the ability to transform digital competencies into employment, career growth, salary increases, transition to a more productive industry, or the creation of a digital business.

The results show that Kazakhstan has made the most significant progress at the first and second levels, while the main gender constraints are moving to the third and fourth.

Further confirming women's strong willingness to master digital professional development formats are the data from the Skills Enbek platform. During 2025, about 570 thousand people were trained on the platform. Among the unemployed citizens who received certificates, more than 56% were women - about 32 thousand people (Ministry of Labour and Social Protection of the Population of the Republic of Kazakhstan, 2026).

This indicates that women's insufficient participation in the digital economy cannot be explained solely by a lack of interest in professional development. On the contrary, women actively use online professional training formats.

Regionally, the largest number of unemployed women who completed training at Skills Enbek in 2025 were registered in the Turkestan region - about 3.5 thousand people, Kostanay region - 2.8 thousand, Kyzylorda region - 2.6 thousand, as well as in Almaty and Karaganda regions - about 2.3 thousand people each (Ministry of Labour and Social Protection of the Population of the Republic of Kazakhstan, 2026).

Table 4 — Participation of unemployed women in Skills Enbek training in selected regions of Kazakhstan, 2025

Region	Women who received the certificate, thousand people
Turkestan region	3,5
Kostanay region	2,8
Kyzylorda region	2,6
Almaty	2,3
Karaganda region	2,3
Kazakhstan, total	около 32,0
Source: compiled by the authors according to the data of the Ministry of Labour and Social Protection of the Population of the Republic of Kazakhstan (Ministry of Labour and Social Protection of the Population of the Republic of Kazakhstan, 2026).	

The distribution shows that the demand for digital vocational training is not limited to the largest agglomerations. High activity is also observed in areas with significantly different economic structures and levels of urbanisation.

This matters for the spatial dimension of women's employment. Digital learning has the potential to reduce territorial restrictions on access to professional

competencies. A woman living in a small town or rural settlement can study without moving to Almaty or Astana.

However, this result simultaneously reveals the limitations of the digital learning performance indicators used today. The number of students who completed the course and received certificates reflects educational activity, but it does not answer whether the training has improved women's position in the labour market.

To assess actual effectiveness, it is necessary to track the participant's subsequent work trajectory: whether they found a job, how long it took to find employment, whether the job matches the acquired qualifications, whether wages changed, and whether employment lasted six or twelve months.

Therefore, the central indicator of the digital inclusion policy should not be the number of certificates issued, but the conversion of training into employment and income.

The analysis allows us to identify several mechanisms through which digital technologies affect women's position in the labour market.

The first mechanism is related to the expansion of information access. Online platforms and electronic job exchanges reduce the cost of job searching and give women the opportunity to access information about employers regardless of their place of residence. This mechanism is especially important for regions with a limited local skilled employment market.

The second mechanism is educational in nature. Online courses allow you to acquire new skills with less time and territorial costs. This is especially important for women who combine professional activities with family responsibilities or return to the labour market after a long career break.

The third mechanism is related to the development of remote employment. Digital technologies reduce employees' dependence on the employer's physical location and can allow women from the regions to access jobs concentrated in Almaty, Astana, or even outside Kazakhstan.

The fourth mechanism is related to entrepreneurship. E-commerce, marketplaces, social networks, digital advertising and online payments reduce part of the start-up costs of entrepreneurial activity. Previous research in Kazakhstan also shows that ICT development creates additional opportunities for women to participate in e-commerce and online markets (Kireyeva et al., 2022).

However, the fifth is the most significant: the professional and technological mechanism. The maximum economic return occurs when a woman stops acting exclusively as a consumer of a digital service and moves into the category of a specialist who creates, implements, or professionally uses technology.

It is at this level that programming, data analysis, artificial intelligence, cybersecurity, cloud technologies, digital product management, process automation and other competencies that form the most sought-after segments of the modern labour market are located.

In this regard, the growth of artificial intelligence creates both new opportunities

and new risks for gender equality. If differences in women's and men's access to AI competencies form at the initial stage of these technologies' spread, the existing professional digital divide can be reproduced in a new form.

Based on the analysis, the relationship between digitalisation and women's employment can be presented as follows:

digital access → basic digital skills → professional digital competencies
→ access to digital professions → quality of employment → wages and career advancement.

The results show that the restrictive effect in Kazakhstan is less and less concentrated at the first link in the chain and is increasingly shifting to later stages.

Women practically do not have a significant gap in the very fact of access to the Internet. They actively use online services and demonstrate a high interest in digital learning. However, this still does not lead to gender parity in technological education, ICT employment and wages.

Consequently, the empirical results do not support the assumption that increased Internet penetration alone is sufficient to reduce gender disparities in Kazakhstan's labour market.

On the contrary, at the present stage, the qualitative digital divide is becoming more significant - differences in the type of digital skills, the scope of their application and the ability to turn them into economic results.

Thus, the main result of the analysis is to identify the shift from the gender gap in digital access to the gender gap in digital returns. Kazakhstan has largely solved the problem of connecting women to the digital infrastructure. However, the next task is to ensure equal opportunities to convert digital access into professional human capital, and the latter into high-quality employment, high labour productivity, and income.

This gap between formal digital access and actual economic returns should be considered a key issue in developing strategic directions to reduce gender gaps in Kazakhstan's labour market.

Discussion. The results clarify the traditional formulation of the gender digital divide problem in Kazakhstan. The analysis shows that, at present, the main source of digital inequality is no longer the availability of Internet access, but the nature of digital technology use, the level of professional competencies, and the ability to translate digital skills into economic advantages. This is especially important for Kazakhstan, where differences between men and women in basic Internet use are minimal. In contrast, differences in wages, sectoral employment patterns, and representation in technology-intensive professions persist.

If we evaluate digital inclusion solely through the proportion of Internet users, we could talk about practically achieved gender parity. However, the results of the study show the limitations of this approach. Almost the same probability of using the

Internet does not mean the same digital human capital. Women and men may have comparable access to the web. However, they differ in the intensity of technology use, the types of digital tools used, the level of specialised competencies, and the opportunities to monetise these skills.

The results are consistent with the modern concept of multilevel digital inequality, which distinguishes the digital divide at the first, second, and third levels. The first level gap is related to physical access to digital infrastructure and devices; the second is related to differences in digital skills and ways of using technology; and the third is related to unequal social and economic results of digitalisation. In conditions of high Internet penetration, the second and third levels are gradually becoming decisive (van Deursen and van Dijk, 2019; ITU, 2024).

This sequence is of particular importance for Kazakhstan. The results indicate that the primary digital divide between men and women has largely been overcome. At the same time, a gap remains in access to professionally relevant digital competencies, especially in the ability to translate them into better employment, higher incomes, and career advancement. This allows us to talk about the transition from the problem of digital access to the problem of digital outcomes.

This conclusion aligns with the results of Galperin and Arcidiacono (2021), which showed that the availability of Internet access alone does not eliminate gender differences in the labour market. The economic effect of digitalisation depends on how digital technologies are integrated into a person's educational and professional trajectory. For women, it is especially important not only to have access to the Internet, but also to link digital skills with real employment opportunities, professional mobility and higher wages.

In Kazakhstan, this problem is exacerbated by ongoing horizontal segregation in the labour market. Women are highly represented in education, healthcare, social services, trade, and services, while many of the highest-paid technical and technological fields are characterised by higher male representation. Consequently, even with comparable levels of basic digital literacy, the economic benefits of digital skills can vary significantly by industry and professional position.

The revealed combination of almost complete gender parity in Internet access and the persistent wage gap is particularly revealing. The results do not allow us to conclude that this gap is formed directly by differences in digital competencies, since wages depend on a wide range of factors, including industry, profession, position, length of service, education, and working hours. However, the data show that expanding digital accessibility by itself has not automatically equalised the economic outcomes of men and women.

That is why digital inclusion should be considered not as a result, but as a multi-step process. In the first stage, a person gains access to digital infrastructure. In the second stage, he acquires basic user skills. In the third stage, he learns professional digital competencies. It is only at the fourth stage that digital human capital is transformed into a specific economic result — employment, wage growth, professional mobility or entrepreneurial income.

From this point of view, Kazakhstan's results show significant progress in the first two stages and limitations in the third and fourth. Most of the population can already use smartphones, Internet banking, electronic government services, social networks, and digital communications, but this is not enough to generate high returns from the digital economy. The modern labour market is increasingly demanding specialised competencies such as programming, data analysis, cybersecurity, cloud technologies, digital product management, artificial intelligence, business process automation and digital marketing.

Therefore, further improvement in the general level of basic computer literacy, although it remains important for certain groups of the population, will generally have less additional effect in reducing gender inequality. A more promising direction is developing professionally oriented digital competencies directly related to employers' needs.

The results also raise the question of the effectiveness of the existing digital learning model. Women's high activity on online education platforms indicates demand for advanced training, but completing a course or obtaining a certificate does not guarantee a change in career trajectory. Educational activity should be considered an intermediate, not a result.

From a practical point of view, the sequence in which professional digital learning is directly related to the labour market seems to be more effective: training → certification → practical training or internship → employment → career support. Such a model makes it possible to reduce the gap between the formal acquisition of competence and its actual use in production activities.

The spatial dimension of the revealed inequality requires special attention. The average figures for Kazakhstan may conceal significant differences between the largest cities, regional centres, small towns and rural areas. Almaty and Astana concentrate a significant part of highly skilled employment, ICT companies, educational opportunities and innovative infrastructure. In the regions, the set of available professional trajectories may be significantly narrower.

At the same time, territorial digital inequality is not limited to the quality of the Internet connection. Even with technical access, a woman living outside a large city may face fewer job offers, fewer professional communities, fewer internships, fewer mentoring programs, and fewer employers interested in specialists with advanced digital skills.

Therefore, women may be particularly vulnerable when digital restrictions combine with other barriers: low income, living in rural areas, a long career break, a high family burden, or a lack of professional connections. In such circumstances, having a smartphone or Internet connection alone does not reflect the real ability to access high-quality digital employment.

At the same time, the digital economy can ease territorial restrictions. The expansion of remote employment makes it possible to separate the employee's place of residence from the employer's location. For women from the regions, this

may mean access to jobs at companies in Almaty, Astana, and other large centres without mandatory physical migration. In the longer term, cross-border remote employment can expand access to the international labour market.

However, to realise this potential, not only technical connectivity is needed, but also professional training, foreign-language skills, remote interaction skills, the ability to work with international digital platforms, and compliance with employer requirements.

The results also confirm the need for more careful attention to women's transition from digital technology users to developers and professional creators. Kireyeva et al. (2022) show that ICT development is already empowering women in Kazakhstan in e-commerce and the online economy. However, the most significant reduction in the structural gender gap can be achieved not only through women's use of digital sales channels, but also by increasing their participation in software development, data management, digital product development and the introduction of new technologies.

This problem is becoming even more urgent due to the rapid spread of artificial intelligence. Generative AI is changing employee competency requirements far beyond the ICT sector. The skills of using artificial intelligence tools are gradually becoming part of professional literacy in education, finance, marketing, management, consulting, scientific activity and other fields.

In these circumstances, a new digital divide may emerge. If men learn to use artificial intelligence professionally faster, differences may arise even with full equality of access to the Internet and digital devices. Therefore, gender digital inclusion policy should be proactive and account not only for existing differences, but also for potential new forms of technological inequality.

For Kazakhstan, this means a gradual transition from a policy of mass digital literacy to one that develops productive digital human capital for women. Such a policy should aim to increase women's access to STEM and ICT education, professional retraining, the development of competencies in data analysis and artificial intelligence, internship programs, mentoring, and career development support in technology companies.

At the same time, it is necessary to change how we evaluate the effectiveness of these measures. The number of trained women, completed online courses, or issued certificates should not be the only measure of success. Indicators such as employment after training, transition to a new profession, salary changes, employment sustainability, advancement to technical and managerial positions, and the proportion of women among specialists who directly create digital products are more informative.

Thus, the conducted research shows that the modern gender digital divide in Kazakhstan is gradually taking on a qualitatively new form. The main barrier is shifting from Internet access to differences in the structure of digital human capital and the economic benefits of using it. Therefore, further reducing gender differences

requires not so much an additional increase in the total share of Internet users as creating conditions under which women can move from basic digital consumption to professional and productive use of technology.

However, the results of the study must be interpreted taking into account several limitations. First, some digital access indicators used over the years were designed for different age groups, which limits the ability to construct a fully homogeneous time series. Second, aggregated statistics do not allow establishing an individual cause-and-effect relationship between a particular woman's level of digital skills and her employment or salary. Third, the average gender pay gap does not control for differences in profession, industry, education, length of service, and length of working hours. Therefore, further research should supplement these findings with individual survey data and an econometric assessment of the impact of digital competencies on women's employment likelihood, income level, and career mobility.

Despite these limitations, the results allow us to draw a key conclusion: for Kazakhstan, the main issue in gender digital policy is no longer whether women have access to technology, but how effectively they can transform that access into professional competencies, high-quality employment, and economic advantages. It is the transition from digital access to digital returns that should become the central focus of further analysis of gender differences in the labour market.

Conclusion. The conducted research shows that the nature of gender digital inequality in Kazakhstan has significantly transformed.

Over the past decade, the country has achieved a high level of Internet technology adoption, and the differences between men and women in basic connectivity indicators have become minimal. In 2015, 73.0% of men and 72.7% of women aged 6-74 used the Internet, and by 2024 the corresponding figures were close to 96%.

However, the narrowing of the primary digital divide has not automatically eliminated gender differences in the labour market.

In 2025, women made up 48.3% of Kazakhstan's workforce, but their labour force participation rate was 85.4% of men's. Significant wage inequality persists: the average salary of women in 2025 was 372.2 thousand tenge, compared with 518.3 thousand tenge for men.

The results suggest that women's digital inclusion in Kazakhstan is less about a lack of access to technology than about the uneven formation of productive digital capital.

Digital inequality manifests in the ability to master sought-after professional competencies, apply technology at work, and translate digital skills into higher wages, sustainable employment, entrepreneurial income, and career advancement.

In this regard, strategic policy directions should include the development of advanced digital competencies of women; expanding girls' access to STEM and ICT education; professional retraining of women returning to the labour market after a

career break; linking digital learning programs with specific jobs; development of remote employment in the regions; creation of internship and professional mentoring programs; support for women in the development of artificial intelligence and data analytics.

The transition from digital access assessment to digital outcomes assessment is of fundamental importance. The criterion for the effectiveness of public policy should be not only the number of women who have access to the Internet or have completed an online course, but also the proportion of women who, thanks to digital competencies, have got a new job, increased wages, moved to a more productive sector or started sustainable business activities.

Thus, further reducing gender gaps in Kazakhstan's labour market requires a shift from universal digital connectivity to productive digital inclusion that gives women equal opportunities to shape and benefit from the digital economy.

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ISSN 2518–1467 (Online),

ISSN 1991–3494 (Print)

<http://www.bulletin-science.kz/index.php/en>

Managing Editor: A.Shormakova
Editors: D.S. Alenov, M.Konyrbekov
Computer layout: G.D. Zhadyranova

Signed for print: October 15, 2026
Format: 70×90 1/16. 26.5 printed
sheets. Order No. 5.