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Editors office address:
Jusup Balasagyn Kyrgyz National University
720033, 66 Manas Avenue, Bishkek, Kyrgyz Republic
E-mail: info@balasagynbulletin.com
https://balasagynbulletin.com/en

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Жусуп Баласагын атындагы Кыргыз Улуттук университети
720033, Манас проспектиси, 66, Бишкек ш., Кыргыз Республикасы
E-mail: info@balasagynbulletin.com
https://balasagynbulletin.com/ky

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Адрес редакции:
Кыргызский национальный университет имени Жусупа Баласагына
720033, проспект Манаса, 66, г. Бишкек, Кыргызская Республика
E-mail: info@balasagynbulletin.com
https://balasagynbulletin.com/ru

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Digital technologies as a catalyst for training high-demand specialists: New opportunities for education and the labour market

Nelli Akylbekova*
Doctor of Economics, Professor
Jusup Balasagyn Kyrgyz National University
720033, 547 Frunze Str., Bishkek, Kyrgyz Republic
https://orcid.org/0000-0002-8829-0094

Kishimzhan Zhakshylykova
PhD in Pedagogical Sciences, Associate Professor
Kyrgyz State University named after I. Arabaev
720026, 49 I. Razzakov Str., Bishkek, Kyrgyz Republic
https://orcid.org/0009-0005-8075-6565

Irina Mukambaeva
Doctor of Economics, Associate Professor
Jusup Balasagyn Kyrgyz National University
720033, 547 Frunze Str., Bishkek, Kyrgyz Republic
https://orcid.org/0000-0002-9323-3756

Saltanat Omurova
Doctor of Economics, Associate Professor
Jusup Balasagyn Kyrgyz National University
720033, 547 Frunze Str., Bishkek, Kyrgyz Republic
https://orcid.org/0009-0004-0105-7823

Almagul Attokurova
PhD in Economic Sciences, Associate Professor
Jusup Balasagyn Kyrgyz National University
720033, 547 Frunze Str., Bishkek, Kyrgyz Republic
https://orcid.org/0009-0005-7424-8345

Abstract. In an era of rapid technological advancement, digital technologies and artificial intelligence (AI) are transforming professional education by offering innovative solutions for the training of highly skilled specialists. This article sought to explore the role of digitalisation as a key driver in shaping modern educational systems, enhancing learning efficiency, and aligning graduate competencies with labour market demands. This study aimed to analyse the impact of digital technologies on professional training and their potential to bridge the gap between education and employment. The research examined the integration of AI-driven learning platforms, virtual and augmented reality, adaptive learning systems, and big data analytics into professional training programmes. It also evaluated the extent to which these technologies contribute to the development of skills that meet the evolving needs of the industry. Additionally, the study highlighted the benefits of digital tools in improving accessibility, personalisation, and the overall quality of education. It addressed the role of digitalisation in fostering lifelong learning, reskilling, and upskilling to ensure continuous workforce development. However, the study also acknowledged key challenges, including infrastructure development, digital literacy, and the need for regulatory frameworks. The findings emphasised

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*Corresponding author

that digital transformation in education plays a crucial role in shaping a future-ready workforce, equipping specialists with the competencies required for success in an increasingly digital economy

Keywords: information and communication technologies; personal computer; website; artificial intelligence; professional education; adaptive learning; digital transformation

INTRODUCTION

The rapid development of digital technologies and artificial intelligence (AI) is reshaping the global education landscape, offering unprecedented opportunities to enhance professional training and workforce development. As industries evolve in response to technological advancements, the demand for specialists equipped with digital competencies continues to grow. Traditional education models, often characterised by rigid curricula and standardised teaching methods, struggle to keep pace with the dynamic needs of the labour market. Consequently, there is an increasing need to integrate digital solutions that facilitate flexible, personalised, and competencybased learning approaches.

Digital technologies are transforming education and the labour market, creating new opportunities and challenges. The rise of digital skills has led to the emergence of new professions and the need for adaptable, interdisciplinary competencies (Liventsova *et al.*, 2018). According to N. Shmidt (2024), key competencies in demand include collaboration, leadership, emotional intelligence, self-development, adaptability, and digital skills. As noted by S. Nestulya & S. Shara (2023), the COVID-19 pandemic has accelerated the shift towards remote work and education, necessitating a rethinking of the global labour market. Digital transformation is driving demand for a new type of IT specialist, requiring higher education to adapt to these evolving labour market needs (Nadezhdina *et al.*, 2024).

According to G. Nurmukhanbetova (2020), new technologies have the potential to eliminate many jobs, but will also generate new ones. The main driver of job creation is expected to be the service sector. The development of new transversal skills in the digital era is emphasised, taking into account generational characteristics, as well as the emergence of new opportunities across a range of professions. Digital nomads are primarily characterised by their mobility and constant connectivity to the Internet. In the face of contemporary challenges, such as the COVID-19 pandemic and the global social isolation it induced, there is a pressing need to reconsider the global labour market and embrace emerging opportunities for remote work, including within the education system.

The relevance of the current study lies in the fact that the dynamics of the traditional methodological approach to the educational process, in light of global trends, determine the growing priority of the competency-based approach (Liubarets *et al.*, 2024). Educational institutions must adapt their approaches to training specialists, emphasising flexibility and digital competencies to meet future labour market demands. However, as noted by A. Yuriev (2020), while digital technologies have made teaching and learning more engaging and efficient, the potential drawbacks of their use in education should not be overlooked. Overall, the integration of digital technologies into education and the workplace is essential for preparing specialists to meet the demands of the modern labour market (Riznyk & Riznyk, 2024).

This article examined how digital technologies serve as a catalyst for transforming professional education, ensuring that graduates possess the skills required to succeed in the contemporary workforce. The integration of AI-powered learning systems, virtual and augmented reality (VR/AR), big data analytics, and adaptive educational platforms has the potential to bridge the gap between theoretical knowledge and practical application. Digitalisation enables personalised learning pathways, real-time performance monitoring, and data-informed decisionmaking, fostering a more efficient and student-centred educational environment. Furthermore, the study highlighted how digital tools contribute to improving access to education, reducing geographical and economic barriers, and expanding opportunities for lifelong learning. However, despite these benefits, the transition to digitalised professional education presents several challenges, including infrastructural constraints, digital literacy gaps, and the need for regulatory frameworks to ensure the effective and ethical implementation of emerging technologies. By analysing the impact of digitalisation on professional education, this study aimed to provide insights into how digital technologies can support the development of a highly skilled and adaptable workforce. The discussion was focused on key innovations, their practical applications, and the potential implications for the future of education and employment.

MATERIALS AND METHODS

To explore the integration of digital technologies and intelligent systems within the education sector, a comprehensive review of scholarly literature, policy documents, and industry reports was conducted. The study focused on examining global trends in digital education and their applicability to the educational framework of the Kyrgyz Republic. The insights gained from these sources were used to formulate original findings and practical recommendations aimed at improving the training of high-demand specialists.

The research methodology encompassed data collection, systematic processing, and synthesis of scientific materials, complemented by logical reasoning and statistical analysis techniques. A combination of qualitative and quantitative approaches was employed to assess the effectiveness of digital learning tools. Additionally, the study

relied on statistical data sourced from the National Statistical Committee of the Kyrgyz Republic (NSC KR, n.d.) to support analytical assessments and conclusions, ensuring evidence-based recommendations for educational policy and workforce development.

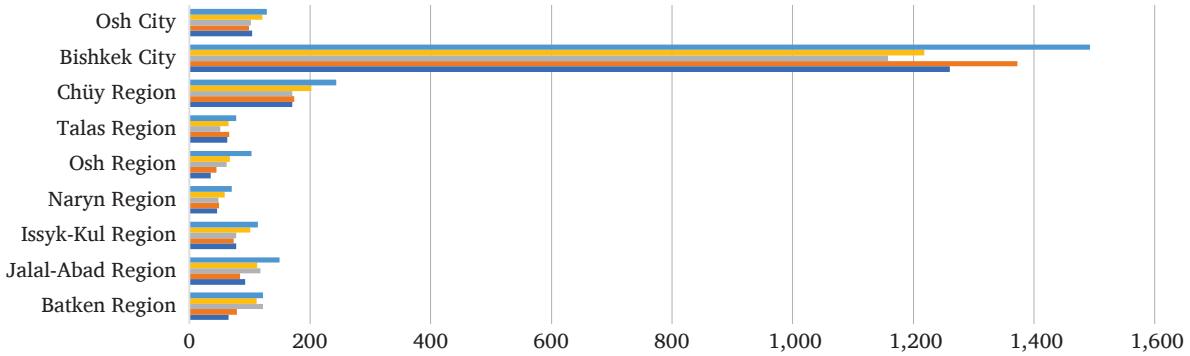
The study also incorporated a systematic analysis of existing educational frameworks and models of digital technology integration from various international contexts. This comparative approach enabled the identification of best practices and potential adaptations suited to the Kyrgyz Republic's educational landscape. The analysis focused on identifying key success factors, potential barriers, and the overall impact of digital technologies on educational outcomes, thereby providing a more comprehensive understanding of how digital transformation can be strategically implemented to enhance professional training and meet the evolving demands of the labour market.

RESULTS

The use of digital technologies to enhance the efficiency of enterprises is becoming increasingly vital in today's rapidly evolving business environment. Digital tools, such as automation, data analytics, and cloud computing, enable businesses to streamline operations, improve decisionmaking processes, and optimise resource management. These advancements lead to greater productivity, cost reduction, and the ability to adapt swiftly to market changes. However, to fully harness these technological opportunities, there is a growing need to prepare specialists with digital skills. Workers must be equipped with the knowledge and expertise to operate advanced technologies, manage digital platforms, and implement innovative solutions. As the demand for digitally skilled professionals continues to rise, it is crucial for educational systems and training programmes to prioritise digital literacy, ensuring a workforce capable of driving business success and innovation in the digital age.

The analysis of the availability of dedicated websites across different regions in the Kyrgyz Republic from 2018 to 2022 demonstrates notable trends in the digital presence of various entities. Overall, the total number of entities with their own websites has shown a steady increase from 1,915 in 2018 to 2,501 in 2022 (NSC KR, n.d.). This growth indicates a positive trend towards digitalisation, reflecting the broader adoption of online platforms by institutions and organisations across the country. Looking at the regional distribution, Bishkek City consistently recorded the highest number of entities with websites, increasing from 1,260 in 2018 to 1,493 in 2022. This rise aligns with the capital's central role in the country's economic and administrative activities, suggesting a higher level of digital engagement in urban areas. Other regions also demonstrate varying trends. For example, Chüy Region, with a steady increase from 171 in 2018 to 243 in 2022, indicates robust growth in the number of organisations going online. Osh Region, which showed a notable rise from 35 units in 2018 to 103 in 2022, reflects a similar pattern, albeit from a lower starting point. In contrast, the Jalal-Abad Region experienced a more fluctuating trajectory, reaching 150 units in 2022 after variable changes in previous years.

Regions such as Batken Region and Naryn Region have exhibited some fluctuations in the number of entities with websites; however, both show overall growth, reaching 122 and 70 units in 2022, respectively. Talas Region displayed a more gradual rise, from 63 units in 2018 to 78 in 2022 (Fig. 1). Overall, while the trend towards digitalisation in the Kyrgyz Republic appears to be advancing, urban centres such as Bishkek and Osh continue to dominate in terms of digital presence. Smaller regions also exhibit growth, though the pace and scale vary. The data suggests that expanding digital literacy and infrastructure in rural areas could further accelerate the adoption of online platforms across the country.

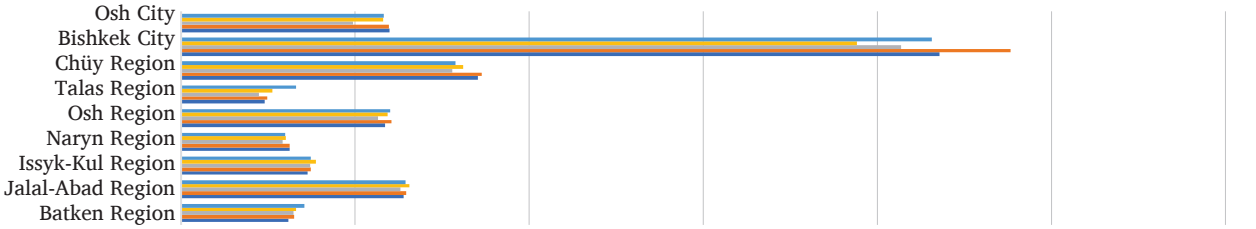


	Batken Region	Jalal-Abad Region	Issyk-Kul Region	Naryn Region	Osh Region	Talas Region	Chüy Region	Bishkek City	Osh City
2022	122	150	114	70	103	78	243	1,493	128
2021	111	113	101	59	67	65	202	1,218	121
2020	122	118	78	48	62	51	171	1,158	102
2019	79	84	73	49	45	66	174	1,372	99
2018	65	93	78	46	35	63	171	1,260	104

Figure 1. *Availability of own website in the Kyrgyz Republic, units*
Source: *compiled by the authors based on data from NSC KR (n.d.)*

The analysis of the number of enterprises and organisations using information and communication technologies (ICT) in the Kyrgyz Republic from 2018 to 2022 reveals a general upward trend in the adoption of ICT. The total number of ICT-utilising enterprises increased from 12,152 in 2018 to 12,258 in 2022, demonstrating steady growth in technology adoption across the country (NSC KR, n.d.). Examining regional trends, Bishkek City consistently recorded the highest number of ICT users, with some fluctuations in the data. The figure rose from 4,356 units in 2018 to 4,764 in 2019, declined in 2021 to 3,883, and then increased again to 4,313 in 2022. Despite the dip in 2021, Bishkek remains the leading region for ICT usage, reflecting the capital's greater access to technology and infrastructure. Other regions also exhibit positive growth. Osh City showed a gradual rise, an increase from 1,197 units in 2018 to 1,165 in 2022. However, the data indicate fluctuations during the observed period, particularly in 2020.

Chüy Region also maintains a high level of ICT adoption, with figures rising from 1,706 units in 2018 to 1,575 in 2022, although this reflects a slight overall decrease, especially in the final year. Similarly, the Talas Region experienced notable growth, from 480 units in 2018 to 661 in 2022, indicating a positive trend in ICT uptake in this region. Jalal-Abad Region also showed steady growth, peaking at 1,313 in 2021 before slightly decreasing to 1,289 in 2022. Other regions, such as Issyk-Kul, Naryn, and Batken, demonstrated growth in ICT usage, albeit with some yearto-year variation. For example, the Issyk-Kul Region peaked at 776 units in 2021 but declined to 746 in 2022, while the Naryn Region experienced a modest decline between 2020 and 2022. Batken Region, however, showed consistent growth, reaching 710 units in 2022 (Fig. 2).



	Batken Region	Jalal-Abad Region	Issyk-Kul Region	Naryn Region	Osh Region	Talas Region	Chui Region	Bishkek City	Osh City
2022	710	1,289	746	599	1,200	661	1,575	4,313	1,165
2021	660	1,313	776	603	1,188	523	1,620	3,883	1,161
2020	647	1,260	740	583	1,131	448	1,557	4,137	988
2019	648	1,294	746	625	1,207	496	1,728	4,764	1,193
2018	615	1,279	726	622	1,171	480	1,706	4,356	1,197

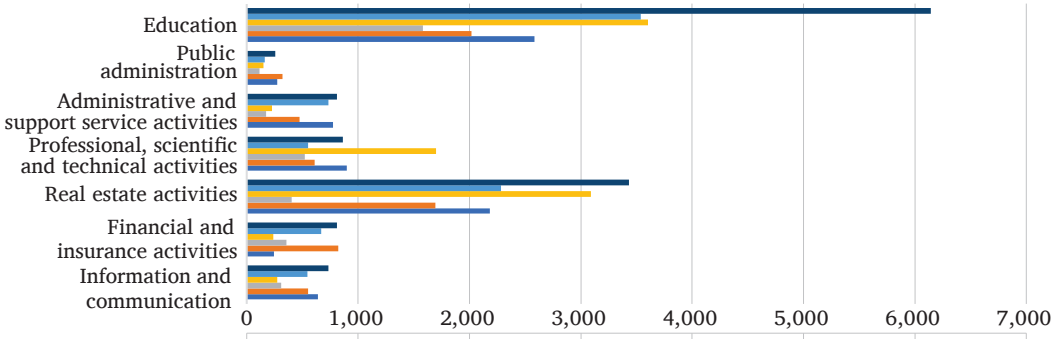
Figure 2. *Number of enterprises and organisations using ICT in the Kyrgyz Republic, units*
Source*: compiled by the authors based on data from NSC KR (n.d.)*

In conclusion, there is a clear trend of increasing ICT adoption by enterprises and organisations across the Kyrgyz Republic. While urban centres such as Bishkek and Osh continue to lead, other regions – particularly Talas, Chüy, and Jalal-Abad – are showing encouraging growth, suggesting a widening access to ICT nationwide. However, further investment in infrastructure and digital literacy is necessary to accelerate ICT adoption in less developed areas. The analysis of new job creation by the economic sector in the Kyrgyz Republic from 2018 to 2023 reveals significant variation across industries. Overall, the total number of newly created jobs increased by 13.7%, rising from 96,013 in 2018 to 109,168 in 2023, indicating positive employment trends across the economy (NSC KR, n.d.).

Information and communication. The number of new jobs in this sector fluctuated, with a sharp decline in 2020 (310 jobs), likely attributable to the pandemic. However, by 2023, the sector experienced a strong recovery, reaching 735 new jobs – an increase of 115.4% over the period. Financial and insurance activities. This sector experienced exceptional growth, particularly in 2022 and 2023. The number of new jobs increased significantly, rising from 244 in 2018 to 809 in 2023, reflecting a growth rate of 231.6% (Fig. 3). This expansion may be attributed to the growing digitalisation of financial services and the expansion of financial institutions.

Real estate activities. The real estate sector exhibit ed considerable fluctuation, with a notable peak in 2021 (3,089 jobs). By 2023, the sector had generated 3,434 new jobs, representing a growth rate of 157.2%. This trend suggests recovery and continued growth in real estate, possibly driven by increased demand for housing and property-related services.

Professional, scientific and technical activities. This sector displayed variability in job creation, with a significant spike in 2021 (1,702 jobs). However, by 2023, the number of new jobs had declined to 864, resulting in a total growth of 96.1% over the period. The downturn in 2020 and 2022 may reflect global disruptions and shifting demand for specific professional services.



	Information and communication	Financial and insurance activities	Real estate activities	Professional, scientific and technical activities	Administrative and support service activities	Public administration	Education
2023	735	809	3,434	864	812	258	6,145
2022	545	666	2,283	552	731	160	3,539
2021	276	241	3,089	1,702	227	151	3,603
2020	310	358	405	524	176	116	1,580
2019	551	824	1,696	608	476	322	2,018
2018	637	244	2,185	899	773	272	2,584

Figure 3. *Number of new jobs created by type of economic activity in the Kyrgyz Republic, units*
Source: *compiled by the authors based on data from NSC KR (n.d.)*

Administrative and support service activities. Employment in this sector experienced moderate growth, with new jobs increasing from 773 in 2018 to 812 in 2023 – equivalent to a growth rate of 5%. Fluctuations in 2020 and 2022 are likely linked to the effects of the COVID19 pandemic and subsequent economic recovery.

The number of new jobs in public administration declined slightly in 2020 and 2022 but remained relatively stable overall. In 2023, 258 jobs were created, indicating a growth rate of 5.1%, and suggesting a slower recovery in the public sector compared with other areas. The education sector recorded the highest growth in job creation, rising from 2,584 jobs in 2018 to 6,145 in 2023 – a growth rate of 137.8%. This rapid expansion may be linked to increasing demand for online learning, the introduction of new educational programmes, and the broader development of the education sector.

In the following sectors, the use of digital technologies is especially prominent due to the nature of their services, the need for operational efficiency, and the increasing reliance on technological innovations. These sectors are inherently reliant on digital tools, underpinned by ongoing advancements in IT infrastructure, communication networks and software development. The widespread adoption of cloud computing, mobile technologies and digital platforms is essential for day-to-day operations, data transmission and content delivery.

The financial sector has undergone rapid digital transformation, characterised by the adoption of online banking, mobile payment systems, blockchain technology and fintech innovations. Digital technologies have transformed customer service, transaction processing, risk management, and financial analysis, enabling businesses to provide faster and more secure services. Digital technologies are also increasingly utilised in the real estate sector through online property listings, virtual tours and AI-driven tools for property valuation and management. Platforms offering digital solutions for property transactions and administration have become essential, streamlining processes and enhancing accessibility for both buyers and sellers. This sector extensively incorporates digital tools, such as advanced software, data analytics, artificial intelligence (AI), and machine learning to support research, development, consultancy and a range of technical services. The integration of digital technologies improves the accuracy, efficiency and reach of professional services across engineering, architecture, scientific research and legal advisory.

In administrative and support services, digital technologies – including cloud-based tools, automation software and project management platforms – have optimised workflows, improved communication, and increased operational efficiency. These technologies also support remote working solutions, which are becoming increasingly integral to the contemporary workplace. The public sector has progressively adopted digital technologies to improve governance, increase transparency and deliver services more efficiently. E-government platforms, digital citizen services and data-driven decision-making represent key areas in which technology is modernising public administration processes. Digital technologies are also widely used in education through online learning platforms, digital classrooms and e-learning tools. The shift towards digital education, particularly in response to the COVID-19 pandemic, has accelerated the adoption of virtual learning environments (VLEs), educational applications, and online course delivery, enhancing accessibility and flexibility in educational

provision. Overall, these sectors have acknowledged the necessity of digital transformation to remain competitive, boost productivity and respond to the changing needs of consumers, students and employees. In conclusion, the data illustrate the dynamic nature of job creation in the Kyrgyz Republic, with certain sectors, such as financial and insurance activities, demonstrating exceptional expansion. The education sector also stands out due to its substantial job creation, reflecting the country's commitment to broadening educational opportunities. Despite some fluctuations, the job market is showing signs of recovery, and the digital transformation across various sectors is likely a contributing factor to this growth in employment.

The integration of digital technologies into professional education has introduced a range of innovative tools and approaches that are redefining the way students acquire skills and prepare for employment. These innovations not only improve learning outcomes but also ensure that graduates develop competencies aligned with the evolving needs of the labour market. Below are some of the key technological advancements, their practical applications, and the potential implications for the future of education and employment.

1. Artificial intelligence and adaptive learning systems

Practical application. AI-powered adaptive learning platforms analyse students' progress, learning styles and areas of difficulty to personalise educational content. These systems provide real-time feedback, recommend tailored study plans, and conduct automated assessments. AIpowered chatbots and virtual tutors further enhance the learning experience by offering immediate support.

Implications. By tailoring education to individual needs, AI-driven systems enhance learning outcomes, increase student engagement and reduce dropout rates. Additionally, AI enables educators to focus on fostering critical thinking and problem-solving skills rather than relying on rote memorisation.

2. Virtual reality (VR) and augmented reality (AR) in training

Practical application. VR and AR create immersive learning environments in which students can rehearse real-world scenarios in a risk-free setting. For instance, medical students can conduct virtual surgeries, engineers can simulate complex machinery operations, and mechanics can explore three-dimensional models of automotive systems.

Implications. These technologies improve practical skill acquisition, bridge the gap between theoretical knowledge and practical application, and reduce training costs in industries requiring hands-on experience.

3. Blockchain for credentialling and certification

Practical application. Blockchain technology guarantees the security and transparency of academic records and certifications. Digital diplomas and micro-credentials stored on decentralised ledgers prevent fraud, enable instant verification by employers, and support lifelong learning by allowing individuals to accumulate and demonstrate their skills.

Implications. This innovation increases trust in academic credentials, streamlines recruitment processes and reinforces the shift towards skills-based hiring, where verified competencies are prioritised over traditional qualifications.

4. Big Data and learning analytics

Practical application. Educational institutions utilise big data analytics to monitor student engagement, forecast learning outcomes, and optimise curriculum design. By examining large volumes of data, educators can identify at-risk students, enhance course efficacy, and adapt teaching strategies accordingly.

Implications. Data-driven decision-making improves the efficiency of educational systems, facilitates early intervention for struggling learners and ensures that curricula remain responsive to labour market developments.

5. Online learning platforms and microlearning

Practical application. Platforms such as Coursera, Udacity and LinkedIn Learning offer on-demand courses aligned with industry requirements. Microlearning – brief, targeted lessons delivered via mobile applications – allows learners to gain specific skills rapidly and efficiently.

Implications. These adaptable learning formats enable continuous upskilling and reskilling, promoting lifelong learning and enhancing workforce agility in the face of technological change.

6. Internet of Things (IoT) in smart learning environments

Practical application: IoT-enabled smart classrooms employ connected devices – such as interactive whiteboards, wearable technology and real-time monitoring systems – to create interactive, data-driven learning experiences. Smart attendance systems, biometric authentication and AI-powered classroom management tools further streamline educational operations.

Implications. IoT improves classroom efficiency, fosters student engagement, and facilitates personalised learning through the collection and analysis of real-time data.

DISCUSSION

Certain scholars highlight critical issues in the development of education in developing nations, including the enhancement of knowledge acquisition and learning competencies, the effective planning and management of budgets, and the broad adoption of online academic qualifications. As noted by M. Zaki Ewiss (2020), these factors are essential for advancing distance education and mitigating geographical disparities between countries. Furthermore, some researchers have examined the motivations of Information Systems students in their final-year projects and the implications of these motivations for technology and innovation (Lavy & Rashkovits, 2016). Universities play a vital role in positively influencing international students. For example, according to D. Lien & L. Miao (2018) and J. Chen *et al.* (2023), Confucius Institutes in China support local firms in navigating the complexities of international operations, including the adaptation process and associated risks, thereby facilitating a deeper understanding of host-country markets.

Other studies, such as that by D. Frommberger & F. Baumann (2020), emphasise the significant impact of higher education on health behaviours and overall well-being, which is essential for the long-term development of human capital. Additionally, H. Li *et al.* (2017) and H. Fu *et al.* (2022) found that higher education increases individuals' social confidence by enhancing their socio-economic status.

To expand the network of partners in educational development within the Kyrgyz Republic, there is a need to improve the quality of education and diversify the quality of educational services. According to T. Avdeeva *et al.* (2017) and N. Akylbekova *et al.* (2024), existing challenges in higher education – such as the delayed alignment of research with industry needs and the slow adoption of emerging disciplines – can be addressed through the internationalisation and transnationalisation of higher education. Embracing this inevitable trend, alongside the integration of digital technologies, is critical for future progress (Sayakbaeva *et al.*, 2018; Demidchik *et al.*, 2021).

The integration of digital technologies and intelligent systems into the education sector is not only essential for modernising the learning process but also plays a key role in shaping the labour market. A well-developed education system aligned with technological advancements enhances workforce competencies and improves employability (Pérez-Montoro & Tammaro, 2012). In this context, the State Investment Budget (SIB) serves as a powerful driver of economic growth by supporting job creation and accelerating the uptake of innovative technologies. These investments contribute to higher productivity, increased incomes, and overall improvements in living standards, thereby establishing a direct link between education, technological progress, and labour market expansion (Zhakshylykova, 2016).

According to N. Mukambaev *et al.* (2024), the relationship between demographic potential indicators and climatic aspects of water stress underscores the need for specialised expertise to address the challenges of sustainable water management. Digital technologies serve as catalysts for training high-demand specialists capable of developing innovative solutions that balance population growth with environmental sustainability in regions experiencing water scarcity. Quality education, a core component of the United Nations' 2030 Agenda for Sustainable Development (2015), aims to ensure inclusive and equitable education for all. Digital technologies have become indispensable tools for achieving this goal (Boyarinova, 2020; Haleem *et al.*, 2022). As stated by I. Biletska *et al.* (2021), the integration of digital solutions enables students to complete tasks more efficiently and apply new tools competently in professional contexts. Educators across general secondary schools, colleges, vocational institutions, and universities need to develop key competencies in using cloud technologies to enhance the educational process, particularly in the context of distance learning (Vakaliuk *et al.*, 2021). Several studies, including that of M. Beardsley *et al.* (2021), have explored the motivation and capacity of teachers to integrate digital technologies into their pedagogical practices.

In Ukraine, according to V. Dudar *et al.* (2021), the widespread implementation of distance learning alongside traditional education has been identified as a strategic priority, involving the integration of information and communication technologies and digital tools. To meet the evolving expectations of a new generation of learners, higher education institutions are increasingly adopting digital platforms such as Virtual Learning Environments (VLEs) and social media (Lacka & Wong, 2021).

Research by M. Qureshi *et al.* (2021) highlights the importance of advancing education and cultivating high-tech competencies. As digital technologies continue to shape the future of education, traditional educational models are anticipated to be progressively replaced. S. Revunov *et al.* (2023) advocate for the adoption of digital tools to strengthen education exports, align with international edtech standards, and address the challenges of digital transformation in the education sector. To advance and achieve international recognition in higher education, it is vital to enhance teaching quality through relevant educational programmes and to create environments that unlock students' intellectual and creative potential. A competency-based approach is central to developing the skills necessary for effective societal participation and future employment. D. Frommberger & F. Baumann (2020) argue that the development of international vocational qualifications and the promotion of global cooperation in vocational education are essential for the internationalisation of vocational training. According to L. Xing *et al.* (2021) and Y. Du *et al.* (2023), the rising demand for education exports is driven by the need to strengthen human capital in knowledge-intensive service sectors and to resolve the persistent mismatch in human capital, which constrains innovation. This necessitates increased investment in education and in upskilling the workforce. In essence, the integration of digital technologies into education is not merely a modernisation effort but a strategic imperative to cultivate a globally competitive workforce, expand access to quality education, and foster sustainable development. Achieving these goals demands sustained international collaboration and significant investment in both infrastructure and human capital.

CONCLUSIONS

Digital technologies are rapidly transforming the landscape of education and the labour market, offering new opportunities for both sectors. The integration of digital tools into education facilitates more efficient learning, enhanced access to knowledge, and the development of essential skills that align with the demands of modern industries. As businesses increasingly rely on digital solutions to improve productivity and adapt to evolving environments, the need for professionals with digital competencies has never been more urgent. The development of digital literacy and specialised skills through education systems is crucial for preparing the workforce for the future. Higher education institutions, in particular, must prioritise the integration of digital technologies into their curricula, ensuring that

students acquire the capabilities necessary to succeed in an increasingly technology-driven employment landscape. Moreover, collaboration between educational institutions and the private sector will be essential in aligning academic programmes with industry requirements, fostering innovation, and promoting the growth of sectors driven by digital transformation. By embracing digital technologies, education systems can better prepare learners for the challenges of tomorrow's labour market, enabling them to become highly skilled professionals who contribute meaningfully to economic development and societal advancement.

The rapid adoption of digital technologies in professional education is reshaping how individuals prepare for the labour market. Innovations such as AI-driven learning systems, VR/AR simulations, blockchain-based credentialing, and big data analytics are making education more accessible, personalised, and industry-relevant. However, these developments also pose challenges, including limitations in digital infrastructure, cybersecurity risks, and the necessity for educators to adapt to new pedagogical approaches. To fully realise the benefits of digital transformation, governments, educational institutions, and industry stakeholders must collaborate in formulating policies that support technological integration, promote digital literacy training, and ensure that education systems remain responsive to evolving labour market demands. By embracing these innovations, professional education can become more inclusive, efficient, and aligned with the competencies required for future employment.

In conclusion, the integration of digital technologies into education and workforce development offers a significant opportunity to bridge the divide between education and industry, ensuring that individuals are equipped with the skills required to thrive in a dynamic global economy. Ongoing collaboration among all stakeholders will be pivotal in shaping a future in which digital competencies are central to both personal fulfilment and professional success. Future research should prioritise longitudinal studies to evaluate the long-term effects of specific digital education interventions on career trajectories and labour market adaptability, particularly across diverse socioeconomic contexts.

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Санариптик технологиялар суроо-талапка ээ адистерди даярдоо катализатору катары: билим берүү жана эмгек рыногу үчүн жаңы мүмкүнчүлүктөр

Нелли Акылбекова
Экономика илимдеринин доктору, профессор
Ж. Баласагын атындагы Кыргыз улуттук университети
720033, Фрунзе көч., 547, Бишкек ш., Кыргыз Республикасы
https://orcid.org/0000-0002-8829-0094

Кишимжан Жакшылыкова
Педагогика илимдеринин кандидаты, доцент
И. Арабаев атындагы Кыргыз мамлекеттик университети
720026, И. Раззаков көч., 49, Бишкек ш., Кыргыз Республикасы
https://orcid.org/0009-0005-8075-6565

Ирина Мукамбаева
Экономика илимдеринин доктору, доцент
Ж. Баласагын атындагы Кыргыз улуттук университети
720033, Фрунзе көч., 547, Бишкек ш., Кыргыз Республикасы
https://orcid.org/0000-0002-9323-3756

Салтанат Омурова
Экономика илимдеринин доктору, доцент
Ж. Баласагын атындагы Кыргыз улуттук университети
720033, Фрунзе көч., 547, Бишкек ш., Кыргыз Республикасы
https://orcid.org/0009-0004-0105-7823

Алмагуль Аттокурова
Экономика илимдеринин кандидаты, доцент
Ж. Баласагын атындагы Кыргыз улуттук университети
720033, Фрунзе көч., 547, Бишкек ш., Кыргыз Республикасы
https://orcid.org/0009-0005-7424-8345

Аннотация. Тез технологиялык өнүгүү доорунда санариптик технологиялар жана жасалма интеллект (ЖИ) жогорку квалификациялуу адистерди даярдоо үчүн инновациялык чечимдерди сунуштоо менен кесиптик билим берүүнү өзгөртүп жатат. Бул документ заманбап билим берүү системаларын калыптандырууда, окутуунун натыйжалуулугун жогорулатууда жана бүтүрүүчүлөрдүн компетенцияларын эмгек рыногунун талаптарына шайкеш келтирүүдөгү негизги кыймылдаткыч катары санариптештирүүнүн ролун изилдөөгө багытталган. Бул изилдөөнүн негизги максаты санариптик технологиялардын кесиптик даярдыкка тийгизген таасирин жана алардын билим берүү менен жумуштуулуктун ортосундагы ажырымды жоюу мүмкүнчүлүгүн талдоо болгон. Изилдөө профессионалдык окуу программаларында ЖИ менен башкарылган окутуу платформаларынын, виртуалдык жана кеңейтилген реалдуулуктун, адаптацияланган окутуу системаларынын жана чоң маалыматтардын аналитикасынын интеграциясын карады. Ошондой эле бул технологиялар тармактардын өнүгүп жаткан муктаждыктарына жооп берген көндүмдөрдү өнүктүрүүгө канчалык салым кошооруна баа берилди. Андан тышкары, документ билим берүүнүн жеткиликтүүлүгүн, персоналдаштырууну жана жалпы сапатын жакшыртууда санариптик куралдардын артыкчылыктарын баса белгиледи. Анда санариптештирүүнүн өмүр бою билим алууга көмөктөшүүдөгү, кайра квалификациясын жогорулатуудагы жана жумушчу күчүнүн үзгүлтүксүз өнүгүшүн камсыздоодогу ролу каралган. Бирок, изилдөө ошондой эле инфраструктураны өнүктүрүү, санариптик сабаттуулук жана ченемдик укуктук базанын зарылдыгын камтыган негизги көйгөйлөрдү моюнга алды. Изилдөөлөрдүн жыйынтыгында билим берүүдөгү санариптик трансформация келечекке даяр жумушчу күчүн калыптандырууда чечүүчү ролду ойноп турганы, адистерди барган сайын санариптик экономикада ийгиликке жетүү үчүн зарыл болгон компетенциялар менен жабдуу баса белгиленди

Негизги сөздөр: маалыматтык-коммуникациялык технологиялар; персоналдык компьютер; веб-сайт; жасалма интеллект; кесиптик билим берүү; адаптивдик окутуу; санариптик трансформация

Цифровые технологии как катализатор подготовки востребованных специалистов: новые возможности для образования и рынка труда

Нелли Акылбекова
Доктор экономических наук, профессор
Кыргызский национальный университет имени Ж. Баласагына
720033, ул. Фрунзе, 547, г. Бишкек, Кыргызская Республика
https://orcid.org/0000-0002-8829-0094

Кишимжан Жакшылыкова
Кандидат педагогических наук, доцент
Кыргызский государственный университет имени И. Арабаева
720026, ул. И. Раззакова, 49, г. Бишкек, Кыргызская Республика
https://orcid.org/0009-0005-8075-6565

Ирина Мукамбаева
Доктор экономических наук, доцент
Кыргызский национальный университет имени Ж. Баласагына
720033, ул. Фрунзе, 547, г. Бишкек, Кыргызская Республика
https://orcid.org/0000-0002-9323-3756

Салтанат Омурова
Доктор экономических наук, доцент
Кыргызский национальный университет имени Ж. Баласагына
720033, ул. Фрунзе, 547, г. Бишкек, Кыргызская Республика
https://orcid.org/0009-0004-0105-7823

Алмагуль Аттокурова
Кандидат экономических наук, доцент
Кыргызский национальный университет имени Ж. Баласагына
720033, ул. Фрунзе, 547, г. Бишкек, Кыргызская Республика
https://orcid.org/0009-0005-7424-8345

Аннотация. В эпоху стремительного технологического прогресса цифровые технологии и искусственный интеллект (ИИ) трансформируют профессиональное образование, предлагая инновационные решения для подготовки высококвалифицированных специалистов. Цель данной работы состояла в том, чтобы изучить роль цифровизации как ключевого фактора в формировании современных образовательных систем, повышении эффективности обучения и согласовании компетенций выпускников с требованиями рынка труда. Основной задачей исследования было проанализировать влияние цифровых технологий на профессиональную подготовку и их потенциал для преодоления разрыва между образованием и трудоустройством. В исследовании рассматривалась интеграция обучающих платформ, управляемых искусственным интеллектом, виртуальной и дополненной реальности, адаптивных систем обучения и аналитики больших данных в программы профессиональной подготовки. Также оценивалась степень, в которой эти технологии способствуют развитию навыков, отвечающих меняющимся потребностям отраслей. Кроме того, в статье подчеркнуты преимущества цифровых инструментов в повышении доступности, персонализации и общего качества образования. В ней рассмотрена роль цифровизации в содействии обучению на протяжении всей жизни, переквалификации и повышении квалификации для обеспечения непрерывного развития специалистов. Однако в исследовании также были отмечены основные проблемы, в том числе касающиеся развития инфраструктуры, цифровой грамотности и необходимости создания нормативно-правовой базы. Полученные результаты подчеркивают, что цифровая трансформация образования играет решающую роль в формировании специалистов, готовых к будущему, обладающих компетенциями, необходимыми для успешной работы в условиях современной экономики, которая все больше зависит от цифровых технологий

Ключевые слова: информационно-коммуникационные технологии; персональный компьютер; веб-сайт; искусственный интеллект; профессиональное образование; адаптивное обучение; цифровая трансформация

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Cyberpedagogy – the educational challenge of the 21st century

Gulaiym Duishonbekova
PhD in Pedagogical Sciences, Associate Professor
Jusup Balasagyn Kyrgyz National University
720033, 547 Frunze Str., Bishkek, Kyrgyz Republic
https://orcid.org/0009-0008-3634-7010

Ainura Baitokova*
PhD in Pedagogical Sciences, Associate Professor
Jusup Balasagyn Kyrgyz National University
720033, 547 Frunze Str., Bishkek, Kyrgyz Republic
https://orcid.org/0009-0001-0514-6477

Abstract. With the rapid development of digital technologies, education is faced with the need to integrate modern digital tools into the learning process, which makes cyberpedagogy a prominent area of research. The purpose of the present study was to identify the effects of digital educational technologies on student engagement and academic performance, and to analyse the effectiveness of the Kahoot platform in the learning process. To fulfil this purpose, the study employed the methods of theoretical analysis of scientific literature, empirical research with questionnaire survey of students, as well as comparative analysis of control and experimental groups. The study assessed students' digital competences before and after training in the use of the Kahoot platform. The study found that pre-training in digital tools positively influenced the level of mastery: in the experimental group, the number of students confidently using the platform increased by 46%, while in the control group the changes were minimal. The analysis revealed that digital educational tools helped to increase the engagement and interactivity of the learning process and improved the perception of learning material. It was found that the use of interactive platforms contributed to the development of students' independence, stimulated their cognitive activity, and helped to form critical thinking skills. The key competences of a teacher necessary for the effective use of digital technologies in educational activities were identified, including technological literacy, adaptability, and the ability to integrate digital teaching methods. The practical value of the study lies in the possibility of using its findings by university and college teachers to optimise the educational process, as well as in the development of methodological recommendations for the implementation of digital educational tools in teaching practice, which will make learning more accessible, interactive, and effective

Keywords: digitalisation of education; teacher's role; hybrid learning; critical thinking; educational technologies; innovations in learning

INTRODUCTION

In recent decades, technology has developed at an incredible pace, and digital devices and the internet have become an integral part of everyday life, making education a major challenge. Contemporary learners have instant access to a vast array of information, which changes not only the ways of acquiring knowledge, but also the very role of the educator. V. Akhrenov *et al.* (2020) noted that "the lack of communication between students and teachers contributes to the loss of the emotional component of the educational process". Researchers noted that the digital transformation of education is accompanied by both positive changes and major challenges (Selwyn, 2021; Bond *et al.*, 2021). The digital revolution revealed problems such as outdated teaching methods, low levels of digital literacy among educators, lack of necessary technical resources in a series of educational institutions, and the absence of a unified strategy for the introduction of digital technologies into the educational process. Other studies also highlighted the

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*Corresponding author

risks of alienation and decreased student motivation in the transition to digital learning formats (Dai *et al.*, 2021). Students who are used to interactive and dynamic formats of the digital world may lose interest in conventional forms of learning. At the same time, A. Redecker & Y. Punie (2017) showed that digital technologies can not only increase student engagement but also improve the personalisation of learning. As a result, an imbalance can be observed: on the one hand, there are rapidly developing digital tools that can make learning more engaging and effective, while on the other hand, there is an education system that is not always ready for these changes. Educators are faced with the challenge of not only mastering the latest technologies, but also reorganising their usual ways of working, which requires time, resources, and effort.

Cyberpedagogy is one of the promising areas in pedagogical science, aimed at using digital technologies, online platforms, virtual and augmented reality, as well as artificial intelligence in the educational process. G. Vorobiev (1986) noted that "the aspect of cyberpedagogy is the informational nature of the learning environment", but modern research emphasises the development of interactive technologies and adaptive learning systems (Redecker & Punie, 2017). Most importantly, however, cyberpedagogy proposes to rethink the very role of the educator from a source of knowledge to a facilitator and moderator who helps students effectively use digital resources for learning. It is a section of pedagogy that outlines the methodology of automatic programme management of computer-assisted learning in contrast to conventional pedagogy that considers the methodology of intuitive guidance of learning by the teacher "manually" (Bespalko, 2017).

The significance and relevance of this subject are conditioned by the fact that in the 21st century education can no longer exist outside the digital space. The COVID-19 pandemic clearly showed how critical the readiness of educational institutions to transition to the online format is (Agranovich & Drenyova, 2020). Educational institutions faced difficulties due to the lack of relevant competences among educators. Even after several years, the problem continues to be acute: not all educational programmes are adapted to the digital environment, and educators lack support and teaching materials (Radina & Balakina, 2021).

Cyberpedagogy is becoming not just a trend, but a necessity. It allows not only modernising the educational process but also preparing students to live and work in a digital society. S. Belov & I. Belova (2020) noted that "information and media literacy of school and university students makes provision for their effective interaction with media and information services, assumes the ability to work with any sources of information, as well as with all types and kinds of information, is expressed in knowledge, skills, and abilities that enable pupils and students to become active participants in the socialising Internet environment of cyberspace". However, its implementation requires a systematic approach, including the training of teachers, technical equipment of educational institutions, and the development of modern teaching methods. The solution of these problems is becoming a priority for educational systems around the world, which determined the relevance of the study of cyberpedagogy as an educational challenge of the 21st century.

In addition, the introduction of cyberpedagogy in Kyrgyzstan is accompanied by a series of major problems and challenges. Kyrgyzstan is far behind developed countries in the field of digitalisation of education. Many educational institutions lack the necessary technological infrastructure, including access to high-speed internet, modern computers, and software. Even more acute is the shortage of qualified teachers who are ready to apply cyber-pedagogical methods. The system of teacher training and retraining in this area is only beginning to develop, which hinders the full-fledged introduction of digital technologies into the educational process. In the context of the transition from the industrial to the information age, the ability of a person to effectively apply digital technologies to solve various tasks is of particular significance. The purpose of this study was to analyse the effects of cyberpedagogy on the educational process, to assess the effectiveness of digital tools in student learning, and to identify opportunities for increasing engagement and building digital skills using the Kahoot platform.

MATERIALS AND METHODS

This study employed a methodological approach combining theoretical and empirical methods to analyse the role of cyberpedagogy in modern education. The study aimed to investigate the effectiveness of digital tools such as the Kahoot platform in the educational process. The study reviewed academic literature including books, articles, and studies on cyberpedagogy, digital educational tools, and pedagogical competences using the theoretical analysis method. This provided a theoretical framework for the study and identified key trends in digital learning. The method enabled the identification of key trends in digital education, which is particularly significant in the context of rapid technological development and its effects on the educational process.

The study used practical experience of working with college and university students, which allowed observing the process of mastering digital tools in real learning environments. It was based on the idea that cyberspace influences students' perception of reality, as argued by J. Suler (2016). Practical application of digital tools in the educational process provided an opportunity to assess not only the level of knowledge, but also the degree of students' engagement in learning through technology.

A questionnaire – survey study was conducted among the students of the Kyrgyz National University named after J. Balasagyn and Teachers College to assess their knowledge and skills in using the Kahoot platform before and after the training. The questionnaire survey helped to record the dynamics of changes in students' knowledge and skills before and after the training. The study included two

groups: control group (SG-1, 17 students) – students with no prior training on the Kahoot platform; experimental group (SG-2, 19 students) – students with prior training on the use of Kahoot before testing. After the questionnaires were administered, quantitative data demonstrating changes in the students' knowledge and skills were obtained. All procedures were conducted following the American Sociological Association's Code of Ethics (2018).

The study was conducted in several stages: preparatory stage – analysis of the relevance of the topic and selection of scientific sources on cyberpedagogy and digital educational technologies; data collection – review of scientific publications, educational platforms, and existing research; training of the experimental group – SG-2 students received preliminary instruction and practical training on the use of Kahoot; questionnaire – testing of students of SG-1 and SG-2 before and after the experiment; data analysis – processing of the results of the questionnaire, assessment of changes in the level of knowledge and skills of students. The use of a mixed approach helped to obtain both theoretical findings and empirical data, providing a comprehensive understanding of the role of digital tools in modern pedagogy and assessing their effects on the formation of pedagogical competences.

RESULTS AND DISCUSSION

Theoretical foundations of cyberpedagogy and its impact on education

According to V. Bespalko (2016), cyberpedagogical learning technology starts with a clear understanding and formulation of what result society expects from the educational process – whether it is learning within the entire educational institution or a concrete course. The theory of cyberpedagogical learning technology defines in advance what criteria and indicators can be used to assess how well a student is prepared for their future professional activity. As a result, society's demand for educational outcomes can be expressed very succinctly, but in a way that is clear and precise for the professionals who design educational programmes. Thus, cyberpedagogical teaching technology allows creating educational programmes that meet the requirements of modern society to the maximum extent possible and guarantee quality training of students. This is the key feature of cyber-pedagogical teaching technology – orientation towards the concrete demands of society and clear criteria for assessing the quality of students' training. The educational process begins with an understanding of what knowledge and skills society needs. With predetermined assessment criteria, learning becomes more transparent and efficient. This approach ensures the creation of curricula that not only meet modern requirements but also help to create competent professionals ready for real professional tasks.

Digital learning can be so effective that students can immerse themselves deeper into the educational process, perceiving virtual tasks, simulations, and online interactions as a full part of their reality. According to psychologist J. Suler (2016), "cyberspace is one way of altering the state of consciousness. As in an altered state of consciousness in general, cyberspace and everything that happens in it seems real – often even more real than reality itself". Cyberpedagogy takes advantage of this property of cyberspace by creating conditions where educational materials become not just information, but a "lived experience". This promotes better learning, critical thinking, and the development of new skills. By engaging and experiencing the reality of the digital environment, learning becomes more interesting and meaningful for today's learners who are used to constant interaction with technology. Cyberpedagogy is an innovative direction of pedagogy, which is based on scientific principles and aims at systematic organisation and purposeful activity in the field of cybereducation, cyberlearning and cybereducation. It aims at building the necessary skills and competences in cyberspace in modern human beings, using information and communication, computer and digital technologies as the main tools for cybersocialisation (Suler, 2016).

The opinion about the professional suitability of a teacher and its significance in the development of pedagogical professionalism belongs to the pedagogue T. Bechturov (2019). His papers emphasise that professional suitability is not limited only to knowledge but also includes significant values that guide the educator in their professional activities. T. Bechturov (2019) emphasised that professional suitability is the basis for pedagogical excellence, which is the result of personal growth and life experience of a teacher. Professional suitability of a teacher in the context of cyberpedagogy acquires special significance, since a modern teacher should not only possess conventional pedagogical knowledge, but also actively master the latest digital technologies. At this time, cyberpedagogy requires the teacher to develop not only professional knowledge, but also digital literacy, the ability to work with information and communication technologies, and the ability to integrate these technologies into educational activities.

The term "cybersocialisation" was introduced by V. Pleshakov (2011) and describes the process of changing the structure of the individual's self-consciousness and its needs-motivational sphere under the influence of modern information technologies. Cybersocialisation has substantially affected the development of cyberpedagogy, as it became the basis for understanding how technologies affect the development of the individual and their socialisation in the digital space (Pleshakov *et al.*, 2021). Initially, cyberpedagogy focused on the use of technology to improve the learning process, introducing computer and internet resources into the educational process. The use of the latest technologies in teaching was experimental rather than systematic, which led to the need to create a theoretical basis for the introduction of technologies into pedagogical practice. At first, only basic computer technologies such as projectors and simple learning programmes were used in educational institutions. However, with the development of the internet and software, there was a need for more in-depth research into the role of digital technologies in

teaching and learning. From this point, the first theoretical works on cyberpedagogy began to appear, which emphasised the significance of incorporating technology into the pedagogical process and its influence on teaching methods.

By the late 2000s, with the massive proliferation of the internet, social media, and online platforms, cyberpedagogy had greatly evolved. Educators began to recognise the value of building students' IT skills and the need to introduce innovative learning formats such as distance and online learning. As a result, learning has become more flexible, personalised, and accessible to the wider public. The information revolution has had a tremendous impact on the educational sphere, radically changing approaches to learning. With the development of the internet, mobile devices and cloud technologies, many new opportunities have emerged to improve the effectiveness of the learning process. Educational institutions began to use e-textbooks, online courses, distance learning platforms, and other tools that have greatly expanded the accessibility of education.

Many educators and researchers are actively engaged in the development of cyberpedagogy, exploring its key aspects and specific challenges. There is a growing number of studies in various universities and research institutions that cover a wide range of issues related to the use of digital technologies in education. These include topics such as the accessibility and quality of distance education, stressors associated with distance learning, and the effectiveness of pedagogies and technologies in digitalisation. Particular attention has been paid to issues such as identity verification in online examinations and maintaining academic integrity in virtual educational environments (Dobrovinsky *et al.*, 2018; Shtykhno *et al.*, 2020). These studies help to better understand how to use digital technologies to improve the quality of education and overcome the challenges faced by educators and students in online learning environments. S. Kolovorotny (2003), considering the characteristics of the virtual reality system, notes its ability to change information flows, combine them and generate new ones. According to his opinion, virtual reality, due to its ability to simulate various situations, can be an effective tool for the acquisition and consolidation of practical skills, including the ability to interact in society and successful socialisation.

The primary impact of the information revolution is that learning has become more accessible, flexible, and personalised. The use of technology allows educators to create interactive, engaging, and multimedia educational materials that enhance learning. The interactivity and accessibility of learning resources allows students to study at their convenience, which is crucial for people with disabilities or those who, for various reasons, cannot attend conventional educational institutions. According to the U.S. Department of Education (2010) report, "Evaluating Evidence-Based Online Learning Practices: A Meta-Analysis and Review of Research", students who learned content in an online format performed slightly better than those who learned in a traditional face-to-face setting". This finding suggests that online learning can be just as effective, and in some cases even more effective, than conventional forms of learning. This emphasises the significance of digital learning technologies and their potential to improve students' academic achievement by giving them flexibility, access to a variety of resources, and the opportunity to learn at their individual pace.

What appeals to and inspires contemporary young people may be vastly different from what was familiar to previous generations. It is vital to recognise that each generation seeks to pursue what is meaningful, interesting, and relevant to them, finding their personal ways of fulfilment and expression in a changing world. In this context, the key challenge is to create conditions in which members of each generation can develop their abilities and pursue their interests using modern tools and approaches. Understanding and respecting these differences allows not only to build effective educational processes, but also to create an environment in which innovative ideas and initiatives are supported and developed.

As a result of the information revolution, a new concept of education has emerged that focuses on the use of technology as a tool for developing the competences required in the digital society. Cyberpedagogy is focused on developing students' skills in working with digital tools, as well as on teaching critical thinking and Internet safety, which corresponds to modern requirements and challenges of society. According to A. Strokov (2020), digital education has contradictory consequences. The widespread use of digital technologies leads to a weakening of society's intellectual culture. In researcher's opinion, when a "machine" begins to perform those functions that previously contributed to the development of human intelligence, it inhibits development and leads to the degradation of mental abilities. This opinion raises critical questions about the balance between technology and conventional educational methods. On the one hand, digital technologies open new opportunities: access to vast amounts of information, interactive learning, personalisation of the educational process. On the other hand, relying entirely on automated systems risks losing critical thinking and independent analysis skills.

However, this is not a matter of the technology itself, but of how it is used. The intelligent and informed introduction of digital tools can greatly enrich the educational experience, while over-reliance on 'machines' can actually be detrimental to intellectual development. The foremost task of the educator is to teach students how to maintain a balance so that technology serves as a supplement to human development, not a replacement for conventional teaching methods (Riznyk & Riznyk, 2024). In the context of cyberpedagogy, the formation of students' active subjective position becomes especially significant because online education requires students to be more self-regulated, proactive, and responsible. The development of such qualities as activity, commitment, responsibility, and autonomy allows students not only to effectively learn the educational material, but also to interact successfully in the virtual educational space. Therefore, it

is essential to develop students' active subjective position in educational and professional activities, as it contributes to the development of these very qualities (Kulagina & Apasova, 2018).

Despite numerous innovations and technological advances in education, such as the use of virtual reality, adaptive learning, and other digital technologies, it is vital to remember that human qualities, education, and care for the student will always remain the basis of successful learning. Ultimately, technological tools only create the conditions for more effective learning, but they cannot replace the genuine desire for learning that can only come from the educator. In cyberpedagogy, especially as teaching increasingly moves into the online space, it is key that the educator maintains their role as a mentor who not only transmits knowledge, but also keeps students motivated and creates an atmosphere of trust and confidence. Human beings, not technology, are the primary source of inspiration and support. A kind attitude towards students, attention to their personal motivation, tolerance for diversity of approaches and concern for everyone are invariable components of an effective educational process. It is educators who have an in-depth knowledge of their subject, who actively use technology tools, who can create space for students' creativity and autonomy, while maintaining a prominent level of human engagement. Thus, the use of technology should only be a complement to the core values of pedagogy, helping to create a space for personal growth and creative expression for students.

Practical application of cyberpedagogy: The role of digital tools and the educator in the educational process

Modern educational technologies successfully combine conventional teaching methods with digital tools to form an interactive and adaptive environment. Lectures and the explanatory-illustrative method are supplemented with electronic presentations, interactive models and videos, which improves the perception of information and makes learning more visual. The active introduction of digital technologies contributes to improving the quality and accessibility of education. Online platforms such as Google Classroom, Google Meet, Moodle, and Zoom allow for distance learning, course management, and live classes. Interactive whiteboards provide visualisation of learning materials and communication apps (WhatsApp, Telegram) facilitate the coordination of learning activities.

Digital tools have also transformed the knowledge assessment system. Automated tests on Kahoot, Quizizz, and AVN enable objective verification of learning progress, and discussions are moving beyond the classroom to digital forums and educational chats. Digital technologies are also widely used in project work: collaborative work is organised through Google Docs and Miro, enabling convenient and productive interactions. Digital technologies play an equally significant role in the administration of the educational process. Electronic diaries allow students and their parents to quickly receive information about their academic progress, while university educational platforms (e.g., AVN) allow uploading academic work, interacting with teachers, and receiving prompt feedback. Thus, digital literacy is becoming an integral part of the educational process. Information competence includes the ability to seek, analyse, and use information using digital tools, which is vital to prepare students for the modern world. Within the competence approach embedded in the state educational standards, special attention is paid to the ability not only to work with information, but also to apply it to argue conclusions and make decisions.

The development of digital technologies changes not only the educational environment, but also the role of the teacher. In cyberpedagogy, the teacher ceases to be the only source of knowledge, becoming a facilitator who guides students in finding and critically analysing information. The role of the teacher in cyberpedagogy is particularly significant considering the rapid development of digital technologies and their introduction into the educational process. In the context of cyberpedagogy, there are a series of changes both in the requirements for the professional competence of teachers and in the structure of the educational process, which greatly affects the role of the teacher. On the one hand, there are new requirements to the professional competence of teachers, which can be attributed to the following:

- technological literacy, where educators must be capable of using a variety of digital platforms and resources to develop learning materials, deliver lessons, and assess results;
- cybersecurity, where it is vital to train educators in internet safety, data protection and the protection of students' personal information;
- flexibility and adaptability, where the educator must be ready to respond quickly to changes in educational technologies and innovations, be ready to introduce innovative approaches and methods.

On the other hand, changes in cyberpedagogy significantly affect the teacher's role and the structure of the learning process when:

- the use of digital technologies allows teachers to adapt the learning process to the needs of each student, creating individual learning trajectories while accommodating personal preferences and needs;
- the learning process becomes hybrid, combining conventional teaching methods with elements of distance and online learning.

Thus, the teacher in cyberpedagogy not only retains their role as a mentor, but also becomes an active participant in the innovative educational process, capable of working effectively in the digital environment. The pedagogue's information competence includes the skills of purposeful search for missing data, critical analysis and comparison of information, and formulation of hypotheses based on a comprehensive understanding of the obtained information. In the educational process, a key role in the development of these skills is played by the digital environment, including

electronic diaries and educational platforms (e.g., AVN in higher education institutions), which provide interactive interaction between students and teachers. To successfully implement the competency-based approach, a teacher should not only master modern methods of working with information but also create conditions conducive to the development of students' critical thinking, unassisted search for knowledge, and meaningful application of digital technologies in educational and professional activities.

An empirical study: The impact of Kahoot use on student engagement

Modern digital technologies are rapidly penetrating the educational process, which affects both teaching methods and the role of the educator. The educational environment is increasingly combining conventional teaching methods with modern digital tools such as online platforms and interactive services. One such tool is the Kahoot platform, the use of which can increase student engagement and make the learning process more interactive. To assess the effectiveness of digital tools in the educational process, a questionnaire survey was conducted among the students at the Kyrgyz National University named after J. Balasagyn and the Pedagogical College. The purpose of the study was to assess the level of students' awareness of the Kahoot platform and the dynamics of their skills in using this tool after preliminary training. The study included two groups of students: the control group (SG-1, 17 students) – students did not receive prior training on Kahoot; the experimental group (DO-2, 19 students) – students received prior training on the use of Kahoot before testing. The results of the questionnaire are presented in Table 1.

Table 1. *Results of students' questionnaires*

No.	Platform Kahoot	KNU named after J. Balasagyn, Pedagogical College			
		SG-1 (control group)		SG-2 (experimental group)	
		before	*after*	*before*	*after*
1	*Do not know it*	*4*	*3*	13	0
2	*Know and can use it*	*4*	*5*	2	11
3	*Know but cannot use it*	*9*	*9*	4	8

Source: *developed by the authors*

The results of the questionnaire showed the following: among the students who did not know about Kahoot, in the control group (SG-1) their proportion decreased from 4 out of 17 (23.53%) to 3 out of 17 (17.65%), while in the experimental group (SG-2) – from 13 out of 19 (68.42%) to 0 out of 19 (0.00%). The percentage of students who were familiar with and knew how to use Kahoot increased from 4 out of 17 (23.53%) to 5 out of 17 (29.41%) in SG-1 and from 2 out of 19 (10.53%) to 11 out of 19 (57.89%) in SG-2. The number of students who knew about the platform but did not know how to use it stayed unchanged at 9 out of 17 (52.94%) in the control group, while it increased from 4 out of 19 (21.05%) to 8 out of 19 (42.11%) in the experimental group. These findings revealed that pre-training positively influenced the students' awareness and ability to use Kahoot. In the experimental group, the percentage of students who were not familiar with the platform decreased to 0% and the percentage of students confidently using Kahoot increased significantly. These results emphasised the significance of targeted training in digital tools. Simply integrating technology into the educational process is insufficient – training for both students and teachers is required.

The information competence of the teacher plays a key role in the successful mastering of digital technologies by students. Online platforms (Google Classroom, Zoom, Moodle), interactive whiteboards, cloud services, and mobile applications for communication are actively used in the educational process. However, the effective use of these tools requires a suitable level of teacher training, including technological literacy – the ability to use digital platforms and resources to develop learning materials, conduct lessons, and assess knowledge; cybersecurity – knowledge of the principles of personal data protection and Internet security; flexibility, and adaptability – the willingness of teachers to learn the latest technologies and methods, adapting them to meet educational needs. Thus, the integration of digital technologies, such as Kahoot, requires not only the technical equipment of educational institutions, but also the suitable level of training of teachers and students. For the successful implementation of digital tools, it is vital to consider the specifics of each educational institution, as well as to develop methodological recommendations for their use.

CONCLUSIONS

The study analysed modern approaches to the integration of digital technologies into the educational process, their influence on teaching methods, the role of the teacher, and the quality of learning. Practical aspects of cyberpedagogy were considered, including the use of online platforms, interactive tools, and digital services to organise the learning process. An empirical study revealed that purposefully teaching students how to use digital tools such as Kahoot considerably increases their engagement and digital competence. The key finding was that the combination of conventional and digital teaching methods forms an adaptive, personalised, and interactive learning environment that promotes not only knowledge acquisition but also the development of key competencies required in the digital economy. However, effective implementation of cyberpedagogy requires rethinking not only teaching methods, but also the role of the teacher. The teacher no longer just imparts knowledge but becomes

a mentor and guide in the world of digital information, helping students to develop critical thinking, independence, and the ability to analyse data.

Therewith, the process of digitalisation of education presents a series of challenges. Many educational institutions face inadequate funding, which limits the ability to purchase modern equipment such as interactive whiteboards and AI-based programmes. Problems with technical support, cybersecurity, and methodological support also stay unresolved. Despite this, the development of cyberpedagogy is essential to ensure accessible and quality education in the future. Prospects for further research include developing methodological recommendations for the effective implementation of digital technologies in the educational process; studying the effects of digital tools on the development of critical thinking and independence of students; assessing the long-term effect of digitalisation on educational outcomes and professional training of graduates; analysing the possibilities of using artificial intelligence in pedagogical practice and developing approaches to its integration into teaching. Thus, cyberpedagogy continues to be a key area of education modernisation, contributing not only to the improvement of educational results, but also to the development of digital literacy, which is in demand in modern society.

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Киберпедагогика – XXI кылымдагы билим берүү чакырыгы

Гулайым Дуйшонбекова
Педагогика илимдеринин кандидаты, доцент
Ж. Баласагын атындагы Кыргыз улуттук университети
720033, Фрунзе көч., 547, Бишкек ш., Кыргыз Республикасы
https://orcid.org/0009-0008-3634-7010

Айнура Байтокова
Педагогика илимдеринин кандидаты, доцент
Ж. Баласагын атындагы Кыргыз улуттук университети
720033, Фрунзе көч., 547, Бишкек ш., Кыргыз Республикасы
https://orcid.org/0009-0001-0514-6477

Аннотация. Санариптик технологиялардын тез өнүгүүсүнүн шартында билим берүүнүн заманбап санариптик инструменттерди окуу процессине интеграциялоо зарылдыгына туш болушу, илимий изилдөөлөр чөйрөсүндө Киберпедагогиканы маанилүү багытка айландыруунда. Иштин негизги максаты санариптик билим берүү технологияларынын студенттердин активдүүлүгүнө жана академиялык жетишкендиктерине тийгизген таасирин аныктоо, ошондой эле билим берүү процессиндеги Kahoot платформасынын натыйжалуулугун талдоо болгон. Бул максатка жетүү үчүн илимий адабияттарды теориялык талдоо методдору, студенттердин сурамжылоолору менен эмпирикалык изилдөөлөр, контролдук жана эксперименталдык топтордун салыштырма анализи колдонулган. Изилдөө студенттердин санариптик компетенцияларын Kahoot платформасын колдонуу боюнча тренингге чейин жана андан кийин баалады . Санариптик инструменттер боюнча алдын ала окутуу алардын өнүгүү деңгээлине оң таасирин тийгизгени аныкталды: эксперименталдык топто платформаны ишенимдүү колдонгон студенттердин саны 46%га көбөйдү, ал эми контролдук топто өзгөрүүлөр минималдуу болгон. Талдоо санариптик билим берүү инструменттери окуу процессине катышуунун жана интерактивдүүлүктүн жогорулашына жана окуу материалын кабыл алууну жакшыртууга салым кошконун көрсөттү. Интерактивдүү аянтчаларды колдонуу окуучулардын өз алдынчалыгын өнүктүрүүгө өбөлгө түзүп, алардын тааныш-билүү активдүүлүгүн стимулдап, критикалык ой жүгүртүү жөндөмдөрүн өнүктүрүүгө жардам берери аныкталды. Билим берүү ишмердигинде санариптик технологияларды эффективдүү колдонуу үчүн зарыл болгон мугалимдин негизги компетенциялары аныкталган, анын ичинде технологиялык сабаттуулук, жана санариптик окутуу ыкмаларын интеграциялоо жана ынгайлаштыруу жөндөмдүүлүгү. Изилдөөнүн практикалык баалуулугу анын натыйжаларын ЖОЖдордун жана колледждердин окутуучулары тарабынан окуу процессин оптималдаштыруу үчүн колдонуу мүмкүндүгүндө, ошондой эле санариптик билим берүү инструменттерин окуу практикасына киргизүү боюнча методикалык сунуштарды иштеп чыгууда, бул окууну жеткиликтүү, интерактивдүү жана натыйжалуу кылат

Негизги сөздөр: билим берүүнү санариптештирүү; педагогдун ролу; гибриддик окутуу; критикалык ой жугүртүү; билим берүү технологиялары; окутуудагы инновациялар

Киберпедагогика – образовательный вызов XXI века

Гулайым Дуйшонбекова
Кандидат педагогических наук, доцент
Кыргызский национальный университет имени Ж. Баласагына
720033, ул. Фрунзе, 547, г. Бишкек, Кыргызская Республика
https://orcid.org/0009-0008-3634-7010

Айнура Байтокова
Кандидат педагогических наук, доцент
Кыргызский национальный университет имени Ж. Баласагына
720033, ул. Фрунзе, 547, г. Бишкек, Кыргызская Республика
https://orcid.org/0009-0001-0514-6477

Аннотация. В условиях стремительного развития цифровых технологий образование сталкивается с необходимостью интеграции современных цифровых инструментов в учебный процесс, что делает киберпедагогику важным направлением исследований. Основной целью работы было выявление влияния цифровых образовательных технологий на вовлеченность студентов и их академическую успеваемость, а также анализ эффективности платформы Kahoot в учебном процессе. Для достижения поставленной цели использованы методы теоретического анализа научной литературы, эмпирическое исследование с анкетированием студентов, а также сравнительный анализ контрольной и экспериментальной групп. В ходе исследования была проведена оценка цифровых компетенций студентов до и после обучения использованию платформы Kahoot. Установлено, что предварительное обучение цифровым инструментам положительно влияло на уровень их освоения: в экспериментальной группе число студентов, уверенно владеющих платформой, увеличилось на 46 %, тогда как в контрольной группе изменения были минимальными. Анализ показал, что цифровые образовательные инструменты способствовали повышению вовлеченности и интерактивности учебного процесса, а также улучшали восприятие учебного материала. Выявлено, что применение интерактивных платформ способствовало развитию самостоятельности студентов, стимулировало их познавательную активность и помогало сформировать навыки критического мышления. Определены ключевые компетенции педагога, необходимые для эффективного использования цифровых технологий в образовательной деятельности, включая технологическую грамотность, адаптивность и способность интегрировать цифровые методы обучения. Практическая ценность исследования заключается в возможности использования его результатов преподавателями вузов и колледжей для оптимизации образовательного процесса, а также в разработке методических рекомендаций по внедрению цифровых образовательных инструментов в преподавательскую практику, что позволит сделать обучение более доступным, интерактивным и результативным

Ключевые слова: цифровизация образования; роль педагога; гибридное обучение; критическое мышление; образовательные технологии; инновации в обучении

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Psychological and pedagogical aspects of developing professional competencies in future teachers through educational technologies

Tuigun Bekturov*
PhD in Pedagogical Sciences, Associate Professor
I. Arabaev Kyrgyz State University
720026, 51 Razzakov Str., Bishkek, Kyrgyz Republic
https://orcid.org/0009-0001-3382-0684

Meerim Kozhogeldieva
PhD in Psychological Sciences, Associate Professor
Jusup Balasagyn Kyrgyz National University
720033, 547 Frunze Str., Bishkek, Kyrgyz Republic
https://orcid.org/0009-0007-8809-6156

Abstract. In Kyrgyzstan, the problem of training future teachers with the necessary professional competences is more acute than ever. Modern educational space requires from teachers not only the knowledge of the subject, but also the ability to apply pedagogical technologies that contribute to the development of personal and professional qualities. Psychological and pedagogical approach to the formation of competences of future teachers is an important aspect of the educational process, because only by taking into account the psychological characteristics of the personality and pedagogical technologies it is possible to prepare a teacher capable of effectively solving modern problems. The purpose of this paper was to analyse the psychological and pedagogical aspects of the formation of professional competences of future teachers with a focus on the use of modern pedagogical technologies. The article considered the key psychological and pedagogical factors influencing the process of formation of professional competences, including the need to take into account the personal characteristics of both teachers and students. Based on the analysis of theoretical studies of such scientists as V. Slastenin, L. Mitina, N. Kuzmina and L. Antsyferova, the importance of implementing pedagogical technologies that promote not only professional but also personal development of future teachers was emphasised. Special attention was paid to the formation of students' self-regulation skills, emotional stability and professional identity. The importance of teachers' internal motivation, their aspiration for self-improvement and development was also emphasised. The results of the study demonstrated that the active application of pedagogical technologies oriented to the development of intellectual, emotional and social competences is a necessary condition for the successful training of future teachers. The practical value of this study lies in the possibility of using its results to improve educational programmes and methods of teacher training in Kyrgyzstan

Keywords: personal development; innovative methods; emotional stability; self-regulation; project activity; professional identity; professional identity

INTRODUCTION

Regardless of the world's state – be it traditional, digital, or high-tech – the quality of education is invariably determined by the standard of teacher training. It is the teacher who lays the foundation of knowledge, skills, and values, thereby shaping the future generation. However, contemporary society faces a growing challenge: the demands placed upon the educational process are changing rapidly, and the level of pedagogical preparation is not

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*Corresponding author

keeping pace with these shifts. The modern school necessitates teachers who can foster key competencies in students, such as critical thinking, independent information-seeking skills, digital literacy, and adaptability, rather than merely transmitting knowledge. Nevertheless, as noted by L. Johanson & S. Karlsen (2021), the teacher training system itself remains conventional and does not always meet the challenges of the present era. Curricula in pedagogical higher education institutions are often based on outdated methods, with a prevalence of theoretical instruction detached from actual school practice. Prospective teachers study historical pedagogical concepts but do not acquire sufficient experience working with contemporary educational technologies, digital tools, and active learning methodologies (Abedi, 2023).

Furthermore, the teaching profession necessitates not only subject-specific and methodological knowledge but also advanced psychological competencies. According to S. Noreen & B. Kazim (2022), educators encounter emotional and cognitive demands daily, interacting with pupils of varying abilities, resolving conflicts, and providing motivation and support. However, this crucial aspect receives insufficient attention during professional preparation. Consequently, many early career teachers experience stress, professional burnout, and disillusionment with the profession, leading to a decline in teaching quality and high staff turnover in educational institutions.

It is also important to acknowledge that, in the context of rapidly advancing technologies, the demands on the teaching profession are set to increase. As L. Kartashova & I. Plish (2020) point out, educators must be prepared to utilise digital tools, integrate novel teaching methodologies, and adopt a flexible approach to the educational process. However, without the systemic development of professional competencies, this objective becomes unattainable (Diachuk, 2024). The core issue lies in the fact that despite the pivotal role of the teacher in any society, their professional preparation frequently remains rooted in the last century. This contributes to a decline in educational quality, a mismatch between educators' skill levels and contemporary realities, and an inability to address educational challenges effectively. Notwithstanding an extensive research base, a teacher's professional competence persists as a complex and multifaceted construct (Erokhina, 2019). There is a notable lack of scholarly consensus regarding its structure and the mechanisms for its development, which presents considerable difficulties in educational practice. Consequently, prospective teachers often encounter preparation that is not sufficiently systematic and does not consistently align with the realities of the modern educational process.

Analysing contemporary pedagogical practices, the authors sought to identify the key elements of professional competence that require development during the training of future teachers, and to propose avenues for enhancing educational programmes, taking into account psychological characteristics and professional challenges. The formation of future teachers' professional competencies is not merely a timely issue, but a critically important task, upon the resolution of which the future of education and society as a whole depends. Recognising the relevance of this problem, the authors identified the need to investigate the development of future teachers' professional competencies, considering psychological and pedagogical factors. This study aimed to analyse the psycho-pedagogical aspects of competency development in educators during their training.

LITERATURE REVIEW

The issue of a teacher's professional competence consistently remains a central focus of pedagogical science. Contemporary research underscores the importance of adapting education to the digital environment and implementing innovative teaching methodologies. For instance, the research by J. Seibert *et al.* (2020) provides instructions for conducting multitouch experiments aimed at enhancing the effectiveness of chemistry learning. Collaborative learning systems, where students work together in small groups to achieve educational objectives, have been the subject of study by researchers such as J. Lock & P. Redmond (2021), S. Mende *et al.* (2021), and C. Johnson *et al.* (2021). In contrast to traditional instruction, where the teacher plays the primary role, collaborative learning involves students actively interacting with one another, sharing knowledge, discussing ideas, and jointly solving problems. This method fosters the development of social, cognitive, and communication skills, rendering the educational process more dynamic and motivating. It is widely applied in schools and universities, as well as in professional training. Amidst rapid societal changes, education, despite its inherent traditionalism and conservatism, is compelled to align with current trends. A. da Silva (2021) and A. Haleem *et al.* (2022) emphasise that the successful transformation of the educational process necessitates the timely identification of promising directions, their congruence with institutional resources, and their effective integration into pedagogical practice.

One of the most crucial aspects of effective education is the competence of educators, which extends beyond the mere possession of knowledge and skills. It encompasses the ability to apply these in real-world practice, to consider the individual characteristics of learners, and to facilitate productive learning. The concept of "competence" entered the academic lexicon in the late 1950s (Bondarevskaya & Kulnevich, 1999). J. Raven (1984) posits that competence is a composite of diverse components that can exist independently. Some of these relate to intellectual abilities, others to the emotional domain, and their interplay dictates an individual's successful behaviour in various situations.

V. Adolf (1998) highlights that professional competence contributes to reducing stress levels, fostering emotional resilience, and easing the transition from training to professional practice. In a related vein, E. Zeer (1988), drawing upon K. Platonov's concept, distinguishes two constituents of professional competence: professional orientation, which includes a system of values, attitude towards the profession, and an awareness of one's place within it;

and professional competence itself, which amalgamates knowledge, proficiencies, skills, and practical experience. A. Shelten views professional competence through the lens of interaction with others, teamwork, the capacity for independent problem-solving, self-development, and continuous learning (Anisimov & Sosonko, 2001). A. Markova (1980) posits that a teacher's professional competence is shaped not only by their level of knowledge and skills but also by their personal attributes, professional activities, communication abilities, and crucially, the ultimate outcome of their work – the level of pupils' learning and personal development. L. Mitina (1998) identifies three pivotal components of a teacher's professional development: orientation, competence, and emotional flexibility. These factors are largely determinative of pedagogical success. N. Kuzmina (1985) expresses an analogous viewpoint, defining professional competence as a synthesis of profound knowledge, mastery of teaching methods, and the personal qualities essential for effective instruction.

Furthermore, considerable research attention is directed towards the role of digital technologies in the educational process. Digital literacy, as highlighted in contemporary scholarship, encompasses a complex set of skills necessary for engaging with digital media and for the retrieval, processing, and analysis of information. An important dimension of educational digitalisation is parents' attitudes towards their children's use of digital tools, a topic explored in detail in the research by I. Palaiologou (2016). Thus, a review of academic literature indicates that a teacher's professional competence is a complex, multi-component phenomenon, incorporating both cognitive and personal aspects. Its development necessitates the implementation of modern pedagogical technologies, the integration of digital tools, and a consideration of the changes occurring within the educational environment.

MATERIALS AND METHODS

The methodological foundation of this study was formed by concepts from the competency-based approach in pedagogy, the study of researchers from Kyrgyzstan and other countries in the field of teacher professional training, and psychological theories of personality development and learning. Specifically, the articles of philosophers, educators, and psychologists such as J. Raven (1984), E. Zeer (1988), and V. Adolf (1998), amongst others, were analysed. In authoring this article, several methods were employed to facilitate a comprehensive approach to the topic under investigation. Analytical and comparative methods were thus utilised to systematise theoretical material and to juxtapose different approaches to training future educators. The interrelationship between psycho-pedagogical aspects and pedagogical practices was analysed, which allowed for the identification of their influence on the process of professional competency development. A reflective method was used for considering personal competencies and analysing the role of psychological factors in the preparation of future teachers. The method of generalisation enabled the integration of various theoretical and practical materials, whilst the inductive method aided in constructing conclusions based on an analysis of existing theories and examples drawn from the educational process.

In addition, the authors surveyed 298 practising educators from various regions of Kyrgyzstan, aiming to identify key challenges in their professional activities. The study encompassed a wide array of issues, including pupils' attainment levels, the availability of educational materials, the application of digital technologies, classroom management, interaction with parents and administration, and the constraint of time for lesson preparation. Furthermore, an analysis of the respondents' professional experience provided insight into the ratio of experienced practitioners to early career teachers, which allowed for an assessment of areas requiring attention in the training of future professionals. The survey was administered between October and December 2024, employing an online format with anonymous questionnaires. Participation was voluntary, and each participant received information regarding the study's objectives and guarantees of confidentiality. The survey adhered to the principles outlined in the Code of Ethics of the American Sociological Association (2018) and the Guidance Note of the European Commission on Ethics and Data Protection (2021). Analysis of the collected data facilitated the identification of the primary difficulties faced by teachers, such as a scarcity of educational materials, challenges in utilising digital technologies, classroom management, and engagement with parents. These findings were taken into account when evaluating the significance of psycho-pedagogical training for future professionals. The application of all the methods described facilitated the formation of a wellfounded understanding of the pivotal role of psycho-pedagogical training in the development of future teachers' professional competencies.

RESULTS AND DISCUSSION

Structure of teacher professional competencies

Teacher professional competencies constitute a combination of the knowledge, proficiencies, skills, and personal attributes requisite for effective professional performance. They determine an educator's level of preparedness, their capacity to adapt to shifts in the educational landscape, and their ability to ensure quality teaching and the holistic development of pupils. The structure of professional competencies comprises several interconnected components:

- subject-matter and methodological competence entails knowledge and understanding of the subject being taught, mastery of teaching methods and technologies, and the ability to apply contemporary pedagogical approaches;
- psychological and pedagogical competence signifies knowledge of pupils' age-specific and individual characteristics, and mastery of methods for motivating, diagnosing, and correcting learning activities;
- communicative competence is manifested in the ability to interact effectively with pupils, parents, and

colleagues, as well as in the possession of public speaking and pedagogical rhetoric skills;

- organisational and managerial competence is evident in the ability to plan and organise the educational process, create a conducive learning environment, and manage a classroom collective;
- information and communication competence involves proficiency in digital technologies within educational practice, and the use of electronic resources and distance learning;
- reflective and research competence presupposes the capacity for self-analysis, selfdevelopment, the assimilation of new knowledge, the conducting of pedagogical research, and the implementation of innovative technologies;
- moral and ethical competence is associated with an awareness of professional responsibility and adherence to the ethical norms and principles of pedagogical activity.

The professional competencies of a teacher can be viewed through three key components, each playing a significant role in their professional practice. The cognitive component encompasses the body of knowledge necessary for the effective execution of pedagogical tasks. It covers fundamental and applied knowledge in the subject being taught, its methodology, pedagogy, psychology, developmental physiology, and contemporary educational technologies. A teacher must understand the patterns of knowledge acquisition by pupils, and the principles of curriculum design, possess methods for assessing student achievements, and be able to apply modern scientific approaches to teaching (Reid *et al.*, 1987). Furthermore, the cognitive component involves an awareness of current educational standards, the legal framework governing pedagogical activity, and prevailing trends in the evolution of the education system.

The operational and practical component constitutes a system of skills and abilities that ensure the effectiveness of pedagogical work. It encompasses the capacity to develop curricula and syllabi, create didactic materials, employ diverse teaching methodologies and technologies, consider the individual characteristics of learners, and foster their cognitive engagement. This component also includes the ability to organise the educational process, manage the classroom, maintain discipline, and motivate pupils to learn. A crucial aspect is the ability to orchestrate collaborative activities with students, colleagues, and parents, alongside mastery of tools for assessing educational outcomes.

The personal and motivational component covers a teacher's individual qualities, their pedagogical thinking, value orientations, and motivation for self-development and professional advancement. It incorporates such personal characteristics as responsibility, empathy, patience, creativity, and resilience to stress. A high level of motivation for learning and refining pedagogical expertise facilitates the successful implementation of innovations, the pursuit of novel approaches in working with students, and continuous self-improvement. Furthermore, this component reflects pedagogical culture and ethics, the capacity for reflection and an awareness of one's strengths and weaknesses, as well as a commitment to professional growth through participation in continuing professional development courses, scholarly research, and pedagogical experiments.

The formation and development of a teacher's professional competencies is a continuous process, contingent upon the system of pedagogical education, practical experience, and the drive for continuous improvement in one's professional practice. Furthermore, the development of a future teacher's professional competence is not feasible without adequate psychological readiness, which encompasses motivation for pedagogical activity, emotional stability, reflectivity, communication skills, and the capacity for self-development. These attributes not only determine success during studies in a pedagogical higher education institution but also exert a decisive influence on the professional development of an early career teacher. Moreover, the psychological aspect plays a vital role at all junctures of an educator's professional career, remaining a key determinant of effectiveness even with considerable experience. The ability to manage emotions, sustain motivation, analyse one's practice, and cultivate productive interactions with pupils and colleagues is essential not only for the novice teacher but also for the experienced educator striving for professional growth and adaptation to the evolving educational landscape.

Firstly, motivation serves as a pivotal component of psychological readiness, as it is this that impels the prospective educator to assimilate new knowledge, seek efficacious teaching methods, and strive for professional advancement. Should a student possess an inherent interest in the profession from the outset, recognising its significance and societal responsibility, they will acquire subject-specific, methodological, and psycho-pedagogical competencies with greater purposefulness. Conversely, a lack of sustained motivation can result in a perfunctory acquisition of pedagogical disciplines and diminished learning effectiveness. Secondly, the development of professional competence necessitates emotional stability, given that pedagogical activity is associated with considerable psychological demands. The future teacher must learn to regulate their emotions, maintain composure in stressful situations, and cultivate constructive interactions with pupils, parents, and colleagues. The enhancement of stress resilience contributes to the successful acquisition of communicative and organisational-managerial competencies, which are crucial in an educator's work. Another vital aspect of psychological readiness is reflection, which facilitates a conscious engagement with one's own professional practice. The prospective teacher must be able to analyse their successes and setbacks, modify their working methods, and recognise their strengths and weaknesses. Developed reflective competence empowers an educator to refine their teaching methodology, adapt to the individual characteristics of their students, and effectively address emergent issues in the educational process.

Furthermore, a prospective educator's psychological readiness influences the development of their personal and motivational component of professional competence. This encompasses pedagogical thinking, humanistic values, empathy, and accountability for the outcomes of their work. A teacher's personal qualities are largely determinative of whether they can become not only a proficient professional but also a mentor capable of inspiring students and fostering a positive educational environment. Thus, psychological readiness serves as a foundation for the formation of a future teacher's professional competencies. Without stable motivation, emotional stability, and developed reflection, it is impossible to fully acquire subject-specific, methodological, communicative, and managerial competencies. Therefore, in the process of professional training for future educators, it is crucial to prioritise not merely the transmission of knowledge and the development of skills, but also the cultivation of the psychological attributes essential for effective performance in schools.

Challenges faced by educators in Kyrgyzstan and ways to overcome them

To identify the pertinent issues confronting teachers in their professional practice, the authors surveyed practising educators, the results of which facilitated the identification of key difficulties and impediments in teaching. The survey included 298 teachers from various regions of Kyrgyzstan. Analysis of the respondents' length of service indicated that the overwhelming majority of teachers (65.1%) have more than 10 years of experience, suggesting a significant contingent of seasoned professionals within the profession. However, there is also a notable proportion of educators with limited experience: 18.2% have been working for less than three years, 7.3% for three to five years, and 9.4% for six to ten years (Fig. 1). This highlights that whilst experienced specialists constitute the largest group among the surveyed teachers, there are also early career educators for whom the possession of well-developed professional competencies is particularly crucial to successfully navigate emergent challenges.

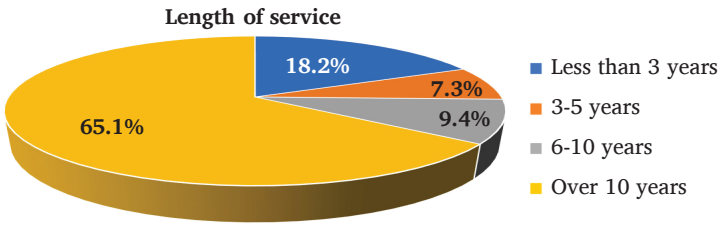

Figure 1. *Length of service of surveyed educators from different regions of Kyrgyzstan*
Source: *compiled by the authors*

An analysis of the data obtained from the survey of practising teachers revealed several significant difficulties that they encounter in their professional work. Among the most pressing problems noted were a low level of pupil preparedness, a scarcity of educational materials, challenges in using digital technologies, insufficient pupil motivation, a lack of time for lesson preparation, complexities in interacting with parents, classroom management issues, and an absence of administrative support (Fig. 2). These challenges impede effective teaching and demand a high level of professional competence from educators.

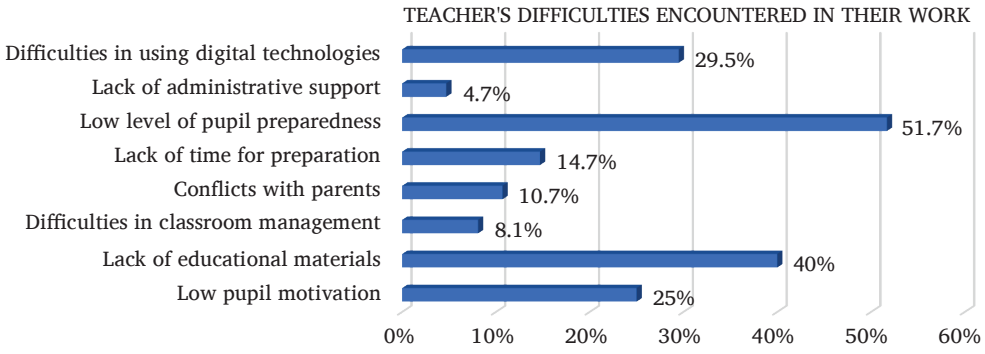

Figure 2. *Difficulties encountered by surveyed educators in Kyrgyzstan*
Source: *compiled by the authors*

The obtained data underscore that the professional training of future educators in higher education institutions should take into account the actual difficulties encountered by teachers. This necessitates increased attention to the following aspects: the development of digital literacy skills for the confident use of educational

technologies; the formation of methodological competence, including the ability to adapt educational material for varying levels of pupil preparedness; the development of communication skills for effective interaction with pupils, parents, and administration; the mastery of methods for classroom management and motivating pupils; and providing future educators with knowledge regarding working with educational materials and sourcing alternative educational resources.

Thus, the preparation of future teachers should be grounded in the real-world problems identified through the analysis of practising educators' experiences. Attention needs to be focused on the development of their psycho-pedagogical competencies, encompassing methodological and digital literacy, the capacity for pedagogical interaction, the ability to work with pupil motivation, and the adaptation of educational materials to suit different levels of pupil preparedness. The formation of these competencies should be facilitated through the use of modern pedagogical technologies, thereby enabling future teachers to confidently apply theoretical knowledge in practice and successfully integrate into the professional environment. This will ensure that university graduates are well-equipped to meet the challenges of the contemporary school and apply their professional competencies effectively in their practice.

The formation of future educators' professional competencies is contingent upon the mastery of modern pedagogical technologies, which contribute to making the learning process more productive, interactive, and oriented towards the pupil's personal development. Pedagogical technologies represent a composite of methods, techniques, and resources that facilitate the optimal organisation of the educational process. Their implementation enhances teaching effectiveness by actively engaging students in learning activities; develops practical teaching skills and the ability to work with pupils; fosters the reflective and communicative skills necessary for professional growth; and creates conditions for the individualisation and differentiation of learning, which is particularly crucial in the context of the contemporary school.

It is essential for the future teacher not merely to possess theoretical knowledge of pedagogy but also to be adept at applying modern technologies in practice. In this context, particular importance is attached to the following types of pedagogical technologies. A teacher's subjectmethodological competence is cultivated through the assimilation of active learning technologies, problem and project-based methods, and digital educational resources. By mastering these tools, educators can move beyond simply explaining material to prompting pupils towards independent problem-solving and fostering their critical thinking and creative abilities. Interactive technologies involve active learner engagement and the development of collaboration and critical thinking skills. These include discussions, debates, case studies, group work, and educational games. They equip future teachers with the skills to manage the learning process, work effectively in teams, and interact constructively with pupils.

Project-based learning technologies centre on students' independent activity involving the resolution of practical tasks. The application of a project-based methodology in teacher training contributes to the development of analytical, research, and communication skills and instils the ability to apply knowledge in practical contexts. Problem-based learning technologies are designed to cultivate prospective educators' capacity to analyse complex situations, devise innovative solutions, and form research skills. Problem-based learning trains students not merely to impart knowledge but to encourage their own pupils to seek solutions autonomously. Digital technologies are indispensable for the contemporary teacher. The use of electronic educational platforms, interactive whiteboards, virtual laboratories, and online courses not only diversifies the educational process but also enhances its effectiveness. Digital literacy constitutes the composite of skills enabling effective engagement with digital media, and the execution of information search, analysis, and processing (Cabero-Almenara *et al.*, 2020). Reflective technologies represent a significant element of professional training. The future teacher must be able to evaluate their own work, identify strengths and weaknesses, and adjust their pedagogical practice accordingly. To this end, technologies of self-assessment, portfolios, and teaching practice diaries are employed.

The development of future teachers' professional competencies is not possible without the mastery of modern pedagogical technologies. These enable the educational process to become more meaningful, practice-oriented, and effective. Integrating pedagogical technologies into teacher training programmes contributes to the development of their methodological, communicative, digital, and reflective competence, thereby preparing them for successful professional practice in the contemporary school environment. Pedagogical technologies serve as a potent instrument for cultivating a teacher's professional competencies, assisting them not only in teaching effectively but also in fostering reflection, managing their emotional state, establishing productive communication, and adapting to shifts within the education system. It is precisely their conscious and purposeful application that allows an educator to fulfil their potential as competent, motivated and accomplished professionals.

Psychological preparation plays a crucial role in the professional formation of the future educator. The development of emotional intelligence, the capacity to comprehend pupils' psychological characteristics, and the ability to accommodate their individual differences facilitate the establishment of effective interaction within the educational process. A profound understanding of developmental psychology enables not only the proper organisation of learning but also the creation of a supportive environment conducive to the development of each child. Psychological readiness also augments a teacher's professional competence, empowering them to operate confidently in complex situations, adapt to changes, and employ an individualised approach with each pupil.

The role of an educator's personal characteristics, cognitive abilities, and emotional intelligence

The effective mastery of pedagogical technologies by prospective teachers is directly contingent upon their cognitive and personal characteristics. These factors determine an educator's capacity to perceive, analyse, and implement modern teaching methods, as well as to adapt to a constantly evolving educational environment. Cognitive characteristics encompass the level of intellectual development, analytical thinking, and the ability to rapidly assimilate information and apply it in practice (Gendina, 2007). Pedagogical technologies necessitate a profound understanding of the subject matter, the capacity to structure knowledge, identify connections between various disciplines, and tailor educational methods to the specific needs of individual pupils. High cognitive flexibility enables a teacher to acquire new approaches, evaluate their efficacy, and refine their pedagogical practice.

Personal characteristics play an equally significant role. Flexibility, creativity, initiative, and openness to new ideas are determinative of a teacher's readiness to adopt innovative technologies, experiment, and develop unconventional solutions. L. Antsyferova posits that personal development is linked to an inherent human striving to transcend one's limitations, achieving the full realisation of one's essence. The personality is perpetually oriented towards the future, manifesting it in the present. This desire for self-improvement and development constitutes the driving force behind an individual (Antsyferova, 1981). An educator possessing a high degree of self-organisation and purposefulness is more successful in mastering complex methodologies, integrating them into the educational process, and adapting to the evolving requirements of the education system.

The combination of well-developed cognitive abilities and personal qualities ensures the successful mastery of pedagogical technologies, empowering future teachers to apply modern teaching methods effectively, adapt to the diverse needs of their pupils, and continuously enhance their professional practice. In addition, emotional intelligence and stress resilience play a crucial role in pedagogical activity, determining a teacher's effectiveness, their capacity for constructive interaction with pupils, colleagues, and parents, and their ability to adapt to challenging situations. Emotional intelligence encompasses the ability to recognise and manage one's own emotions, understand the feelings of others, and cultivate harmonious relationships. A high level of emotional intelligence enables a teacher to regulate their behaviour, circumvent conflicts, maintain pupil motivation, and foster a favourable psychological climate in the classroom. The capacity for empathy facilitates the consideration of children's individual characteristics and the adoption of tailored approaches to each, while well-developed communication skills aid in the effective transmission of knowledge and sustaining interest in learning.

Stress resilience is essential for an educator to maintain work capacity and emotional equilibrium under considerable pressure. A teacher's work involves constant psycho-emotional challenges – they must manage tension, resolve conflict situations, and work with diverse categories of pupils. The ability to maintain composure, recover quickly from stressful situations, and find internal resources to sustain motivation are vital qualities determining professional longevity and the quality of pedagogical activity. Emotional intelligence and stress resilience form the bedrock of successful professional development for a teacher, enabling them to interact effectively with others, adapt to change, and maintain high performance in the demanding conditions of the educational process.

Research by N. Kuzmina (1990) indicates that during the stage of professionalisation, as an individual's work style becomes established, the level of professional activity may decrease, potentially leading to professional stagnation. Similar conclusions are corroborated in the study of L. Mitina (1994). L. Antsyferova (1980), in her analysis of the causes of identity crisis, highlights professional stagnation, which, in her view, results in a person who previously considered themselves a highly competent specialist beginning to feel altered, not as they were before. If professional stagnation occurs, it is necessary to actively work on updating and developing one's skills, seek new challenges and tasks, engage in self-education, find inspiration in innovative approaches and working methods, and seek support and motivation through interaction with colleagues and participation in professional communities.

Professional development for teachers is contingent upon their capacity for self-reflection and the management of their own resources. Pedagogical reflection and self-regulation equip prospective teachers not only to adapt effectively to the profession but also to continuously enhance their practice, thereby improving the quality of their teaching. Reflection facilitates the analysis of both successful and less successful pedagogical approaches, enabling the identification of the root causes of problematic situations and the formulation of solutions. It fosters the development of an individual teaching style, cultivates critical thinking, and promotes a readiness for innovation (Slastenin & Podymova, 1997). Self-regulation, in turn, assists teachers in maintaining internal equilibrium, managing emotions, adjusting to the changing demands of the educational process, and sustaining a high level of motivation. These mechanisms are established during the training period, as students become accustomed to evaluating their achievements, modifying their actions, and incorporating feedback. Subsequently, this forms the basis of professional resilience, empowering teachers to interact effectively with pupils, navigate complex situations, and remain sought-after professionals in a dynamic educational landscape.

Pedagogical technologies and their role in the professional training of the future teacher

While reflection and self-regulation enable educators to structure their activities thoughtfully, manage emotions, and adapt to the demands of the profession, the mastery of modern educational technologies allows them to

implement the teaching process effectively, work with diverse groups of pupils, and achieve high outcomes. The acquisition of pedagogical technologies plays a pivotal role in the professional preparation of prospective teachers, complementing their psychopedagogical readiness. Pedagogical technologies are defined as a composite of methods, techniques, and tools aimed at organising teaching and upbringing. Their knowledge and skilful application ensure the formation of a teacher's key professional competencies: subjectmethodological, communicative, psycho-pedagogical, and organisational-managerial. Future educators must acquire proficiency in interactive teaching methods, project and research activities, digital technologies, and differentiated and individualised instructions to adapt flexibly to the needs of their pupils. The effective synergy of psycho-pedagogical preparation and the mastery of pedagogical technologies shapes a professionally competent teacher capable of not only imparting knowledge but also creating an educational environment that considers the individual characteristics of each child, fosters their abilities, and cultivates a motivation for learning.

In the preparation of future teachers, it is crucial not only to cultivate their psycho-pedagogical readiness but also to equip them with the modern pedagogical technologies they will utilise in practice. Pedagogical technologies are the methods that render learning effective and engaging. Future teachers must not only be knowledgeable about these methods but also capable of adapting them to the specific needs of their pupils, applying them in diverse contexts, and at times creatively modifying them to maximise their benefit.

Active and interactive teaching methodologies constitute crucial tools in the pedagogical arsenal. They serve not only to enhance student motivation and engagement but also to cultivate critical thinking, creativity, and autonomy. By employing such methodologies, future teachers learn not merely to transmit knowledge but to create conditions conducive to active cognitive engagement in their students. Project-based learning is an example of this approach, enabling schoolchildren to undertake tasks independently, devise solutions, collaborate in a team, and present their ideas. This method facilitates the development of practical skills and initiative, alongside fostering a sense of responsibility for the ultimate outcome. The case study method affords pupils the opportunity to examine authentic situations, analyse them, and propose solutions to problems. This cultivates analytical thinking and decision-making abilities in schoolchildren, preparing them to apply acquired knowledge in real-life contexts. Training sessions, in turn, enable pupils to enhance communication skills, work on emotional resilience and self-confidence. They assist students in interacting effectively with others, resolving conflicts, and collaborating within a team. Game-based learning technologies in education contribute to making the learning process more engaging and accessible. Games stimulate pupil activity, aid in better retention of information, and develop collaboration skills. Future teachers must acquire proficiency in these methods, learning to adapt and apply them in diverse educational scenarios to establish an effective and developmentally oriented learning environment.

In addition to traditional pedagogical methods, such as project-based learning, case studies, training sessions, and game-based technologies, digital educational technologies are a crucial element in cultivating the professional competencies of future teachers. Contemporary pupils are growing up in a world saturated with digital technologies, and educators must acknowledge this reality to interact effectively with students and prepare them for future challenges. As S. Litvinova (2019) noted in her study, "to keep pace with the development of the modern changing world, students must have a high level of education, and this is not possible without the implementation of modern innovative technologies". Digital technologies facilitate the creation of interactive learning materials, online courses, virtual laboratories, and other resources that significantly expand opportunities for learning and self-development. They also contribute to the individualisation of the learning process, as digital tools enable the adaptation of content and methods to the needs of each student. Future teachers must acquire proficiency in working with these technologies, rather than being limited to traditional methods alone.

Teachers should not only possess the ability to utilise digital technologies but also be prepared to instruct their pupils in using them consciously and beneficially. It is crucial to convey to children that digital technologies are not merely a means of entertainment or leisure but also a potent instrument for self-education, information retrieval, project development, and resolving various tasks. The capacity to leverage digital resources for learning and development constitutes a significant component of a teacher's professional competence. The teacher ought to serve as a role model in this regard, actively integrating digital technologies into the educational process and educating children on the appropriate use of the internet, educational applications, and other digital tools. They must cultivate in schoolchildren not only digital literacy but also critical thinking, which will enable them to navigate the flow of information and employ technologies to the advantage of their learning and development. Ultimately, this contributes to preparing students for life in a digital society and assists them in effectively utilising the resources available within the modern educational process.

Continuing the theme of training future educators in the context of psycho-pedagogical competence, an important aspect is also the development of their ability to employ an individualised approach in teaching. In the context of student diversity, their individual characteristics, levels of preparedness, and psychological needs, the capacity to teach while taking these factors into account becomes an integral part of modern pedagogical practice. An individualised approach in the training of future teachers not only implies considering various student characteristics but also necessitates deep knowledge in the fields of psychology and pedagogy. During their training in a pedagogical university, students must learn to identify the specific needs of

each pupil and understand their motivation, interests, and difficulties. This requires future teachers to possess a high level of psychological competence and the ability to adapt teaching methods and resources according to a child's individual characteristics.

The psychological significance of an individualised approach lies in its contribution to fostering self-confidence in pupils, reducing stress, and increasing motivation and engagement in the learning process. This enables students to assimilate material more effectively, develop their abilities, and unlock their potential. An individualised approach helps maintain a positive emotional state among learners and creates conditions conducive to successful socialisation and harmonious personality development. Future educators who have mastered this principle during their training will be capable of not only enhancing the effectiveness of their work but also significantly improving the overall quality of education. An individual approach to learning becomes a crucial aspect of their professional competence, subsequently enabling them to work with diverse student populations, successfully address pedagogical challenges, and adapt to the evolving conditions of the educational environment.

The interconnectedness of psychology and pedagogy plays a key role in shaping the professional competencies of future educators. These two disciplines, while possessing their own distinct characteristics, are closely intertwined, forming the basis for effective teaching and upbringing. Psychology provides educators with an understanding of mental processes, mechanisms of perception, development, and learning, which allows for a deeper and more informed approach to addressing educational challenges. Pedagogy, in turn, encompasses the methods and principles for organising the educational process, aimed at student development, their socialisation, and the transmission of knowledge. Psychological knowledge assists teachers in more accurately diagnosing the needs and characteristics of pupils and in determining strategies that contribute to the successful assimilation of material and harmonious personality development.

The development of future teachers' competencies is contingent upon an understanding of the psychological aspects of their professional role. Knowledge concerning psychophysiological and emotional processes, as well as the age-related and individual characteristics of pupils, enables educators to select the most effective teaching approaches, establish trusting relationships with students, and provide appropriate motivation and support for their learning endeavours. An important dimension is also the teacher's own personality, their emotional intelligence, and stress resilience, which are likewise integral components of professional competence. The capacity to manage one's emotions, adapt to stressful situations, and cultivate harmonious relationships with students and colleagues directly influences the quality of pedagogical work. Successful pedagogical influence is not feasible without psychological preparation, and the personal attributes of an educator, such as emotional maturity and stress resilience, enhance their effectiveness in addressing pedagogical tasks and contribute to the establishment of a positive educational environment.

According to N. Slota (2024), "for the formation of professional competence, higher education institutions must cultivate informed students capable of critical thinking and solving various problems". It is important to note that excellent knowledge and skilful application of pedagogical methods, theories, and technologies directly influence a teacher's psychological state. When an educator possesses a thorough understanding of their work, they feel confident in their abilities and actions, which in turn reduces levels of stress and anxiety. Comprehending which methods and approaches to employ in different situations, and how to structure and plan a lesson, assists the teacher not only in being more effective but also in maintaining psychological calmness (Asmolov, 2002). Knowledge of pedagogical technologies and theory provides the teacher with a clear understanding of how to influence students, which methods are suitable for different groups, and how to optimise the educational process. This allows the educator to anticipate potential difficulties, prepare for lessons in advance, and create an atmosphere of trust and mutual understanding, all of which favourably affect their psychological state.

The interaction between psychology and pedagogy contributes to the formation of the complex and multifaceted process of a future teacher's professional identity, commencing during their training at a pedagogical university and continuing throughout their entire professional career. A teacher's professional identity encompasses not only knowledge and skills but also values, attitudes, and the role the educator defines for themselves within the educational process. This involves an understanding of their mission, an awareness of responsibility towards students, colleagues, and society, and the capacity to adapt their pedagogical methods and approaches in response to changing circumstances. The process of shaping a teacher's professional identity also includes an awareness of their own value and uniqueness as a specialist. An educator who understands and accepts their strengths, while also recognising areas of their practice that require enhancement, will be successful in their profession and capable of fostering a positive educational climate, promoting student development, and building professional relationships founded on respect and trust.

CONCLUSIONS

The development of future teachers' professional competencies serves as the bedrock of quality education and the development of the younger generation. An educator is not merely an individual who imparts knowledge but also a mentor who shapes the student's personality and assists in the development of their emotional intelligence, socialisation, and moral values. A teacher's professionalism exerts a considerable influence not only on the standard of education but also on upbringing, which is vital for the development of future specialists across various fields. By

employing their pedagogical and psychological knowledge, teachers help not only to educate but also to guide students towards self-improvement and the achievement of their goals. The complex social and psychological challenges encountered by contemporary pupils necessitate specialised training for educators. In the context of Kyrgyzstan, where conflicts occur between students and teachers, as well as inter-personal and inter-group clashes among schoolchildren, the psychopedagogical preparation of future teachers assumes particular importance. Understanding children's emotional needs, coupled with the competent application of pedagogical technologies and skills in working with diverse student groups, assists teachers in mitigating levels of aggression and conflict within schools.

Psychological and pedagogical training for teachers is of immense significance, as it equips them to be more sensitive, tolerant, and prepared for addressing challenging situations. Collaborative work between the teacher and psychologists, social educators, parents, and other specialists facilitates the creation of a supportive environment within the school that is conducive to the comprehensive development of the child. This necessitates active interaction and attention to the psychological characteristics of each student from all participants in the educational process. It is precisely through the enhancement of teachers' professional competencies that a favourable atmosphere for nurturing a new generation can be established, teaching children how to interact with one another, understand their emotions, and assume responsibility for their actions. Schools must become spaces where children feel supported and can develop not only intellectually but also emotionally and socially. In turn, the pedagogical mastery of teachers and their capacity to apply psychological and pedagogical knowledge directly impact the well-being and academic success of pupils, as well as the overall atmosphere within educational institutions. Perspectives for further research, building upon the data obtained from the conducted survey, encompass the cultivation of future teachers' professional competencies that align with the current demands of the educational landscape. Based on the identified needs, it is imperative to continue efforts to refine curricula and training methodologies for aspiring educators. One avenue for exploration involves an in-depth study into the influence of psychological and pedagogical competencies on teachers' preparedness to address students' social and emotional challenges. This could entail the development of specialised training programmes and courses aimed at enhancing teachers' emotional resilience and their capacity to manage conflict situations. Furthermore, it is crucial to focus on the integration of interdisciplinary knowledge within educational programmes. Based on the survey findings, practical modules could be devised to include collaborative work between educators and psychologists, social educators, and other specialists, to foster a supportive school environment. Additionally, the research could be directed towards the adaptation and implementation of novel pedagogical technologies that would facilitate future teachers' understanding and consideration of students' individual needs, thereby augmenting their ability to teach effectively and support children's socialisation. Thus, further investigation grounded in the survey results will enable a precise determination of which pedagogical technologies are requisite for the formation of professional competencies in future teachers, empowering them to fulfil their role successfully in the contemporary school setting.

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Туйгун Бектуров
Педагогика илимдеринин кандидаты, доцент
И. Арабаев атындагы Кыргыз мамлекеттик университетинин
720026, Раззаков көч., 51-А, Бишкек ш., Кыргыз Республикасы
https://orcid.org/0009-0001-3382-0684

Мээрим Кожогелдиева
Психология илимдеринин кандидаты, доцент
Ж. Баласагын атындагы Кыргыз Улуттук университети
720033, Фрунзе көч., 547, Бишкек ш., Кыргыз Республикасы
https://orcid.org/0009-0007-8809-6156

Аннотация. Кыргызстанда керектүү кесиптик компетенцияларга ээ болгон болочок мугалимдерди даярдоо көйгөйү орчундуу деп айтсак болот. Учурдагы билим берүү мейкиндиги мугалимдерден предметин билүүдөн сырткары, жекече жана кесиптик сапаттардын өнүгүшүнө таасир берген педагогикалык технологияларды да колдонуу билгичтигин талап кылат. Болочок мугалимдердин компетенцияларын калыптандырууда психологиялык-педагогикалык ыкма билим берүү процессинин негизги аспекти болуп саналат. Себеби, инсандын психологиялык өзгөчөлүктөрүн жана педагогикалык технологияларды эске алуу менен заманбап көйгөйлөрдү эффективдүү чече алган мугалимди даярдайй алабыз. Болочок мугалимдин кесиптик жактан ийгиликтүү өсүшүнө таасир берген факторлордун бирден бири болуп, интеллектуалдык гана эмес, ошондой эле эмоционалдык, коомдук компетенциялардын өнүгүшүнө багытталган инновациялык педагогикалык технологияларды колдонуу саналат. Макалада, кесиптик компетенциялардын калыптануусунун психологиялык-педагогикалык аспектилери менен бирге мугалимдерди даярдоо процессинде алардын жана окуучулардын инсандык өзгөчөлүктөрүн эске алуу маанилүүлүгү каралат. В.А. Сластенин, Л.М. Митина, Н.В. Кузьмина, Л.И. Анцыферова сыяктуу окумуштуулардын изилдөөлөрүнүн негизинде болочок мугалимдердин кесиптик жана инсандык жактан өнүгүүсүнө таасир берген педагогикалык технологияларды киргизүү зарылчылыгы келип чыгат. Сластенин мугалимдин инновациялык жактан өзүн көрсөтүү үчүн шарттарды түзүүгө көңүл бурат. Бул андан жаңы контент менен иш алып барууну жана окутууда өзгөчө ыкмаларды колдонууну талап кылат. Митина эмоционалдык ийкемдүүлүктүн жана өзгөрүүлөргө болгон даярдыгын белгилейт. Бул белгилүү компетенциялардын өнүгүшүнө багытталган ар түрдүү педагогикалык технологияларды колдонуу менен ишке ашат. Кузьмина педагогикалык технологиялар кесиптик иденттүүлүк кризисин жеңе алууга таасир берээрин айтат. Ал эми анцыферова мугалимдин ички мотивацияссынын маанилүүлүгүн, анын мыкты болууга жана өнүгүүгө болгон умтулуусун белгилейт. Мындан сырткары, студенттерде – болочок мугалимдерде өзүн башкара билүү, эмоционалдык туруктуулук көндүмдөрүн жана кесиптик компетенцияларын калыптандыруу үчүн психологиялык-педагогикалык технологияларды колдонуу маанилүү. Бул технологиялар болочок мугалимдерге теориялык билимге ээ болууга гана эмес, ошондой эле аларды билим берүү процессинде чыныгы шарттарда колдонгонду үйрөнүүгө жардам берет. Болочок мугалимдин компетенцияларын калыптандыруу, инсандын өнүгүшүнө жана кесиптик квалификацияларынын жогорулашына багытталган педагогикалык технологияларды активдүү колдонуусуз мүмкүн эмес

Негизги сөздөр: инсандык өнүгүү; инновациялык методдор; эмоционалдык туруктуулук; өзүн өзү башкаруу; долбоордук ишмердүүлүк, кесиптик иденттүүлүк

Психолого-педагогические аспекты формирования профессиональных компетенций будущих учителей с использованием педагогических технологий

Туйгун Бектуров
Кандидат педагогических наук, доцент
Кыргызский государственный университет им. И. Арабаева
720026, ул. Раззакова, 51, г. Бишкек, Кыргызская Республика
https://orcid.org/0009-0001-3382-0684

Мээрим Кожогелдиева
Кандидат психологических наук, доцент
Кыргызский национальный университет имени Ж. Баласагына
720033, ул. Фрунзе, 547, г. Бишкек, Кыргызская Республика
https://orcid.org/0009-0007-8809-6156

Аннотация. В Кыргызстане проблема подготовки будущих педагогов, обладающих необходимыми профессиональными компетенциями, стоит как никогда остро. Современное образовательное пространство требует от учителей не только знания предмета, но и умения применять педагогические технологии, которые способствуют развитию личных и профессиональных качеств. Психолого-педагогический подход к формированию компетенций будущих учителей является важным аспектом образовательного процесса, ведь только с учетом психологических особенностей личности и педагогических технологий можно подготовить педагога, способного к эффективному решению современных задач. Целью данной работы был анализ психолого-педагогических аспектов формирования профессиональных компетенций будущих педагогов с акцентом на использование современных педагогических технологий. В статье рассмотрены ключевые психолого-педагогические факторы, влияющие на процесс формирования профессиональных компетенций, включая необходимость учета личностных особенностей как учителей, так и учащихся. На основе анализа теоретических исследований таких ученых, как В. Сластенин, Л. Митина, Н. Кузьмина и Л. Анцыферова, подчеркнута важность внедрения педагогических технологий, способствующих не только профессиональному, но и личностному развитию будущих педагогов. Особое внимание в работе было уделено формированию у студентов навыков саморегуляции, эмоциональной устойчивости и профессиональной идентичности. Также подчеркнута важность внутренней мотивации учителя, его стремления к самосовершенствованию и развитию. Результаты исследования продемонстрировали, что активное применение педагогических технологий, ориентированных на развитие интеллектуальных, эмоциональных и социальных компетенций, является необходимым условием для успешной подготовки будущих учителей. Практическая ценность данной работы заключается в возможности использования ее результатов для совершенствования образовательных программ и методик подготовки педагогических кадров в Кыргызстане

Ключевые слова: личностное развитие; инновационные методы; эмоциональная устойчивость; саморегуляция; проектная деятельность; профессиональная идентичность

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Ways for developing digital competence in future educators within a collaborative digital environment

Klara Buzaubakova*
Doctor of Pedagogical Sciences, Professor
Taraz University named after M.Kh. Dulaty
080012, 7 Suleimenov Str., Taraz, Republic of Kazakhstan
https://orcid.org/0000-0002-9124-9893

Rakhat Sulaymanova
Doctor of Pedagogical Sciences, Professor
Jusup Balasagyn Kyrgyz National University
720033, 547 Frunze Str., Bishkek, Kyrgyz Republic
https://orcid.org/0009-0008-8433-939X

Abstract. The information age demands globally competitive educators who can systematically integrate digital technologies into their professional practice, manage the educational process efficiently, and engage in ongoing research to improve teaching and learning. Such professionals must possess advanced digital and creative competences. Therefore, it is essential to equip future educators with the necessary digital tools and skills. This article aimed to identify effective ways to develop digital competence in future educators in a collaborative digital environment. The research employed both theoretical and empirical methods, including abstraction, modelling, synthesis, testing, and pedagogical experimentation, among others. Key concepts examined include "digital literacy", "digital competence", "digital competence of future educators", "collaboration", and "collaborative digital environment". The study outlined the benefits of fostering digital competence in future educators; the structure of digital skills and competences by the European Framework for the Digital Competence of Educators; the concept of "collaboration" as part of the 4Cs – cooperation, coordination, communication, and creativity; as well as the structure and key features of the proposed pedagogical portal, the Digital Educational Environment. A review was conducted of scholarly and pedagogical literature concerning the development of digital competence in future educators within a collaborative digital environment. An online course entitled Digital Learning Technologies was conducted, and an international online competition, The Most Effective Digital Educational Platform, was organised for prospective educators. Based on the outcomes of the study, content and discourse analyses were carried out to classify collaboration as a form of social cooperation. A collaborative partnership was established between the Kazakhstan universities – M. Dulaty Taraz University, Kokshetau University named after Sh. Ualikhanov and Zhetysu University named after I. Zhansugurov – and the Kyrgyz university – Kyrgyz National University named after J. Balasagyn, represent a model of networked cooperation. The practical value of the study lies in the consolidation of intellectual resources from Kazakhstan and Kyrgyzstan universities into a single channel, allowing prominent academics and methodologists from these institutions to combine their efforts in jointly developing high-quality digital educational content for pedagogical disciplines

Keywords: collaboration; consortium; educational website; professional competence; digital resource; online course

INTRODUCTION

The process of digitalisation is impacting the education system and calls for a reassessment of how educators' professional qualifications are enhanced in this new context. Measures must be taken to strengthen the functionality of schools and to further improve educators' skills and social standing. Educators represent the intellectual vanguard of

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*Corresponding author

the nation, laying the groundwork for its long-term progress. While excellent curricula, modern school facilities, and advanced management systems are valuable, nothing can be achieved without proficient educators. Like professionals in any other field, educators must possess digital literacy, encompassing the fundamental knowledge, skills, and attitudes required for navigating a digital society (Message from the Head of State K. Tokayev to the people of Kazakhstan, 2024).

The teaching of any subject should be contextualised within the student's future profession, serving as a means to synthesise their acquired knowledge, proficiencies, and skills. The content of professional pedagogical education possesses unique characteristics and differs significantly from professional training in other higher education institutions. Contemporary societal development trends and the quest for novel, effective teaching and learning approaches demand that future educators are capable of reflective thinking and possess a strong command of developmental pedagogy and effective methodologies (Aitenova *et al.*, 2020). Research conducted by A. Turalbayeva *et al.* (2021) indicates that prospective educators favour the use of information technologies when undertaking academic research and completing independent creative assignments.

Digital competence is underpinned by digital literacy and digital skills. Literacy, in a general sense, denotes the capacity to comprehend, interpret, generate, communicate, and calculate information using printed and written materials. Furthermore, by analysing substantial volumes of information regarding students and their activities within the digital realm, contemporary educators can provide appropriate support, and indeed, every educator can operate autonomously within the digital environment. Digital literacy and digital skills form the bedrock of digital competence. While the term "digital literacy" enjoys widespread international usage, "digital competence" remains a more fitting term, as it conveys a broader and more holistic meaning. In this comprehensive concept of digital competence, mastery over both pedagogical approaches and the subject matter itself, alongside technical skills, constitutes only a part of this complex notion. The digital competence of a future educator represents the synthesis of abilities to effectively utilise information and communication technologies and digital media when formulating and resolving tasks related to information processing, work, learning, socialisation, and the expansion of existing opportunities (Diachuk, 2024).

Digital technologies form the bedrock of contemporary technological advancement and are set to retain their pivotal role in the foreseeable future. The digital educational environment paves the way for novel opportunities: facilitating a transition from classroom-based learning to anytime, anywhere learning; enabling the development of personalised learning pathways; and transforming learners from mere consumers of electronic resources into creators of new ones. A digital educational environment constitutes an open complex of resources, conditions, and opportunities for the learning, development, and socialisation of prospective educators. According to the definition provided by UNESCO (2018), a digital educational environment is a composite of the conditions necessary for implementing educational programmes through the use of e-learning and distance learning technologies. This encompasses the functioning of an electronic information and educational environment, which includes electronic information resources and an information educational milieu comprising: educational resources that ensure comprehensive mastery of educational programmes irrespective of location; a suite of information and telecommunication technologies; and relevant digital technology tools.

According to R. Sulaimanova *et al.* (2021), the development of future educators' sociopedagogical competence is gaining particular significance within the context of contemporary professional pedagogical education. This is attributable to several factors influencing the socialisation of the younger generation: uncertainty in government policy concerning youth upbringing and education; an increase in both internal and external migration processes; the growing dependence of young people on technological devices; and the consequences of the global pandemic, which are yet to be fully comprehended. Thus, educator training must account for these factors to ensure the effective social adaptation and development of the burgeoning generation.

C. Kimm *et al.* (2020) investigated pre-service educators' confidence in their ISTE technology competencies. The findings of this quantitative study indicated that prospective educators felt they had not yet attained a sufficient level of technological competence in line with ISTE standards. Future special education educators with experience in team-based learning exhibit a significantly higher level of technological competence compared to other groups. According to the findings of research by S. Nurzhanova *et al.* (2024), the technology use skills and digital literacy of prospective educators were generally at a higher level than those of more experienced in-service educators in mainstream schools. Furthermore, the study revealed that the digital literacy of future educators is a significant predictor of their technology use skills.

The quality of an educator's professional development is largely determined by the nature of the learning content. This content should encompass a broad spectrum of issues about all areas and aspects of pedagogical education. This research aimed to identify methods for developing the digital competencies of future educators within a collaborative digital environment.

MATERIALS AND METHODS

General theoretical, empirical, and statistical methods of scientific inquiry were employed to effectively implement the experimental research on the formation of future educators' digital competencies within a collaborative educational environment based on the interaction of higher education institutions in the Republic of Kazakhstan and the Kyrgyz Republic. To measure, determine, and record the results of the conducted scientific investigations, the

following theoretical and empirical research methods were utilised: abstraction, modelling, synthesis, survey, testing, online testing, pedagogical experiment, induction, and deduction. For the sorting and processing of the data obtained during the research, statistical methods were applied, including data selection and collection, ranking, mathematical-statistical methods, pedagogical monitoring, and others.

In the studies focused on developing digital competence in future educators within a collaborative educational environment supported by partnerships between Kazakhstan and Kyrgyzstan universities, interactive methods were used, which are considered effective among contemporary research approaches. The online course Digital Learning Technologies was conducted. In addition, as part of the modernisation of the higher education system, online testing and online surveys entitled What I Know and What I Have Learned were conducted to assess the level of digital competence among future educators within this collaborative context. The results were systematically organised. A total of 102 future educators from universities in Kazakhstan and Kyrgyzstan participated in the survey after completing the online course Digital Learning Technologies. As part of the modernisation of the higher education system and in line with the collaborative efforts between Kazakhstan and Kyrgyzstan universities, indicators and criteria for assessing levels of digital competence among future educators were identified, and diagnostic monitoring was conducted. The survey was carried out following the ethical standards of scientific research outlined in The Guidance Note of the European Commission on Ethics and Data Protection (2021). The online survey, focusing on the topics What I Know and What I Have Learned, was conducted within the framework of the research project AP19680242 Establishing a Joint Digital Educational Environment in Higher Education Institutions as Part of the Modernisation of the Pedagogical Education System in the Republic of Kazakhstan, funded by the Committee of the Ministry of Education and Science of the Republic of Kazakhstan. Participants were asked to reflect on what they had learned about digital learning technologies, whether their digital skills had improved upon completion of the course, and what specific competencies they had developed (Online survey, n.d.). The survey was conducted entirely anonymously.

RESULTS AND DISCUSSION

Digital competence of future educators

The term "skills" has gained international recognition through the evolution of related concepts. The 21st Century Skills are considered a constituent element of any competence. According to the OECD (2016), "digital skills are those skills related to the safe use of digital technologies in the process of managing and exchanging information, digital interaction, creating and transforming digital content, and solving problems in a digital context". Digital technologies empower future educators to refine existing methods for monitoring and evaluating students' educational attainment and to develop new, more advanced approaches.

The establishment of a digital economy necessitates an appropriate orientation of the education system and the preparation of specialists who utilise modern digital technologies in their work. Research by C. Redecker & Y. Punie (2017) suggests that "digital competence" is one of the unique competencies that must be cultivated in the new generation of educators. Regardless of the complexity of the competence set required for future educators, there exists a baseline of specific competencies that prospective educators must acquire during their training. These include: a knowledge base for teaching and learning; cognitive skills; social skills; personal orientations; and professional suitability (European Commission, 2013; Blömeke *et al.*, 2015). Cognitive skills encompass metacognition, critical thinking, and the capacity to effectively resolve diverse problems. Social skills refer to interpersonal, reflective, and research proficiencies necessary for fostering dialogue and collaboration within the pedagogical community to enhance the working environment. The personal orientations of future educators are defined as encompassing enthusiasm, self-confidence, universal human values, commitment to continuous professional development, building partnerships, and embracing diversity and inclusion. Professional suitability pertains to adaptability, stability, and stress management per the context and needs of prospective educators.

According to research by R. Metsäpelto *et al.* (2021), pedagogical competencies are categorised into three levels: the individual and group level, the organisational level, and the regional, national, and global level. The individual and group level is characterised by supporting student engagement in the learning process; employing personalised methods and dialogic teaching; organising group work; and providing emotional and pedagogical support. The organisational level is defined by planning and preparing the teaching process; collaborating with parents; cooperating with the professional community; and fostering the professional development and leadership of future educators. The regional, national, and global level entails promoting students' civic engageme nt; facilitating rational discourse; encouraging dialogue; cultivating students' global awareness and universal competence; and possessing high civic virtue.

Digital competence refers to educators' capacity to effectively utilise information technologies during their leisure time and for communication, to store and exchange information, to select information and communication technologies securely within the digital sphere, to work efficiently with digital content in a reliable digital environment, and so forth. R. Krumsvik (2011), a researcher in the phenomenon of digital competence, posits that digital competence involves educators possessing a sound understanding of information and communication technologies (ICT) within a professional pedagogical context, grasping their significance for teaching strategies and the digital foundation of learners, and being able to integrate this understanding into their practice. Research conducted by A. Turalbayeva *et al.* (2021) indicates that effective engagement with digital devices (proficiency in using

educational websites and portals) is a crucial characteristic in the formation of a future educator's digital competencies.

The development of digital competence in contemporary prospective educators offers several advantages: it enables future educators to independently enhance their professional qualifications; it fosters their critical thinking skills; it cultivates research competence; and it encourages future educators to seek novel solutions to problems. Instead of serving merely as tools for optimising the delivery of educational content to students, digital technologies are becoming instruments for creating personalised development environments. These environments allow learners to seek out and make sense of information, make decisions, collaborate in groups, and solve problems. Engaging with non-standard, creative tasks empowers the learner to become an active constructor of their own knowledge.

The European framework for digital competence of educators

K. Pelletier *et al.* (2021), in their EDUCAUSE Horizon Report, propose a classification of digital competence comprising five areas: information literacy; communication and collaboration; digital content creation; safety; and problem-solving. Currently, this definition is expanding to encompass the digital transmission of information. From a cognitive standpoint, "digital literacy" is analogous to traditional literacy (the 3 Rs – Reading, WRiting, and aRithmetic). According to the definition provided by UNESCO (2018), "digital literacy is the ability to access, manage, understand, integrate, communicate, evaluate and create information safely and appropriately through digital devices and networked technologies for participation in economic and social life". At the G20 summit in Berlin in 2017, K. Chetty *et al.* (2018) identified the components of digital literacy: approach to innovation; computer literacy; information literacy; communication literacy; media literacy; and digital literacy (Fig. 1). Standards developed by ISTE, the International Society for Technology in Education, also define the ICT competence and digital competencies of participants in the educational process, based on the evolving role of digital technologies in education.

At the end of 2017, the Education Committee of the European Union developed the EU Digital Competence Framework for Educators (DigCompEdu, n.d.). It is founded on the principle of integrating innovative technologies into established pedagogical practice and addresses digital competencies across three key areas: enhancing the use of digital technologies in teaching and learning; developing the skills necessary for digital transformation; and utilising data-driven analysis and forecasting in education (Fig. 2).

	Acquiring knowledge	Gaining knowledge	Creating knowledge
The role of digital technologies in education	Understanding policy	Applying policy	Policy innovation
Curriculum and assessment	Foundational knowledge	Applying knowledge	Skills necessary for knowledge acquisition
Pedagogical practice	Using digital technologies in education	Performing complex tasks	Ability to self-organise
Digital skills	Application	Integration	Transformation
Organisation and management of the educational process	Traditional educational activity	Collaboration	Organisation of the educational activity
Educator professional development	Digital literacy	Establish a network connection	Innovation

Figure 1. *Structure of future educators' digital competence*
Source: *developed by the authors based on research by K. Chetty et al. (2018)*

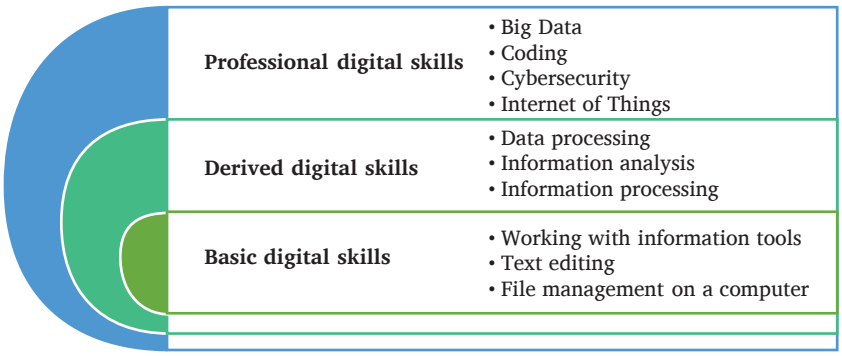

Figure 2. *Structure of digital skills*
Source: *developed by the authors based on data from DigCompEdu (n.d.)*

The goal of the DigCompEdu platform is to demonstrate and describe digital competencies relevant to learners. It comprises 22 competencies categorised into six thematic areas: "Professional engagement", "Digital resources", "Teaching and learning", "Assessment", "Empowering learners", and "Facilitating Learners' Digital Competence". The selection of content for diagnostic instruments is based on established standards for pedagogical ICT competence. All international standards typically incorporate two groups of digital competencies. The first is concerned with developing knowledge, skills, and abilities within the realm of ICT, while the second is necessary for educators to prepare students for life in the information society and the knowledge-based economy. The UNESCO (2018) recommendations examine all facets of pedagogical activity and structure them within six multi-level modules: "Understanding ICT in Education Policy", "Curriculum and Assessment", "Pedagogy", "Application of Digital Skills", "Organisation and Administration", and "Teacher Professional Learning" (Fig. 3).

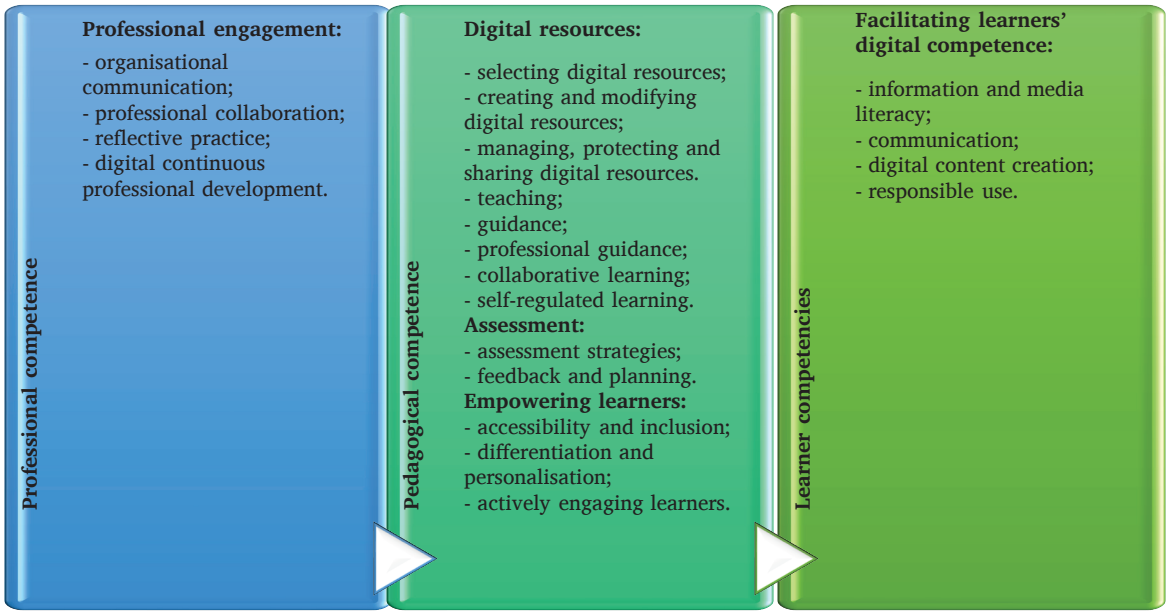

Figure 3. *European framework for the digital competence of educators*
Source: *developed by the authors based on data from DigCompEdu (n.d.)*

DigCompEdu (n.d.) and ISTE Standards (n.d.) establish a unified measurement and broad directions for assessing educators' professional activities. Within the DigCompEdu framework, an educator's digital competence is mapped across six levels of proficiency: Newcomer, Explorer, Integrator, Expert, Leader, and Pioneer. DigCompEdu defines 22 competencies, grouped into six areas. The ISTE Standards delineate seven roles for educators and enumerate the corresponding competencies. The standard structure proposed by UNESCO is presented as a two-dimensional matrix and already establishes certain levels of ICT competence not only for the individual educator but also for the general educational organisation.

Collaborative digital educational environment

"Collaboration" is a term of English origin signifying "cooperation", "joint effort", "partnership", "collective", or "group". D. Engelbart (1984) was among the first to articulate a contemporary understanding of "collaboration", positing that a community guided by a defined set of actions fosters participants' success, cultivates requisite competencies, and integrates them into a group process underpinned by effective relationships to achieve a shared objective. The universal competencies of future educators are influenced by cultural, social, and pedagogical contexts (Berliner, 2001). While some educator characteristics are universally applicable, others are specific to particular educational and political cultures (Klassen *et al.*, 2018). In the research by L. Biggiero & P. Angelini (2015), collaboration is regarded as "joint actions by two or more individuals or organisations to achieve a common goal in any field, aimed at a specific agreement and knowledge exchange". Collective collaboration is identified in studies by E. Antipina (2014) and C. Wang *et al.* (2015) as a form of social organisation whose members "pool the results of their intellectual labour and other resources to create a common product based on the vision and efforts of specialists from various fields of activity".

Cooperation as a contemporary mode of collaboration within the global knowledge economy is expounded upon in the articles of O. Inshakov (2013) and S. Yakunaeva & Yu. Koshurnikova (2013). Research into the specific characteristics of collaboration in the domains of science and education is reflected in the study of scholars such as R. Belderbos *et al.* (2015). According to research by S. Amara *et al.* (2016), "collaboration" is defined as a form of

joint activity, an interactive process uniting two or more participants working together towards a goal unattainable individually, based on technological attributes. The objectives of cooperation and its scope are identified as creative and distributive forces, along with forms of cooperation, while a novel objective for participants in cooperation is the creation of a new intellectual product. E. Polat (2023) and other scholars contend that when an educator's digital competence is well-established, they can readily assume roles such as moderator, mentor, facilitator, and coach.

According to research by O. Maksimenkova & A. Neznanov (2019), the term "collaboration" is used in conjunction with "cooperation" to encompass the concepts of "joint activity", "joint action", "group form of interaction organisation", and "cooperation in education". The concept of collaboration within the educational environment is more extensive. A. Kulikov (2012) notes that "collaboration is a philosophy of education, a foundational concept of joint action, learning, and professional-academic interaction". M. Laal & S. Ghodsi (2012) define collaboration as a philosophy of learning interaction wherein students assume responsibility for their actions and respect the abilities and contributions of their peers. The concept of "collaboration" unites the "4Cs": cooperation – collectivisation (union); communication – interaction; coordination – organisation; creativity – successful activity (Fig. 4).

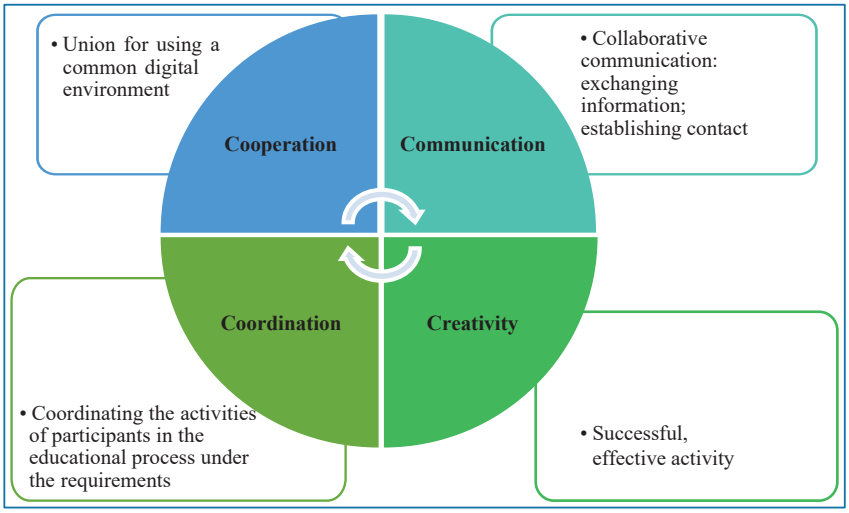

Figure 4. *The 4Cs: Essence of the concept of "collaboration"*
Source: *developed by the authors based on data from DigCompEdu (n.d.)*

Fundamentally, as noted by D. Johnson *et al.* (1990), collaboration in the educational sphere is predicated on the constructivist theory of learning: a) knowledge is constructed and transformed by the learners themselves; the role of educators is to establish appropriate pedagogical conditions through the application of active learning methods and the organisation of group learning interaction; b) the educational process is not a unidirectional influence from educator to student, but rather an active, purposeful interaction among all participants in a subject-subject and subject-object dynamic. In the digital age, the creation of a joint collaborative digital educational environment for higher education institutions within the framework of modernising the pedagogical education system of the Republic of Kazakhstan and Kyrgyzstan is essential.

Collaborative learning is defined as joint learning undertaken interactively, aimed at facilitating the achievement of a final outcome or goal: 1) learning is transformed into an active process wherein students fully assimilate information and connect it with their existing knowledge; this necessitates completing tasks, processing and generalising information, rather than merely memorising and repeating, which is achievable through the active engagement of each learner; 2) future educators recognise the value of understanding the perspectives of experienced educators and derive benefit from this; prospective educators gain practice in articulating their ideas and successfully defending their projects, fostering their social and emotional development; 3) learning is enhanced within a social environment where information and new knowledge are exchanged; future educators augment their intellectual capacity based on constructive thinking; they become capable of communicating effectively, presenting and defending ideas, exchanging diverse information, challenging alternative concepts, and participating actively; 4) the establishment of a collaborative environment will facilitate: a tangible shift towards novel forms of active learning; significantly improved methodological support for subjects at the forefront of scientific and technological advancement; this will not only create a more comprehensive digital footprint for the institution but also broaden opportunities for utilising tools for personal and collective digital memory management.

Based on the research undertaken by the authors of this article, the distinctive features involved in establishing a joint collaborative digital educational environment between higher education institutions in the Republic of

Kazakhstan and the Kyrgyz Republic were identified. It was determined that the internal academic mobility between Kazakhstan and Kyrgyzstan universities increased, allowing future educators to participate in online courses, enhance their digital competence without incurring costs, and result in savings for the state, the universities, and the prospective educators themselves. Each participating higher education institution provided extensive access to the digital educational resources of both Kazakhstan and Kyrgyzstan universities. Furthermore, by conducting online courses, classes, competitions, and webinars, it became feasible to elevate the professional qualifications of both university professors and future educators. This initiative also facilitated the preparation of highly qualified, globally competitive future educators possessing advanced digital competence, thereby addressing the current requirements of the New Kazakhstan and Kyrgyzstan.

The authors of this article identify several goals for creating a digital environment: 1) for the learner: to expand opportunities for shaping their own educational trajectory; to provide access to the latest educational resources; to broaden the range of accessible educational institutions; to enhance the transparency of the educational process; 2) for the educator: to reduce bureaucratic workload through automation; to improve the convenience of monitoring the learning process; to create new conditions for motivating learners during task creation and completion, thereby fostering conditions for the development of the learner's personal educational trajectory. Within a collaborative digital educational environment, the roles of participants undergo a transformation: the educator shifts from an explanatory-narrative teaching method towards action-oriented approaches; the educator becomes an organiser and coordinator of educational activities; and each student becomes an active participant in the learning process.

Within the framework of modernising the pedagogical education system in the Republic of Kazakhstan and the Kyrgyz Republic, a consortium has been established between Kazakhstan and Kyrgyzstan universities to create a joint collaborative digital educational environment for higher education institutions. As part of this initiative, online presentations of scientific studies prepared by scholars from the consortium's member universities have been conducted, and joint online and offline seminars, conferences, forums, methodological workshops, webinars, and coaching sessions in schools have been organised. The contribution of each university to the preparation of digital educational content for specific subjects has been defined, and the quality and characteristics of digital platforms effectively used by universities in the educational process have been evaluated and studied.

The authors identified several advantages stemming from the pedagogical consortium and collaboration. Firstly, it facilitates the concentration of the scientific and intellectual resources of the Kazakhstan and Kyrgyzstan universities within a single channel, enabling leading academics from these institutions to combine their efforts for the joint and high-quality preparation of digital educational content for relevant subjects. Secondly, it provides the opportunity to share high-quality digital educational content for disciplines, such as textbooks, teaching and learning materials, pedagogical cases, electronic portfolios, and teaching practice diaries. This, in turn, ensures the qualitative and substantive preparation of digital educational content for subjects and prevents the unauthorised copying of the results obtained. Thirdly, this collaboration contributes to the activation of both internal and external academic mobility within the Kazakhstan and Kyrgyzstan universities. Fourthly, it opens up significant avenues for the study, research, utilisation, and promotion of innovative practices from Kazakhstan universities in a collaborative setting. Fifthly, the joint research undertaken by scholars from the Kazakhstan and Kyrgyzstan universities makes a substantial contribution to enhancing the quality of pedagogical education and augmenting the competitiveness of the universities.

The digital educational environment pedagogical portal

With the aim of fostering the digital competence of future educators within the collaborative educational environment of pedagogical universities, an innovative information bank fund has been established. Furthermore, to strengthen the pedagogical educational potential of higher education institutions, a joint pedagogical consortium has been formed between M. Dulaty Taraz University, Zhetysu University named after I. Zhansugurov, Arkalyk Pedagogical Institute named after I. Altynsarin, and Kokshetau University named after Sh. Ualikhanov. A new Kazakhstan pedagogical education portal, the Digital Educational Environment (n.d.), has been launched based at Dulaty University. The objectives of this pedagogical education portal are to cultivate a systematic approach to professional activity among future educators; to enhance prospective educators' preparation for self-directed learning; to empower future educators to effectively utilise digital technologies in the educational process; to foster the development of future educators' cognitive activity and their information and creative competencies; to facilitate the formation of digital and creative competencies in future educators; and other related aims.

Advantages of the new pedagogical education portal: creating opportunities for digital communication with students and colleagues; developing skills in exchanging and creating materials with educators in a digital environment; utilising digital content for developing teaching materials and adapting existing ones; deepening knowledge regarding methods of information protection; evaluating the reliability of information and identifying false or biased content; promoting the safe and responsible use of digital technologies; fostering the creative application of digital technologies to address educational challenges; employing digital technologies in the educational process and monitoring students' online activity; and providing training in the use of digital tools for assessing and monitoring students' academic progress and intellectual growth, as well as their creative application.

The pedagogical education portal operates in three languages: Kazakh, Russian, and English. Located in the upper left section of the portal is a "Search" button, which allows users to find necessary materials. The portal's main menu comprises four sections: an "About Us" section, an "About the Project" blog, a "Contact" section, and a "News" section (Fig. 5).

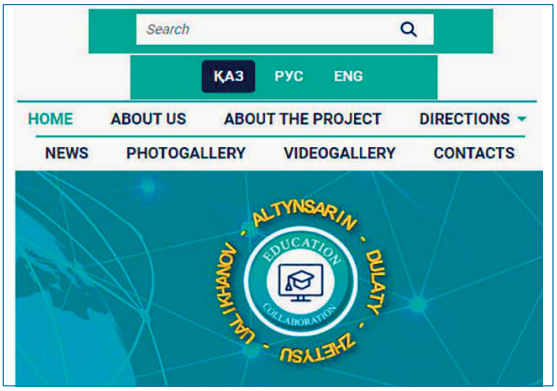

Figure 5. *The main page of the pedagogical education portal*
Source: *screenshot from the Digital Educational Environment website (n.d.)*

The Digital Educational Environment pedagogical portal (n.d.) familiarises future educators with the intricacies of the pedagogical process within a digital environment, fostering a systematic approach to their professional activities and cultivating professionally significant personal qualities in prospective educators. Future educators are introduced to the types and nuances of digital platforms and study digital technologies. The "Gallery" section of the pedagogical education portal features photographs and video clips documenting the activities conducted as part of the Project. The best submissions from future educators who participated in the international online competition organised within the project have been uploaded to the "Pedagogical Technologies" blog on the pedagogical education portal. Any prospective educator can enhance their knowledge and develop their digital competence by viewing the video content available on the portal.

According to research by A. Amirova *et al.* (2018), the development of digital competence in future educators within a collaborative digital environment offers the following advantages: the future educator independently enhances their professional qualifications and can independently seek and promptly locate necessary material and new information; the cognitive activity of the future educator is heightened: throughout the learning process at various levels, the future educator can effectively address tasks arising from their interests and needs; the creative thinking of the future educator is fostered: enabling them to find answers to the most complex questions, identify solutions, and think critically; the future educator learns to evaluate their own viewpoint and that of others, thereby developing critical thinking; the future educator learns to identify logical connections between previously covered material and new knowledge through comparison; the future educator's creative search skills are cultivated: the ability to pose questions, seek answers, sort results, and so forth; research competence is developed; as a result of critical thinking, the future educator finds the optimal solution to a problem and substantiates it with scientific experiments; they conduct comprehensive, in-depth research (monitoring and analysis of the pedagogical process); they endeavour to substantiate their perspective; most importantly, the future educator independently acquires innovative knowledge and develops autonomously. Figure 6 visually presents the "Directions for project development" section of the pedagogical education portal.

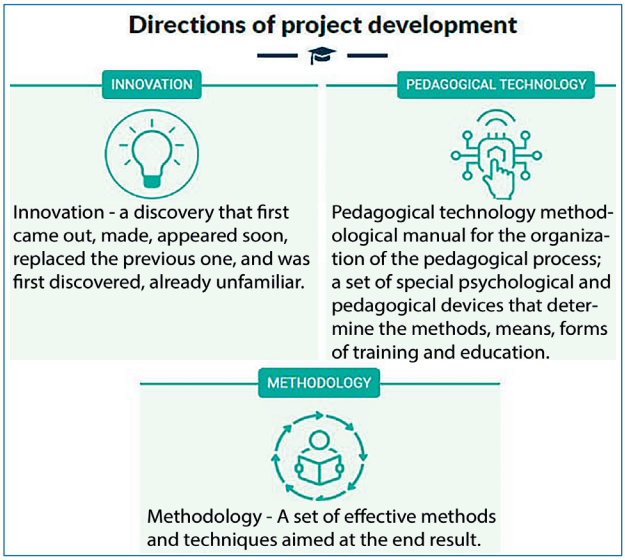

Figure 6. *"Directions for project development" section of the pedagogical education portal*
Source: *screenshot from the Digital Educational Environment website (n.d.)*

The "Methodology" section of the pedagogical education portal presents the regulations for the Digital Learning Technologies online course, specifically organised within the framework of the new Project, along with resources for each scheduled topic. This includes theoretical material and topic outlines. Test questions were incorporated to evaluate and verify the new knowledge regarding digital technologies and digital platforms acquired by future educators who participated in the online course. Based on the findings of the conducted research, the portal familiarises future educators with the nuances of digital platforms and equips them with digital technologies. It cultivates a systematic approach among prospective educators towards their professional activities and professionally significant personal qualities. It prepares future educators for undertaking creative scientific research and engaging in self-innovation in their study of digital technologies. Furthermore, it enables future educators to effectively utilise digital technologies within the educational process,

encourages an action-oriented approach to teaching and learning, contributes to enhancing students' cognitive activity, supports the use of interactive teaching methods, and ultimately fosters the development of future educators' digital competencies.

The pedagogical education portal familiarises future educators with the intricacies of the pedagogical process within a digital environment, fostering a systematic approach to their professional activities and cultivating professionally significant personal qualities. Prospective educators become acquainted with various digital platforms and their nuances and study digital technologies. The following distinctive features of the proposed pedagogical education portal are noteworthy:

1) based on the development of mutually complementary relationships, the intellectual resources of the Kazakhstan and Kyrgyzstan universities will be concentrated within a single channel. Prominent scholars and methodologists from the Kazakhstan universities will collaborate on the preparation of high-quality digital educational content for subjects, thereby opening avenues for the shared use of this expertly prepared digital teaching content;

2) significant opportunities will emerge for the study, research, utilisation, and promotion of innovative pedagogical practices from both Kazakhstan and Kyrgyzstan universities. For instance, as part of joint university research, a collaborative textbook titled "Digital Educator" was published by distinguished academics from M. Dulaty Taraz University and Zhetysu University named after I. Zhansugurov.

Crucially, innovative cooperative relationships have been established between the Kazakhstan and Kyrgyzstan higher education institutions, leading to an enhancement in the quality of education. This collaboration has facilitated free access to foundational knowledge and banked information, client-server, multimedia, and computer learning systems, digital learning resources, and digital content for academic subjects. Furthermore, unrestricted access to teaching and learning materials, electronic textbooks, and computer programmes has been ensured.

In the 21st century, digital competence is defined by the ability to seek information within the information space, establish social partnerships, critically evaluate professionally relevant information, and cultivate a personal trajectory of continuous professional development within an open information environment. The results of the content and discourse analysis presented in this study facilitate the classification of the collaboration between M. Dulaty Taraz University, Zhetysu University named after I. Zhansugurov, Arkalyk Pedagogical Institute named after I. Altynsarin, and Kokshetau University named after Sh. Ualikhanov as a form of social cooperation. It was ascertained that this mode of mutual network interaction possesses several characteristics that distinguish it from the broader concepts of collaboration, cooperation, and collectivity. Analysis of the scientific and pedagogical literature revealed a connection between the typology of socio-pedagogical interaction and the selection of subject-subject interaction acts as a basis for classification. An open digital educational environment empowers future educators to compete, collaborate, engage in mutual learning, conduct objective evaluations, provide information and communication services within the digital space, and effectively utilise digital tools, technologies, platforms, and so forth during the learning process. It enhances creative capacities, fosters collaborative communication skills for teamwork, and facilitates the development of digitalcreative competencies.

Online course Digital Learning Technologies

Digital competence is characterised by a sufficiently high level of proficiency in modern information and communication tools among future educators, coupled with the development of constructive thinking and a critical disposition. Contemporary educators extensively engage in seeking, selecting, sorting, and processing information within a collaborative digital environment, enhancing their knowledge and professional qualifications, developing themselves, and consequently advancing their professional standing. An online course titled Digital Learning Technologies was conducted for future educators as part of this research. The aim of the online course was to elevate the digital competence of prospective educators enrolled in pedagogical education programmes, introduce them to digital learning technologies and platforms, and thereby improve the quality of educator training.

To assess the level of digital competence in future educators who participated in the online course, specifically concerning the digital technologies and platforms they were familiar with prior to the course and those they studied during the course, an online survey was administered on the themes What I Know and What I Have Learned, focusing on digital learning technologies (Online survey, n.d.). The results of the experimental research are presented in Table 1.

Table 1. *Indicators of future educators' mastery of digital learning technologies*

No.	Future educators' level of mastery of DLT	Dulaty University (DU), 26 students		Zhetysu University (ZU), 25 students		Kokshetau University (KU), 26 students		Balasagyn University (BU), Kyrgyzstan, 25 students	
		Before course	After course	Before course	After course	Before course	After course	Before course	After course
1	Low	6 (23.1%)	2 (7.7%)	7 (28%)	3 (12%)	8 (30.8%)	5 (19.2%)	10 (40%)	6 (24%)
2	Medium	19 (73.1%)	16 (61.5%)	16 (64%)	15 (60%)	17 (65.4%)	15 (57.7 %)	14 (56%)	15 (60%)

Table 1. *Continued*

No.	Future educators' level of mastery of DLT	Dulaty University (DU), 26 students		Zhetysu University (ZU), 25 students		Kokshetau University (KU), 26 students		Balasagyn University (BU), Kyrgyzstan, 25 students	
		Before course	After course	Before course	After course	Before course	After course	Before course	After course
3	High	1 (3.8%)	8 (30.8%)	2 (8%)	7 (28%)	1 (3.8%)	6 (23.1%)	1 (4%)	4 (16%)

Source: *developed by the authors*

Based on the research conducted, the 102 future educators who participated in the Digital Learning Technologies online course demonstrated a significantly increased desire to master digital learning technologies after completing the course. For instance, among the 26 prospective educators from M. Dulaty Taraz University, the high level of mastery of digital learning technologies before the course was 3.8%. Following the course, the high level of mastery among these future educators rose by 27.9%, reaching 30.8%, representing an eightfold increase. For the 25 future educators from Zhetysu University named after I. Zhansugurov, the high level of mastery of digital learning technologies before the course stood at 8%. After the course, the high level of mastery among these prospective educators increased to 28%, a rise of 20 percentage points or a 3.5-fold increase. The high level of mastery of digital learning technologies among the 26 future educators from Kokshetau University named after Sh. Ualikhanov increased sixfold. Among the 25 future educators from Kyrgyz National University named after J. Balasagyn, the high level of mastery of digital learning technologies before the course was 4%. Following the course, the high level of mastery among these prospective educators reached 16%, an increase of 12 percentage points or a fourfold increase (Fig. 7).

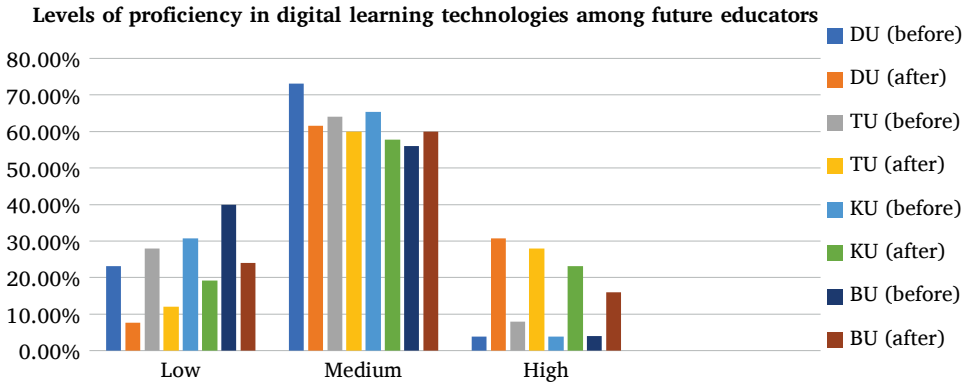

Figure 7. *Levels of future educators' mastery of digital learning technologies*
Source: *developed by the authors based on data from R. Kalimzhanova et al. (2024)*

Following the specifically conducted online course with future educators, there was a notable increase in their desire to master digital learning technologies. During practical sessions, prospective educators introduced students to the learning technologies with which they were familiar and participated in the in-depth exploration of new digital learning technologies by their peers. Each future educator can enhance their knowledge and elevate their digital competence by accessing the video content and didactic resources uploaded to the portal at any time. The online course made a significant contribution to fostering the cognitive activity and the information, creative, and digital competencies of future educators. One hundred out of the 102 respondents indicated the benefit of the Digital Learning Technologies online course for the development of future educators' digital competencies, while 94 survey participants reported that as a result of engaging with the online course programme, their digital competencies had expanded and improved. An international online competition titled The Most Effective Digital Educational Platform was also organised for future educators (Dulaty University, 2024). This international online competition aimed to foster the digital competence of students enrolled in pedagogical education programmes, stimulate the creative activity of future educators, enhance the quality of educational activity and improve the scientific and methodological support for the educational process, increase the digital competence and creative potential of future educators, and facilitate the learning, research, dissemination, promotion, and collection of innovative practices from creative educators within the sphere of digital collaboration. Future educators who participated in the online competition were able to discover the advantages of platforms such as Educaplay, ROQED, Genially, Flippity, Learningapps.org, Classroom Screen, Classroom, Wordwall, Canva, Learningapps, and others. Table 2 presents indicators of digital platform mastery among future educators from the four universities in Kazakhstan that participated in the international online competition The Most Effective Digital Educational Platform.

Table 2. *Indicators of future educators' mastery of digital platforms*

No.	Name of digital platform	Dulaty University, 26 students	Zhetysu University, 25 students	Kokshetau University, 26 students	Balasagyn University, Kyrgyzstan, 25 students
1	Wordwall	6 (23.1%)	7 (28%)	3 (11.5%)	5 (20%)
2	Educaplay	2 (7.7%)	3 (12%)	1(3.8%)	2 (8%)
3	Classroom Screen	1 (3.8%)	2 (8%)	–	1 (4%)
4	Learningapps.org	2 (7.7%)	3 (12%)	2 (7.7%)	2 (8%)
5	ROQED	1 (3.8%)	–	–	–
6	Genially	2 (7.7%)	2 (8%)	1 (3.8%)	1 (4%)
7	Interacty	1 (3.8%)	–	–	1 (4%)
8	Artificial Intelligence	1 (3.8%)	2 (8%)	1 (3.8%)	1 (4%)
9	Spinthewhell	1 (3.8%)	–	2 (7.7%)	–
10	Magigschool	1 (3.8%)	–	2 (7.7%)	–
11	Classroom	2 (7.7%)	2 (8%)	2 (7.7%)	3 (12%)
12	Zoom	1 (3.8%)	2 (8%)	3 (11.5%)	1 (4%)
13	Classroomscreen	2 (7.7%)	–	–	2 (8%)
14	Flippity	2 (7.7%)	2 (8%)	2 (7.7%)	2 (8%)
15	Clideo	2 (7.7%)	–	–	–
16	PowerPoint	1 (3.8%)	–	7 (26.92%)	4 (16%)

Source: *developed by the authors based on data from R. Kalimzhanova et al. (2024)*

As revealed during the experiment, the future educators who participated in the international online competition demonstrated proficiency with the Wordwall platform. For example, 28% of the future educators from Zhetysu University who took part in the competition, 11.5% of those from Kokshetau University, and 23.1% of participants from Dulaty University indicated competence in using the Wordwall platform. Overall, prospective educators exhibited limited familiarity with platforms such as ROQED, Clideo, Classroomscreen, Spin the Wheel, and Magicschool. The best submissions from the future educators who participated in the competition were uploaded to the "Pedagogical Technologies" blog on the Digital Educational Environment pedagogical portal (n.d.), which was specifically established for conducting scientific research. Consequently, future educators gained the opportunity to enhance their knowledge and develop their digital competence by viewing the video content available on the portal.

CONCLUSIONS

The modern educator must be adept at utilising network interaction to facilitate collaborative learning. This necessitates possessing competencies in interacting with students, parents, and colleagues and engaging with them as equal participants in the educational process. As professionals, modern educators must continually strive for professional growth and actively participate in online communities. The research revealed that the contemporary collaborative form of pedagogical interaction is characterised by the network-based nature of interaction and communication among the stakeholders in the educational process. The findings presented in this study allow for the consideration of the collaboration between the Kazakhstan universities – M. Dulaty Taraz University, Kokshetau University named after Sh. Ualikhanov, Zhetysu University named after I. Zhansugurov, and Kyrgyz National University named after J. Balasagyn, as a form of social cooperation.

Analysis of the scientific and pedagogical literature facilitated the identification of a connection between the typology of socio-pedagogical interaction when selecting the nature of subject-subject interaction acts as the basis for classification. Based on a comparative analysis, "collaboration" in digital education (collaborative learning) is recommended to be understood as a distinct type of pedagogical interaction. The results obtained from the specifically organised international online competition The Most Effective Digital Educational Platform and the online course Digital Learning Technologies with future educators indicate the considerable specificity of the new open pedagogical educational portal as a form of educational cooperation among educators, positioning it as a distinct subcategory of pedagogical education. As part of the modernisation of the higher education system, indicators and criteria for assessing the levels of digital competence formation in future educators were defined based on the mutual cooperation between Kazakhstan and Kyrgyzstan universities.

A digital collaborative educational environment facilitates the automation of education quality management processes and the development of learners' digital learning skills within the digital environment. One avenue for enhancing the effectiveness of the educator training system lies in consolidating and integrating the informatisation tools and technologies of pedagogical universities into a unified digital educational environment, given that these are often fragmented at present. Future research should further investigate the domain of School-University collaboration.

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CONFLICT OF INTEREST

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Коллаборативдүү санариптик чөйрөдө болочок педагогдордун санариптик компетенцияларын калыптандыруунун жолдору

Клара Бузаубакова
Педагогика илимдеринин доктору, профессор
М.Х. Дулати атындагы Тараз университети
080012, Сулейменов көч., 7, Тараз ш., Казакстан Республикасы
https://orcid.org/0000-0002-9124-9893

Рахат Сулайманова
Педагогика илимдеринин доктору, профессор
Ж. Баласагын атындагы Кыргыз улуттук университети
720033, Фрунзе көч., 547, Бишкек ш., Кыргыз Республикасы
https://orcid.org/0009-0008-8433-939X

Аннотация. Маалыматтык доор өз практикасында санариптик технологияларды системалуу пайдалануу жөндөмдүү, билим берүү процессин рационалдуу башкара билген, билим берүү процессин өркүндөтүү максатында дайыма илимий изилдөөлөрдү жүргүзгөн, өнүккөн санариптик жана чыгармачылык компетенцияларга ээ глобалдуу атаандаштыкка жөндөмдүү педагогдорду талап кылат. Ошондуктан келечектеги заманбап мугалимдерди санариптик технологиялар менен жабдуу маанилүү. Макаланын максаты кызматташуу чөйрөсүндө болочок педагогдордун санариптик компетенцияларын калыптандыруунун натыйжалуу жолдорун аныктоо болгон. Изилдөөдө изилдөөнүн теориялык жана эмпирикалык методдору пайдаланылды: абстрагирлөө, моделдөө, синтездөө, тестирлөө, педагогикалык эксперимент ж.б. Иште «санариптик сабаттуулук», «санариптик компетенттүүлүк», «болочок педагогдордун санариптик компетенттүүлүгү», «кызматташуу», «коллаборативдүү санариптик чөйрө» түшүнүктөрү изилденген. Келечектеги мугалимдердин санариптик компетенттүүлүгүн калыптандыруунун; санариптик көндүмдөрдүн структурасы жана келечектеги мугалимдердин санариптик компетенттүүлүгү европалык мугалимдердин санариптик компетенттүүлүгүнүн алкагында; 4К катары «кызматташуу» түшүнүгүнүн маңызы: кооперация-координация-коммуникация-креативдүүлүк; КМТУнун сунушталган педагогикалык билим берүү порталынын түзүмү жана өзгөчөлүктөрү сыяктуу артыкчылыктары ачылды. Биргелешкен санариптик чөйрөдө болочок педагогдордун санариптик компетенттүүлүгүн калыптандыруу боюнча илимий-педагогикалык адабияттар талданды. «Окутуунун санариптик технологиялары» онлайн-курсу өткөрүлдү жана болочок мугалимдер үчүн «эң натыйжалуу санариптик билим берүү платформасы» эл аралык онлайн-конкурсу уюштурулду. Изилдөөнүн жыйынтыгы боюнча социалдык кызматташтыктын бир түрү катары кызматташууну классификациялоо боюнча контент жана дискурс-анализ жасалды. Казакстандын М.Х. Дулати атындагы Тараз университетинин Ш. Уалиханов Кокшетау университети, Жансугуров атындагы Жетисуу университети, Ж. Баласагын атындагы Кыргыз улуттук университети менен тармактык өз ара аракеттешүүнүн формасы катары кызматташтыгы орнотулду. Изилдөөнүн практикалык мааниси казакстандык жана кыргызстандык ЖОЖдордун интеллектуалдык ресурстары бир каналда топтолуп, ЖОЖдордун белгилүү окумуштуулары жана методисттери педагогикалык дисциплиналар боюнча сапаттуу санариптик билим берүү контентин биргелешип даярдоо үчүн күч-аракеттерин бириктиришет

Негизги сөздөр: кызматташуу; консорциум; билим берүү сайты; кесиптик компетенттүүлүк; санариптик ресурс; онлайн курс

Пути формирования цифровых компетенций будущих педагогов в коллаборативной цифровой среде

Клара Бузаубакова
Доктор педагогических наук, профессор
Таразский университет имени М.Х. Дулати
080012, ул. Сулейменова, 7, г. Тараз, Республика Казахстан
https://orcid.org/0000-0002-9124-9893

Рахат Сулайманова
Доктор педагогических наук, профессор
Кыргызский Национальный университет имени Ж. Баласагына
720033, ул. Фрунзе, 547, г. Бишкек, Кыргызская Республика
https://orcid.org/0009-0008-8433-939X

Аннотация. Информационный век требует глобально конкурентоспособных педагогов, способных системно использовать цифровые технологии в своей практике, умеющих рационально управлять образовательным процессом, постоянно проводящих научные исследования с целью совершенствования образовательного процесса, обладающих развитыми цифровыми и творческими компетенциями. Именно поэтому важно оснащать современных будущих педагогов цифровыми технологиями. Цель статьи состояла в определении эффективных путей формирования цифровых компетенций будущих педагогов в коллаборативной среде. В исследованиях использованы теоретические и эмпирические методы исследования: абстрагирование, моделирование, синтезирование, тестирование, педагогический эксперимент и др. Были исследованы понятия: «цифровая грамотность», «цифровая компетентность», «цифровая компетентность будущих педагогов», «коллаборация», «коллаборативная цифровая среда». Были раскрыты преимущества формирования цифровой компетентности будущих педагогов; структура цифровых навыков и цифровой компетентности будущих педагогов в рамках Европейской системы цифровых компетенций педагогов; сущности понятия «коллаборация» как 4К: кооперация-координация-коммуникация-креативность; структура и особенности предлагаемого педагогического образовательного портала Digital Educational Environment. Проанализирована научно-педагогическая литература по формированию цифровой компетентности будущих педагогов в коллаборативной цифровой среде. Проведен онлайн-курс «Цифровые технологии обучения» и организован международный онлайн-конкурс «Самая эффективная цифровая образовательная платформа» для будущих педагогов. По результатам исследования сделан контент и дискурс-анализ по классификации коллабораций как вида социального сотрудничества. Установлена коллаборация казахстанских вузов – Таразского университета им. М. Дулати, Кокшетауского университета им. Ш. Уалиханова, Жетысуского университета имени И. Жансугурова с кыргызским вузом – Кыргызским национальным университетам имени Ж. Баласагына как форма сетевого взаимодействия. Практическая значимость исследования заключается в том, что интеллектуальные ресурсы казахстанских и кыргызских вузов будут сконцентрированы в одном канале, а известные ученые и методисты вузов объединят усилия для совместной подготовки качественного цифрового образовательного контента по педагогическим дисциплинам

Ключевые слова: коллаборация; консорциум; образовательный сайт; профессиональная компетентность; цифровой ресурс; онлайн-курс

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The influence of life resilience on students' successful adaptation to the conditions of higher education institutions

Altynbek Kachkyn uulu*
PhD in Pedagogical Sciences, Associate Professor
Jusup Balasagyn Kyrgyz National University
720033, 547 Frunze Str., Bishkek, Kyrgyz Republic
https://orcid.org/0009-0000-8666-1544

Nuriza Zhorobai kyzy
Master's Student
Jusup Balasagyn Kyrgyz National University
720033, 547 Frunze Str., Bishkek, Kyrgyz Republic
https://orcid.org/0009-0007-0023-7963

Abstract. The relevance of the problem lies in the fact that students' life resilience plays a key role in their successful adaptation to the academic conditions of higher education institutions. This, in turn, directly affects their academic performance, social integration, and emotional well-being. The aim of the study was to examine the impact of life resilience on students' successful adjustment to university conditions and to identify the key components that contributed to overcoming stressful situations and promoting social integration in the educational process. The research analysed the role of life resilience in the process of students' adaptation to the conditions of higher education. To achieve this goal, tests on life resilience based on the methodology of Salvatore Maddi were applied, alongside observation and surveys. The findings indicated that life resilience positively influenced students' adaptation. It was associated with their academic success, integration into the social environment, and psychological well-being. Furthermore, a high level of resilience was found to enhance students' ability to cope with stress and challenges encountered during the educational process. The practical significance of the study lies in its potential application for the development of psychological support programmes in higher education institutions aimed at enhancing students' resilience and successful adaptation to university life. The obtained data could serve as a basis for the introduction of training sessions, consultations, and preventive activities focused on strengthening stress tolerance, self-regulation, motivation, and self-confidence within the educational process

Keywords: resilience; psychology; student life; education; social integration

INTRODUCTION

Contemporary reality is characterised by rapid changes, a high degree of uncertainty, an intensive flow of information, and an increased emotional burden. In such conditions, students represent a particularly vulnerable category, as they are at an active stage of personal and professional formation. Constant exposure to stress, the need to adapt to new educational demands, changes in the social environment, and separation from family and relatives all contribute to the emergence of crisis situations (Rudenko, 2025). These crises often disrupt students' habitual lives, causing self-doubt, anxiety, and a reassessment of personal values and goals. In this context, resilience plays a particularly important role as a personality trait that helps individuals overcome adversity, maintain internal balance, and transform life difficulties into opportunities for growth.

Resilience is recognised as a crucial psychological resource that enables students to maintain a positive perception of reality in times of stress, uncertainty, and continuous change (Omelchenko, 2019; Makhrina & Timofeeva, 2022). Thanks to this trait, students are able to cope

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*Corresponding author

effectively with the challenges of adapting to higher education, integrate successfully into academic environments, and achieve significant personal and professional goals. Furthermore, resilience supports stable psychological functioning, reduces the risk of fatigue and depression, and sustains high levels of academic motivation. The constantly changing rhythm of modern life places increasing demands on individuals. Students are expected not only to master academic curricula but also to make responsible decisions, adapt quickly to changing conditions, and engage effectively within multicultural and multi-component social environments (Kuzikova & Shcherbak, 2022). For this, academic preparedness alone is insufficient; developed personal resources are also essential. Stress tolerance, cognitive flexibility, emotional stability, and self-regulation are key characteristics – all of which are integral to the construct of resilience (Tserfus, 2021).

From a scientific perspective, the term *resilience* (*hardiness*) was introduced into psychology by S. Maddi & S. Kobasa (1984) in the context of existential and stress psychology. According to their model, resilience comprises three main components: commitment, control, and challenge. These components, when combined, enable individuals to exert an active influence on their lives, perceive change not as a threat but as an opportunity for development, and remain stable under uncertain conditions.

Contemporary researchers have continued to explore the influence of resilience on students' adaptation to higher education. For example, Y. Park *et al.* (2024) demonstrated that a high level of resilience facilitated effective coping with academic and social difficulties during the COVID-19 pandemic. Students with higher resilience adapted more successfully to remote learning, maintained stronger motivation, and adjusted more easily to new participation formats. The studies of D. Chen *et al.* (2024) highlighted the importance of developing resilience and flexibility under uncertain conditions. According to the authors, this quality enables students to maintain an active life stance and adapt even within unstable educational environments. U. Ononye *et al.* (2022) confirmed that resilience is positively associated with students' overall psychological well-being and may serve as an important predictor of academic success. Their study emphasised that stress tolerance, cognitive ability, and an active approach to life support more effective management of academic challenges. N. Erdemir *et al.* (2024) examined pedagogical strategies aimed at fostering resilience in students. The authors noted that the inclusion of psycho-emotional support, self-regulation training, and resilience development activities in the educational process helped increase academic engagement and reduce anxiety levels.

Thus, the analysis of current research confirms that resilience has a multifaceted positive effect on students' adaptation. It supports not only academic performance but also psychological well-being, self-organisation, social integration, and sustainable development within higher education. The primary objective of this study was to examine the influence of resilience on students' adaptation to the conditions of higher education institutions. Particular attention was given to identifying the key components of resilience that determine the success of the adaptation process, as well as to formulating recommendations for enhancing students' resilience within the educational context.

MATERIALS AND METHODS

The study was carried out with the aim of identifying the influence of life resilience on students' successful adaptation to the conditions of higher education institutions. Quantitative methods of data collection and analysis were selected as the methodological foundation, as they allowed for the objective assessment of participants' psychological characteristics. The primary research methods employed included questionnaire-based surveys, standardised testing, and comparative analysis. The research was conducted at two higher education institutions in Bishkek: Kyrgyz National University named after J. Balasagyn and Bishkek State University named after K. Karasaev. A total of 78 students aged between 17 and 21 years participated in the study. Among them, 16 were male and 62 were female. To assess the level of resilience, the method developed by S. Maddi (1998), adapted by D. Leontiev (2001), was used. This tool encompassed three main components: commitment, control, and acceptance of challenges. Participants were asked to respond to a series of statements describing their typical behaviour and reactions in stressful situations. Based on their responses, scores were calculated for each individual component, as well as for overall life resilience. In addition, an adaptation test widely used in psycho-pedagogical research was applied to evaluate students' level of adaptation to the university environment. This instrument enabled the assessment of social, academic, and psychological adaptation indicators. The survey was conducted in February 2025 among full-time students at the above-mentioned universities. All responses were collected anonymously. Data processing was carried out using methods of mathematical statistics. The survey was conducted anonymously, in compliance with the principles of the American Sociological Association's Code of Ethics (2018).

RESULTS AND DISCUSSION

Table 1 presented the mean values for each component of life resilience, which allowed for a comparative analysis between groups of students from different higher education institutions.

The table presents comparative data for students from two universities – Kyrgyz National University named after J. Balasagyn and Bishkek State University named after K. Karasaev – across a range of psychological and behavioural characteristics. For each characteristic, average numerical values were provided. The overall resilience score (82.11 for KNU students and 82.30 for BSU students) reflected the ability to cope with difficulties and maintain internal stability in the face of adversity. The minimal difference between the scores suggests that students from both

institutions demonstrate similar levels of resilience. The commitment component (33.60 and 34.20, respectively) indicated students' engagement, dedication, and sustained interest in academic or other life activities. The close values point to comparable levels of involvement among both student groups.

Components	J. Balasagyn KNU students	K. Karasaev BSU students
Overall resilience	82.11	82.30
Commitment	33.60	34.20
Control	32.20	31.10
Acceptance of challenges	17.20	16.40

Source: *compiled by the authors*

The control component (32.20 for KNU and 31.10 for BSU) measured the capacity for emotional and behavioural self-regulation and the ability to remain composed in stressful circumstances. The results were again similar, implying that students from both universities possessed comparable self-regulatory skills. The acceptance of challenges indicator (17.20 and 16.40) assessed students' willingness to take risks and make decisions in uncertain conditions. A slight difference was noted, with KNU students showing a marginally higher readiness to embrace risk compared to their BSU counterparts. Overall, across all measured characteristics, students from the two institutions demonstrated broadly similar results. It may therefore be assumed that the differences between the groups had minimal impact on their levels of resilience, commitment, control, and risk acceptance.

Key aspects of the impact of resilience on students' adaptation:

- Psychological resilience: Students with high levels of resilience are better able to cope with academic workloads and study-related stress. They demonstrate cognitive flexibility and adapt more easily to new demands and educational environments. S. Kobasa (1979) and colleagues emphasised that resilience includes three core components: control, commitment, and challenge. These components help individuals to successfully manage stressful situations.
- Coping with stress: A high level of resilience enables students to manage stress arising from new academic demands, study loads, and social adaptation at university more effectively (Nezvankina, 2017).
- Social adaptation: Resilient students adjust more successfully to new social environments and establish positive relationships with peers and lecturers. Studies show that such students are more actively involved in social and extracurricular activities, which facilitates their integration into the university community.
- Academic achievement: Resilience is closely linked to academic success. Students demonstrating higher resilience levels typically achieve better academic results as they are more capable of overcoming academic challenges and maintain motivation towards learning.
- Self-regulation: Resilience contributes to the development of self-regulation skills, helping students to remain motivated and committed even when faced with difficulties and setbacks.
- Emotional well-being: Resilient students possess emotional self-regulation skills, allowing them to maintain emotional balance despite the stress and uncertainty associated with the transition to higher education (Zyatkova *et al.*, 2021).

Thus, resilience plays a crucial role in students' successful adaptation to the conditions of higher education by influencing their academic performance, social integration, and emotional well-being. As a psychological trait, resilience reflects an individual's capacity to endure hardship, adapt to change, and maintain a constructive outlook despite stress and failure. In the context of students' adjustment to university life, resilience is a key factor in enabling successful integration into the new environment.

Previous studies demonstrated that resilience functions as a buffer against negative stress (distress), thereby increasing the probability of successful adaptation to the conditions of higher education (Ermakova, 2021; Fullerton *et al.*, 2021). The findings highlighted the relevance of developing resilience through structured programmes and targeted training focused on enhancing stress tolerance, self-regulation, and self-efficacy. Within the framework of the conducted study, the process of adaptation exerted a direct influence on academic engagement, as effective integration into a new educational environment facilitated the overcoming of academic and social challenges. Adaptation was found to encompass several interrelated aspects (Table 2):

Table 2. *Types of student adaptation*

Type of Adaptation	Definition	Manifestations in Educational Context
Social adaptation	Interaction with peers, teachers, and participation in student community life	Reduction of stress intensity; motivation increases; development of communication and group integration skills
Psychological adaptation	Adjustment of internal mental states, stress tolerance, and self-regulation	Reduced anxiety levels; fewer learning barriers; enhanced emotional stability and adaptability

Table 1. *Continued*

Type of Adaptation	Definition	Manifestations in Educational Context
Academic adaptation	Mastery of learning methods, self-organisation, and engagement with academic tasks	Improved academic performance; better engagement with educational programmes
Physical adaptation	Adaptation to new living conditions (climate, housing, city environment)	Physical well-being improves; regime stabilisation; better concentration and endurance

Source: *compiled by the authors*

The table illustrated how successful adaptation influences various aspects of students' lives and contributes to enhanced academic functioning. The findings of the present study underscored the critical role of resilience in supporting effective adjustment to the demands of higher education. The data indicate that resilience – comprising components such as involvement, control, and risk-taking – significantly improves students' capacity to navigate academic challenges, integrate into social environments, and sustain psychological well-being. These outcomes are consistent with previous research highlighting resilience as a key factor in mitigating stress and fostering adaptive behaviour within educational contexts (Bogomaz, 2009; Akhmadieva, 2020; Alikin *et al.*, 2020). The practical implications of these findings emphasised the necessity of targeted interventions aimed at strengthening resilience, particularly through structured psychological support initiatives embedded within university curricula (Kadilnikova, 2011; Teplyakova, 2016). The comparative analysis conducted between the two participating universities revealed only minimal differences in overall resilience levels, suggesting that this psychological characteristic demonstrates relative consistency across distinct institutional settings. This observed universality reinforces the feasibility of standardised resilience-enhancement programmes adaptable to a variety of higher education environments (Yaroshchuk, 2020).

In light of the obtained results, it is recommended that higher education institutions adopt structured psychological support systems designed to foster resilience. Such systems may involve workshops on stress management, self-regulation, and goal-setting, with the objective of strengthening the key components of resilience: involvement, control, and risk-taking. Furthermore, the integration of resilience-focused content into orientation programmes for first-year students may facilitate smoother transitions into academic and social aspects of university life. Collaboration with mental health professionals to provide ongoing counselling and peer-support networks is also advised to promote psychological stability and adaptive competence. Faculty training initiatives aimed at recognising indicators of low resilience and delivering appropriate academic mentoring could further contribute to the development of a supportive educational environment. Collectively, these recommendations, grounded in empirical evidence, possess the potential to enhance students' academic achievement, social engagement, and emotional resilience, thereby contributing to their sustained success within higher education.

CONCLUSIONS

In the context of modern higher education, resilience is recognised as a key factor in students' successful adaptation to academic workloads, educational processes, and the university environment. The findings of the study confirmed that a high level of resilience supports effective coping with stress, maintenance of psychological balance, development of self-regulation, and reinforcement of intrinsic motivation. The core components of resilience – control, involvement, and acceptance of risk – enable students to respond adaptively to both external changes and internal challenges. The comparative analysis of students from Kyrgyz National University named after J. Balasagyn and Bishkek State University named after K. Karasaev revealed that, despite cultural differences, the levels of resilience were nearly identical, thus confirming the universality of this psychological trait. Furthermore, high resilience was found to positively influence academic achievement, social integration, and emotional well-being. Adaptation to higher education encompasses social, psychological, academic, and physical processes, all of which have a direct impact on students' performance by reducing anxiety and enhancing concentration and motivation. Thus, resilience constitutes a critical psychological resource that should be prioritised within the higher education system. Programmes aimed at fostering self-management, stress tolerance, and self-efficacy can significantly contribute to students' capacity to adapt effectively and achieve meaningful success both academically and personally.

The current study provided a robust foundation for understanding the role of resilience in students' adaptation to higher education, yet several avenues for future research remain. Future research could explore the specific mechanisms through which resilience influences different facets of adaptation, providing a deeper understanding of how to optimize student support systems. Investigating the longitudinal effects of resilience on academic and social outcomes could elucidate how this trait evolves over time and its sustained impact on student success. Additionally, exploring the efficacy of specific resilience-building interventions, such as mindfulness training or peer-support

programs, could offer practical insights for educational institutions. Cross-cultural studies comparing resilience across diverse student populations may further clarify the universal and context-specific aspects of this trait. Finally, integrating qualitative methods to capture students' subjective experiences of resilience could enrich the understanding of its role in adaptation, paving the way for more tailored support strategies in higher education.

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Студенттердин жогорку окуу жайдын шарттарына ийгиликтүү ыңгайлашуусуна жашоо туруктуулуктун тийгизген таасири

Алтынбек Качкын уулу
Педагогика илимдеринин кандидаты, доцент
Ж. Баласагын атындагы Кыргыз улуттук университети
720033, Фрунзе көч., 547, Бишкек ш., Кыргыз Республикасы
https://orcid.org/0009-0000-8666-1544

Нуриза Жоробай кызы
Магистрант
Ж. Баласагын атындагы Кыргыз улуттук университети
720033, Фрунзе көч., 547, Бишкек ш., Кыргыз Республикасы
https://orcid.org/0009-0007-0023-7963

Аннотация. Проблеманын актуалдуулугу – студенттердин жашоого туруштук берүүсү алардын жогорку окуу жайларындагы окуу шарттарына ийгиликтүү көнүгүүсүндө негизги ролду ойнойт. Бул өз кезегинде алардын окуудагы жетишкендигине, социалдык интеграциясына жана эмоционалдык жыргалчылыгына түздөн-түз таасир этет. Максаты – жашоого туруштук берүүнүн студенттердин жогорку окуу жайларындагы окуу шарттарына ийгиликтүү көнүгүүсүнө тийгизген таасирин изилдөө жана стресстик кырдаалдарды жеңүүгө жана билим берүү процессинде социалдык интеграцияга көмөктөш болгон негизги компоненттерди аныктоо. Изилдөөнүн жүрүшүндө жашоого туруштук берүүнүн ролу студенттердин жогорку окуу жайдагы шарттарга көнүгүү процессинде талданды. Максатка жетүү үчүн Сальвадор Маддинин методикасы боюнча жашоого туруштук берүү тесттери, байкоо жана сурамжылоолор колдонулду. Изилдөөнүн жыйынтыгында жашоого туруштук берүү студенттердин көнүгүүсүнө оң таасирин тийгизери аныкталды. Бул – алардын окуудагы ийгилиги, социалдык чөйрөгө кошулуусу жана психологиялык жыргалчылыгы менен байланыштуу. Ошондой эле, жашоого жогору деңгээлде туруштук берүү студенттердин стресске жана окуу процесстеги кыйынчылыктарга каршы туруу жөндөмүн жогорулатары белгилүү болду. Изилдөөнүн практикалык мааниси – анын жыйынтыктарын жогорку окуу жайларында студенттердин жашоого туруштук берүүсүн жана окуу шарттарына ийгиликтүү көнүгүүсүн жогорулатууга багытталган психологиялык колдоо программаларын иштеп чыгууда колдонууга болот. Алынган маалыматтар билим берүү процессине стресс чыдамкайлыгын, өзүн-өзү жөнгө салууну, мотивацияны жана өзүнө болгон ишенимди өнүктүрүүгө багытталган тренингдерди, консультацияларды жана алдын алуу иш-чараларын киргизүүгө негиз боло алат

Негизги сөздөр: туруктуулук; психология; студенттик жашоо; билим берүү; социалдык интеграция

Влияние жизнестойкости на успешную адаптацию студентов к условиям учебы в высших учебных заведениях

Алтынбек Качкын уулу
Кандидат педагогических наук, доцент
Кыргызский национальный университет имени Ж. Баласагына
720033, ул. Фрунзе, 547, г. Бишкек, Кыргызская Республика
https://orcid.org/0009-0000-8666-1544

Нуриза Жоробай кызы
Магистрант
Кыргызский национальный университет имени Ж. Баласагына
720033, ул. Фрунзе, 547, г. Бишкек, Кыргызская Республика
https://orcid.org/0009-0007-0023-7963

Аннотация. Актуальность проблемы заключается в том, что жизнестойкость студентов играет ключевую роль в их успешной адаптации к условиям учебы в высших учебных заведениях, что напрямую влияет на их успеваемость, социальную интеграцию, психологическую устойчивость и общее эмоциональное благополучие. Цель статьи состояла в том, чтобы исследовать влияние жизнестойкости на успешную адаптацию студентов к условиям учебы в высших учебных заведениях, а также определить ключевые компоненты, способствующие эффективному преодолению стрессовых ситуаций и социальной интеграции в образовательном процессе. В статье были использованы методы тестирования жизнестойкости (по методике S. Maddi), наблюдения и опроса для комплексного анализа факторов, влияющих на адаптацию студентов к условиям учебы в высших учебных заведениях. В ходе исследования была детально проанализирована роль жизнестойкости в процессе адаптации студентов к условиям высшего учебного заведения. Выявлено, что жизнестойкость оказывает положительное влияние на успешность адаптации студентов, включая их академическую успеваемость, социальную интеграцию и психологическое благополучие. Также исследование показало, что высокие показатели жизнестойкости связаны с улучшением способности студентов справляться со стрессовыми ситуациями и различными трудностями учебного процесса. Практическая значимость исследования заключается в возможности использования его результатов для разработки программ психологической поддержки студентов, направленных на повышение уровня их жизнестойкости и успешной адаптации к условиям вуза. Полученные данные могут служить основой для внедрения в образовательный процесс тренингов, консультаций и профилактических мероприятий, способствующих развитию стрессоустойчивости, саморегуляции, мотивации и уверенности в себе у студентов

Ключевые слова: устойчивость; психология; студенческая жизнь; образование; социальная интеграция

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Differentiated instruction as a foundation for inclusive education in primary school

Ulanbek Mambetakunov*
Doctor of Pedagogical Sciences, Professor
Jusup Balasagyn Kyrgyz National University
720033, 547 Frunze Str., Bishkek, Kyrgyz Republic
https://orcid.org/0000-0001-5456-6884

Asel Akylbekova
Master's Student
Jusup Balasagyn Kyrgyz National University
720033, 547 Frunze Str., Bishkek, Kyrgyz Republic
https://orcid.org/0009-0001-0936-3954

Abstract. The relevance of this study is driven by the growing focus on inclusive education in the Kyrgyz Republic, aimed at creating equal learning opportunities for children with disabilities and special educational needs. There has been a significant increase in the number of children requiring specialised support from both parents and educators, necessitating the adaptation of educational systems and the introduction of innovative teaching methods that address the specific needs of these children. This study aimed to analyse contemporary approaches to inclusive education and identify the most effective pedagogical strategies for educating such children within the general education system, fostering an effective and motivating learning environment. To achieve this aim, the research employed methods such as analysis of pedagogical practice, review of specialised literature, and observation of the educational process in primary schools. Various models of inclusive education were examined, legislative and organisational aspects of its implementation were analysed, and the specific features of interaction between educators, children with special educational needs, and their parents or legal guardians were studied. It was established that the successful implementation of inclusive education requires a comprehensive approach, encompassing teacher training, the availability of appropriate teaching and learning resources and equipment, as well as the creation of an atmosphere of tolerance and mutual understanding among classmates and their parents or legal guardians. The practical value of the study lies in the potential application of the findings to optimise inclusion processes within the school environment, as well as to develop recommendations for enhancing educational strategies for children with disabilities and special educational needs in primary schools

Keywords: children with disabilities; pedagogical challenges; social integration; individual educational pathways; legislative regulations; tolerance; academic achievement

INTRODUCTION

The relevance of this research is determined by the growing attention to inclusive education in the context of creating equal opportunities for educating children with special educational needs and disabilities (SEND). In recent decades, the Kyrgyz Republic, like other countries, has observed a significant increase in the number of children with special needs, which necessitates a review of existing educational approaches and the implementation of effective methods and technologies to support these children. It is important to note that successful inclusion requires a comprehensive approach, including the training of educators, appropriate infrastructure, and methodological resources (Buniak, 2022). Therefore, in the modern world, the issue of educating and raising children with special educational needs and disabilities is one of the most important topics within the education system.

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*Corresponding author

Any physical or mental impairments can significantly complicate access to educational institutions and resources for such children. They require an individualised approach to learning, yet this should not preclude their ability to interact with other children, participate in group activities, and integrate into society. As N. Toguzbaeva (2024) notes, inclusive education is recognised by the international educational system as the most humane approach, as it grants the right to education to everyone regardless of their conformity or non-conformity with the criteria of the education system (society, school, etc.). This is precisely why issues of inclusive education are becoming a pressing concern, and its implementation needs to commence as early as possible, from both pre-school age and in primary school, as it is aimed at creating equal learning opportunities for all children, including those with special educational needs.

Contemporary research dedicated to inclusive education highlights the necessity of creating inclusive educational environments that support both learners with special educational needs and their peers, thereby fostering harmonious interaction and social adaptation (Suprun *et al.*, 2024). One of the key studies in the field of inclusive education is the research by E. Kamardina (2021), where the author indicates that the quality of inclusive education depends on a comprehensive range of resources. Consequently, the training of educators for working with children with SEND should be normatively and organisationally aligned with the regional and municipal education system for children with disabilities, which ought to become the primary component of the "demand" from the pedagogical community for further professional development.

A. Dmitrieva (2020) analyses the impact of inclusive educational practices on the development of tolerance among learners. She asserts that inclusion not only contributes to improved conditions for children with SEN but also fosters the development of social responsibility among all participants in the educational process. This approach facilitates the creation of a more harmonious educational environment where every learner can demonstrate their talents and abilities, regardless of their health characteristics. The research by M. Kozlova (2021) examines the fundamental principles of inclusive education, including the use of adapted educational materials and teaching methods that accommodate the specific needs of children with SEND. The author notes that a crucial aspect is not merely the accessibility of educational materials but also the cultivation of an atmosphere of trust and mutual understanding, which promotes better assimilation of material by learners with diverse needs.

In the research of N. Gafurova & F. Abduraimova (2022), the challenges of integrating children with special needs into mainstream schools are considered, with an emphasis on the use of modern technologies. They underscore that information technologies play a key role in ensuring access to education for children with SEND, as they enable the creation of individualised educational pathways that take into account the unique requirements of each learner.

V. Karpenko (2021) concludes that inclusive education can only be effective when a comprehensive approach is adopted, one that includes not only the training of educators but also the active involvement of parents in the educational process. E. Dolgushina (2024) examines the issue of creating an educational environment adapted to the needs of children with special educational needs and disabilities (SEND); the key mechanisms for implementing inclusive education are analysed, such as individual psychological and pedagogical support, correctional programmes, and the integration of digital technologies. The professional development of educators is also considered, including the enhancement of their digital competencies, as well as the role of innovative educational tools like augmented reality and virtual environments. The author highlights the necessity of overcoming infrastructural and social barriers, which will contribute to improving the quality of education for children with SEND and their social adaptation.

This study aimed to analyse contemporary approaches to inclusive education and determine the most effective methods for creating a supportive and motivating learning environment for children with special educational needs in primary schools.

MATERIALS AND METHODS

To conduct the study, the following scientific methods were employed: analysis of pedagogical practice and scientific literature, comparative analysis, analysis of regulatory legal documents, and observation of the educational process in primary schools. These methods were selected to gain a comprehensive understanding of the state of inclusive education in primary schools and to evaluate the effectiveness of the pedagogical strategies applied to children with special educational needs and disabilities. The method of analysing pedagogical practice was applied to study existing educational programmes and approaches used in inclusive classrooms. This method allowed for an analysis of the effectiveness of various educational strategies and the identification of practical problems faced by teachers when educating children with SEND. Programmes and methodological guidelines were analysed. Observation of the educational process in inclusive classrooms was used to assess the real-world situation on the ground, analyse the interaction between learners, and observe the use of adapted educational materials and technologies. This method facilitated the identification of both positive and problematic aspects in the organisation of inclusive education. For the analysis of the theoretical basis of the research, articles by contemporary scholars and educators were used, as well as regulatory legal acts governing inclusive education in the Kyrgyz Republic, and international official documents. Thus, combining these methods allowed for an allencompassing picture of the state of inclusive education and the identification of key factors influencing its effectiveness.

RESULTS AND DISCUSSION

Characteristics and principles of inclusive education

One of the most precise and comprehensive definitions of inclusive education is offered by UNESCO (2009). Inclusive education is a process that addresses the diversity of needs of all children, youth, and adults through increased participation in education, cultures, and communities, as well as reducing and eliminating exclusion from and within education. The most important aspects of this concept include humanistic values, the development of creative abilities and intellect, and harmony among the intellectual, emotional, and physical qualities of the individual. According to L. McManis (2020), inclusive education is a system of learning in which all children, regardless of their background, are educated together in the same school and classroom, receiving support in line with their individual needs.

Creating a comfortable educational environment that motivates learning is essential in inclusive education. Establishing such an environment, which considers perceptual characteristics, the pace of material assimilation, and children's individual needs, forms the basis for the successful learning of younger schoolchildren with SEND. A key feature of inclusive education is its social innovativeness, encompassing the conditions for fostering a tolerant society where every individual, regardless of their background, feels part of the collective. From an early age, children learn and respect principles that lay the foundations of a humane and just society. The Declaration of Principles on Tolerance emphasises that "education for tolerance should aim at countering influences that lead to fear and exclusion of others, and should help young people to develop capacities for independent judgement, critical thinking and ethical reasoning" (Mambetakunov & Myrzaliev, 2024).

Another characteristic of inclusive education is psycho-pedagogical preparedness. Primary school is a crucial period during which foundational skills and attitudes are acquired, influencing a child's subsequent personal development. Learning within an inclusive environment helps children develop empathy, communication skills, and the ability to collaborate. For children with SEND, inclusive education provides opportunities for socialisation and adaptation within society. Furthermore, the importance of legislative norms must be underscored. Inclusive education is governed by international standards, such as the Convention on the Rights of Persons with Disabilities (CRPD, 2006), as well as the requirements of many countries, including the Concept for the Development of Inclusive Education in the Kyrgyz Republic for 2019-2023 (2019). The Constitution of the Kyrgyz Republic (2021) guarantees the right of every citizen to education, and the Law of the Kyrgyz Republic "On Education" (2023) establishes equal rights for all citizens to receive quality education. The socio-economic situation in the Kyrgyz Republic necessitates improving the quality of and access to education for all categories of learners, including those with special educational needs and disabilities, following the primary objectives of the country's development strategy and educational legislation.

In the National Development Strategy of the Kyrgyz Republic for 2018-2040 (2018), the objective of forming a system of continuous education is set, taking into account the tasks of medical and social inclusion. One of the tools for its implementation is the development of a legislative framework that considers the diversity of the population's educational needs. The Concept for the Development of Inclusive Education in the Kyrgyz Republic for 2019-2023 (2019) was developed considering the country's strategic documents on the education of individuals with special educational needs and is aimed at creating a more diversity-friendly, effective, and equitable education system, which will enhance its capacity to address new and contemporary challenges. The Concept (2019) also takes into account the international obligations of the Kyrgyz Republic to ensure equal and accessible education for all learners, including the norms of the UN Convention on the Rights of the Child (UNCRC, 1989) and the Convention on the Rights of Persons with Disabilities (CRPD, 2006). In the Concept (2019), the provision of inclusive education is defined as a priority direction for the implementation of state educational policy. Consequently, the Strategy for the Development of Education in the Kyrgyz Republic for 2012-2020 (2012) set the task of ensuring the conditions for providing inclusive education to learners with special educational needs in mainstream and special general education organisations and integrating inclusive education at all levels of education.

Additional characteristics of inclusive education include pedagogical challenges and perspectives. The inclusive environment necessitates new approaches to teaching: individualisation, differentiation, and the application of special methods. Teachers must possess competencies in the fields of defectology and psychology, and utilise modern technologies, thereby contributing to the successful learning of all learners.

The relevance of inclusive education in primary schools underscores the need to create an accessible and equitable educational environment for all children. This not only contributes to the successful socialisation and development of each learner but also fosters a humane society that values diversity and equal opportunities (Popova, 2021). Table 1 presents the core principles of inclusive education.

Table 1. *Key principles of inclusive education*

Principles	Content
The principle of the value of the individual, regardless of their level of development, abilities, and health status	This means that the individual is at the centre of the educational system, and education and upbringing are oriented towards their development. It does not permit the infringement of an individual's rights due to deficiencies in physical or intellectual development, or limited abilities and capabilities.

Table 1. *Continued*

Principles	Content
The principle of building upon the capacity of every individual to feel and think	This means that every individual, regardless of limitations in their development and intellectual capabilities, can develop their thought processes and their emotional and sensory aspects. This requires a specific approach and particular conditions.
The principle of the universal right to communication	Every individual is endowed with the right to express their thoughts through communication; they can listen and have the right to be heard by others.
The principle of mutual assistance, connection, and support	For normal development, an individual needs support from another person. Everyone needs support and the building of connections of various kinds with other people.
The principle of the connection between authentic education and building relationships with others	Learning will only be effective when a system of communication links with other people, collective work, and creativity is established.
The principle of progressive development	Progressive development should be oriented towards unlocking an individual's natural aptitudes and assisting them in performing actions that are accessible and understandable to them. One must not focus on what a person is incapable of doing.
The principle of diversity	This principle suggests that diverse activities and involvement in collaborative work and building relationships within a collective lead to the development of all facets of the personality.

Source: *developed by the authors*

The advantages of inclusive education include the development of tolerance and culture among all learners; improved socialisation of children, taking into account their needs for quality education; the development of flexible teaching methods that are beneficial to all learners; and an increase in the quality of education through modern approaches.

Differentiated instruction:
A key tool in inclusive education

Inclusive education is not merely about educating children with special educational needs and disabilities; it is also about creating an environment in which every child is self-aware and can unleash their potential. Inclusive education involves creating conditions for the learning of all children, irrespective of their individual characteristics and needs (Betker, 2014). One of the key tools for implementing inclusive education is differentiated instruction, which allows for considering the individual capabilities of each learner and adapting the learning process to their needs.

Differentiated instruction is a system of methods and techniques aimed at accounting for learners' individual characteristics when organising the learning process. It involves variability in tasks, the use of diverse teaching methods, and flexibility in assessment (Table 2).

Table 2. *Principles of differentiated instruction*

Principles	Content
Individualisation	Consideration of learners' cognitive abilities, pace of learning, and interests.
Flexibility	Adaptation of content, forms, and teaching methods depending on learners' level of preparation and needs.
Variability	Provision of various learning tasks and materials, considering children's cognitive and psychophysical characteristics.
Support and motivation	Creation of a comfortable educational environment conducive to unlocking the potential of each child.

Source: *developed by the authors*

Applying differentiated instruction in primary schools contributes to the successful socialisation and academic attainment of all learners, including those with special educational needs. The main methods of its implementation include grouping learners by their level of preparation or learning style (grouping by preparation level involves grouping learners based on their knowledge, skills, and academic performance); grouping by learning style (all children learn differently, and considering their cognitive characteristics can increase teaching effectiveness); and using multi-level tasks that allow each learner to work according to their abilities and develop critical thinking. Critical thinking is not about finding fault, but a fair evaluation of the positive and negative aspects of the subject being studied. Other methods involve employing various teaching methodologies (visual, auditory, and kinaesthetic approaches) and a flexible assessment system that considers the individual achievements of each child (Marzuki *et al.*, 2022).

The advantages of differentiated instruction in inclusive education lie in the fact that it takes into account the individual characteristics and needs of learners, increases motivation and interest in learning, improves academic performance and self-confidence, and ensures psychological comfort while reducing anxiety levels in children with special educational needs. Differentiated instruction is an effective tool in inclusive education, which creates conditions for equal access to knowledge and the full development of each child. Its application in primary schools contributes to the formation of a tolerant educational environment where every learner can realise their potential. Since the teacher's role is to link knowledge with the interests of the individual (DeronceleAcosta & Ellis, 2024),

inclusive education, supported by differentiated instruction, helps create equal conditions for all children, which is crucial for their holistic development and social adaptation. The introduction of such approaches in the educational process at the primary school level fosters the creation of a tolerant society and the development of communication and cooperation skills among children, which is an important stage in their growth and socialisation.

CONCLUSIONS

As a result of the conducted research, several key conclusions can be drawn concerning inclusive education and its implementation in primary schools for children with special educational needs and disabilities. One of the primary outcomes is the confirmation that successful inclusion necessitates a comprehensive approach, encompassing not only adapted educational materials and technologies but also teacher training, the creation of suitable infrastructure, and active engagement with parents. The application of differentiated instruction and the use of flexible teaching methods have a significant impact on improving the academic attainment and socialisation of children with special educational needs. The methodology of grouping learners by their level of preparation and the use of various learning styles and teaching methods contribute to creating a comfortable educational environment where every child has the opportunity to develop their abilities and unleash their potential. This, in turn, fosters the development of tolerance among all participants in the educational process.

The practical value of the research lies in the development of recommendations for educators and educational institutions aimed at creating a more effective and inclusive educational environment for children with SEND. Particular attention should be paid to the training of educators, which is an important condition for the successful implementation of inclusion within the school system. Another significant aspect is the integration of innovative educational technologies, such as information technologies and adapted materials. Perspectives for further research in this area could include an in-depth study of the impact of various pedagogical methods on the development of children with SEND in an inclusive environment, as well as an analysis of the integration of digital technologies into the educational process. It is also necessary to continue research on the topic of teacher training, the development of additional professional retraining programmes, and the improvement of the infrastructure of educational institutions to create the most comfortable conditions possible for all children, regardless of their abilities and needs.

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CONFLICT OF INTEREST

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Башталгыч мектепте инклюзивдик билим берүүнүн негизи катары окутууда дифференциалдуу мамиле

Уланбек Мамбетакунов
Педагогика илимдеринин доктору, профессор
Ж. Баласагын атындагы Кыргыз улуттук университети
720033, Фрунзе көч., 547, Бишкек ш., Кыргыз Республикасы
https://orcid.org/0000-0001-5456-6884

Асель Акылбекова
Магистрант
Ж. Баласагын атындагы Кыргыз улуттук университети
720033, Фрунзе көч., 547, Бишкек ш., Кыргыз Республикасы
https://orcid.org/0009-0001-0936-3954

Аннотация. Бул иштин актуалдуулугу Кыргыз Республикасында инклюзивдик билим берүү маселелерине көңүл буруунун көбөйүшү менен шартталган, ал ден соолугунун мүмкүнчүлүктөрү чектелүү жана өзгөчө билимге муктаж балдардын билим алуусу үчүн бирдей шарттарды түзүүгө багытталган. Өлкөдө ата-энелердин да, мугалимдердин да адистештирилген колдоосуна муктаж балдардын санынын олуттуу өсүшү байкалууда, бул ден соолугунун мүмкүнчүлүктөрү чектелүү жана өзгөчө билим берүү муктаждыктары бар балдарды окутуунун өзгөчөлүктөрүн эске алуу менен билим берүү системаларын адаптациялоону жана окутуунун инновациялык ыкмаларын киргизүүнү талап кылат. Иштин максаты – инклюзивдик билим берүүнүн заманбап ыкмаларын талдоо жана жалпы билим берүү системасынын шартында бул балдарды окутуунун эң натыйжалуу педагогикалык стратегияларын аныктоо жана натыйжалуу окутуу жана мотивациялоочу чөйрөнү түзүү болду. Белгиленген максатка жетүү үчүн окутуу практикасын талдоо, атайын адабияттар, башталгыч мектепте окуу процессине байкоо жүргүзүү ыкмалары колдонулган. Инклюзивдик билим берүүнүн ар кандай моделдери изилденген, аны ишке ашыруунун мыйзамдык жана уюштуруучулук аспектилери талданган, мугалимдердин, өзгөчө билим берүү муктаждыгы бар балдардын жана алардын ата-энелеринин/мыйзамдуу өкүлдөрүнүн өз ара аракеттенүүсүнүн өзгөчөлүктөрү изилденген. Инклюзивдик билим берүүнү ийгиликтүү ишке ашыруу комплекстүү мамилени, анын ичинде мугалимдерди даярдоону, тиешелүү окуу-методикалык комплекстердин жана жабдуулардын болушун, ошондой эле классташтарынын жана алардын ата-энелеринин/мыйзамдуу өкүлдөрүнүн деңгээлинде класста сабырдуулуктун жана өз ара түшүнүшүү атмосферасын түзүүнү талап кылаары аныкталган. Иштин практикалык баалуулугу алынган натыйжаларды мектеп чөйрөсүндө инклюзивдүү процесстерди оптималдаштыруу, ошондой эле башталгыч мектепте ден соолугунун мүмкүнчүлүктөрү чектелүү жана өзгөчө билим берүү муктаждыктары бар балдар үчүн билим берүү стратегияларын өркүндөтүү боюнча сунуштарды иштеп чыгуу үчүн колдонуу мүмкүнчүлүгүндө турат

Негизги сөздөр: ден соолугунун мүмкүнчүлүктөрү чектелүү балдар; педагогикалык көйгөйлөр; социалдык интеграция; жеке билим берүү маршруттары; мыйзам ченемдери; толеранттуулук; окуудагы жетишкендиктер

Дифференцированный подход в обучении как основа инклюзивного образования в начальной школе

Уланбек Мамбетакунов
Доктор педагогических наук, профессор
Кыргызский национальный университет имени Ж. Баласагына
720033, ул. Фрунзе, 547, г. Бишкек, Кыргызская Республика
https://orcid.org/0000-0001-5456-6884

Асель Акылбекова
Магистрант
Кыргызский национальный университет имени Ж. Баласагына
720033, ул. Фрунзе, 547, г. Бишкек, Кыргызская Республика
https://orcid.org/0009-0001-0936-3954

Аннотация. Актуальность данной работы обусловлена увеличивающимся вниманием к вопросам инклюзивного образования в Кыргызской Республике, которое направлено на создание равных условий для обучения детей с ограниченными возможностями здоровья и особыми образовательными потребностями в обучении. В стране наблюдается значительный рост числа детей, нуждающихся в специализированной поддержке как со стороны родителей, так и со стороны педагогов, что требует адаптации образовательных систем и внедрения инновационных методов преподавания с учетом специфики обучения детей с ограниченными возможностями здоровья и особыми образовательными потребностями в обучении. Целью работы был анализ современных подходов к инклюзивному образованию и определение наиболее эффективных педагогических стратегий для обучения указанных детей в условиях общей образовательной системы и создания эффективной обучающей и мотивирующей среды. Для достижения поставленной цели использовались методы анализа педагогической практики, анализа специализированной литературы, наблюдения за учебным процессом в начальной школе. Были исследованы различные модели инклюзивного образования, проанализированы законодательные и организационные аспекты его внедрения, а также изучены особенности взаимодействия педагогов, детей с особыми образовательными потребностями и их родителей/законных представителей. Установлено, что успешная реализация инклюзивного образования требует комплексного подхода, включающего подготовку педагогов, наличие соответствующих учебно-методических комплексов и оборудования, а также создание атмосферы толерантности и взаимопонимания в классе на уровне одноклассников и их родителей/законных представителей. Практическая ценность работы заключается в возможности применения полученных результатов для оптимизации процессов инклюзии в школьной среде, а также разработки рекомендаций по совершенствованию образовательных стратегий для детей с ограниченными возможностями здоровья и особыми образовательными потребностями в обучении в начальной школе

Ключевые слова: дети с ограниченными возможностями здоровья; педагогические вызовы; социальная интеграция; индивидуальные образовательные маршруты; законодательные нормы; толерантность; академическая успеваемость

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A personality-developing educational environment as an essential prerequisite for fostering personal potential in Kyrgyzstan

Nasiba Muratalieva*
PhD in Psychology, Associate Professor
Jusup Balasagyn Kyrgyz National University
720033, 547 Frunze Str., Bishkek, Kyrgyz Republic
https://orcid.org/0000-0001-8654-1964

Rano Kutanova
PhD in Pedagogical Sciences, Associate Professor
Jusup Balasagyn Kyrgyz National University
720033, 547 Frunze Str., Bishkek, Kyrgyz Republic
https://orcid.org/0009-0003-1285-9410

Natalia Sukhodubova
PhD in Pedagogical Sciences, Associate Professor
Jusup Balasagyn Kyrgyz National University
720033, 547 Frunze Str., Bishkek, Kyrgyz Republic
https://orcid.org/0009-0000-8733-5716

Salima Bazarkanova
Chief Specialist of the Teacher Professional Development and Inclusive Education Centre
Jusup Balasagyn Kyrgyz National University
720033, 547 Frunze Str., Bishkek, Kyrgyz Republic
https://orcid.org/0009-0008-0556-8785

Abstract. In the era of globalisation and internal transformation, the educational system must adapt to the emerging challenges, ensuring not only the imparting of knowledge, but also contributing to the holistic development of personality. The relevance of the present study lied the need to create an effective personality-developing educational environment for the growth of personality potential in the conditions of globalisation and internal transformation, socio-economic changes taking place in Kyrgyzstan. The purpose of this study was to determine the role of personality-developing educational environment in the shaping and development of personality potential in the context of Kyrgyzstan, to identify the key factors affecting the success of personal growth and self-development in various social groups. The study considered the issues of creating a coherent, adequate to the challenges of time personality-oriented educational environment, where all components would be systematically and purposefully connected: organisational-technological, subject-spatial, social. The principal areas and ways of creating personality-developing educational environment of educational organisations as an open self-developing educational system were covered. The study revealed the principal areas and methods of creating PDE. The significance of a systematic and purposeful approach that combines organisational-technological, subject-spatial, and social components was emphasised. The findings of this study can be used to develop recommendations for improving educational programmes and practices aimed at developing students' personality potential. The study contributed to the understanding of the role of the educational environment in shaping a successful and adaptive personality capable of functioning effectively in the context of modern challenges

Keywords: personality-centred educational environment; PDE components; educational system; personal growth; educational environment

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*Corresponding author

INTRODUCTION

In connection with the introduction of the mechanism of implementation of the Law of the Kyrgyz Republic "On Education" (2023), innovative approaches to achieve the goals of sustainable development in the context of accelerating technologisation of education were defined. The primary target activity of educational organisations, including pre-school educational organisations and schools, is the development of the child's personality potential, independence, and success in the implementation of educational trajectory, readiness to take responsibility for the choice of future profession, resilience, social-emotional skills, activity and mobility corresponding to the globalisation of modern education. To solve such social and psycho-pedagogical problems, educational organisations are offered a comprehensive step-by-step programme that allows them to approach the work on problems both at the level of the community and social institutions of education and upbringing, i.e., combining the efforts of families, preschool organisations, schools, and universities.

The conceptual foundations and methodological approaches of the study were based on the modern scientific achievements (philosophy, pedagogy, psychology, sociology), linking the theory and practice of modern education, considering modern contexts and the cultural diversity of the needs of each child. The theoretical rationale was based on the idea of scientist M. Seligman (2002), who proposed the concept of positive well-being, which includes five elements. Thus, A. Asmolov (2015) emphasised that modern society is characterised by an elevated degree of uncertainty. This applies to both external conditions (economic, political, cultural) and internal processes of the individual. People often find themselves in a situation of choice and uncertainty, which affects their psycho-emotional state and behaviour. The researcher analysed approaches that focus on how personality adapts to uncertainty. This includes theories concerning mental flexibility, cognitive adaptation, and the development of new mechanisms of behaviour in the face of constant change, also focusing on the variety of cultural and social factors that affect personality in the context of globalisation. The researcher's study touches upon the concept of identity and its transformation in a changing world. In the context of globalisation and migration, there is a need to revise conventional notions of personal identity, which requires special attention in psychology.

D. Leontiev (2014; 2016) considered the key aspects of personal identity development through the educational environment. The researcher emphasised the value of motivation and activity as factors contributing to personal growth. Leontiev's studies emphasised the significance of intrinsic motivation and self-actualisation as driving forces in the shaping of personality potential. The concept of the activity-based approach in personality psychology proposed by D. Leontiev, is the basis for understanding the processes occurring in PDE.

V. Yasvin (2018; 2019) explored personal development in the context of education. The researcher emphasised the significance of creating pedagogical conditions that promote the development of critical and creative thinking, as well as students' autonomy. V. Yasvin's findings emphasised the role of innovative educational practices in personality development process. T. Gordeeva (2016; 2017) attached special weight to the problem of studying motivation in the latest approaches, as well as diagnostic methods and practical recommendations that can be used in psychology and related fields. In Gordeeva's definition, motivation is one of the crucial components of human behaviour, and its understanding is of immense value for both theory and practice. The researcher focuses on the fact that modern challenges in social and professional spheres require a new view of motivation, which includes not only theoretical aspects, but also practical ways of diagnosis and correction. The need to optimise the educational process in higher education institutions considering the requirements of the time is also described by I. Ivanova & I. Martyniuk (2024). They emphasised the significance of accounting for the psychological characteristics of students.

For Kyrgyzstan, the work of psychologists and educators from other countries serves as a basis for creating an environment that recognises both individual and social needs of young people. It is also necessary to note the study in the conditions of Kyrgyzstan, conducted by E. Khabieva (2017), which considered the psychological features of trusting relationships of schoolchildren of adolescence and young adulthood. The key focus was paid to the development of trust in adolescents, which is a crucial element in the social and personal development of schoolchildren.

The proposed approaches to the organisation of personal-developmental educational environment are based on the values of personal meaningful reflection, creativity, and respect for the educational work of each participant of the educational system. The first steps on adaptation and renewal of the system of pedagogical activities were implemented at the Kyrgyz National University named after J. Balasagyn, a major component of which was the introduction of the Programme for the development of personality potential in the educational environment. The purpose of this study was to investigate the influence of the environment stimulating personal growth on the shaping and development of individual potential in the conditions of Kyrgyzstan, as well as to identify the key factors contributing to successful personality development and self-improvement in various social groups.

MATERIALS AND METHODS

The methodological framework of the study was based on general scientific research methods, such as analysis, synthesis, comparison, generalisation, as well as theoretical analysis of scientific literature on the subject of the study. Theoretical analysis included the study and systematisation of scientific papers in psychology, pedagogy, and sociolo-

gy, which covered the issues of personal development, educational environment, and personality potential. Particular attention was paid to the studies exploring the influence of sociocultural factors on personality development, as well as to the studies covering the development and implementation of personality-centred educational technologies. Specifically, the researchers relied on the concepts of psychological and pedagogical environment, such as the theories of I. Yakimanskaya (1996) on the personality-centred approach, theories of personality development in the conditions of educational space proposed by such scientists as L. Vygotsky, A. Leontiev, etc. In terms of the foundations of pedagogical activity, the study considered the findings of I. Baeva (2005), I. Dubrovina (2010), G. Bordovsky (2012). Furthermore, the studies of K. Polivanova (2020), I. Dubrovina & D. Lubovsky (2017), and other researchers were considered. In the context of Kyrgyzstan, the influence of national culture, traditions, and modern educational reforms aimed at forming an integrated, developing educational environment for students was factored in (Muratalieva, 2020; Korotenko *et al.*, 2021; Muratalieva *et al.*, 2024).

The comparative analysis considered distinct approaches to creating PDE in educational organisations, both in Kyrgyzstan and in other countries. This helped to identify common patterns and specific features related to cultural and social contexts. The study also employed generalisation and systematisation methods to formulate conclusions and recommendations based on the analysis of theoretical and empirical data. This helped to develop a holistic view of the role of PDE in the development of personality potential and offer practical recommendations for its creation and improvement. In the context of Kyrgyzstan, the influence of national culture, traditions, and modern educational reforms aimed at forming an integrated, developing educational environment for students was considered.

RESULTS AND DISCUSSION

A team of teachers was trained at the Institute for Retraining and Professional Development of Pedagogical Personnel of the Kyrgyz National University named after J. Balasagyn to teach educators, teachers, and managers of educational organisations the skills necessary to ensure socio-psychological safety, socio-emotional skills, and the latest pedagogical techniques for solving educational problems necessary for creating PDE in educational organisations as an open self-developing educational system. The research among schools and kindergartens formed the basis for long-term scientific research. In addition, the value of the programme for the higher education institution lies in the creation of a platform for interaction and continuity in the education system "Family – Preschool Organisations – Schools – Universities".

As a result of the training courses, managers of educational organisations had the opportunity to improve their managerial skills and knowledge necessary to create and maintain a personal development environment. Specifically, they had the chance to:

- improve their qualification on the issues of PDE creation and change management in the educational organisation based on modern approaches in pedagogy, psychology, and management;
- obtain knowledge on how to manage environmental changes in an educational organisation to influence the personal development of the participants of the educational process;
- create and implement projects of such changes based on diagnostic data for their educational organisations, considering their specific features (presence of children with disabilities, the need for preventive actions and support for healthy lifestyles);
- train mentors who will be able to take on the role of coordinators of successful implementation of management projects of changes in the educational environment;
- receive resources and tools to manage changes in the educational organisation in the course of PDE creation, including the development of a team of teachers, diagnostic tools, solving professional problems based on the innovative technology "Professional Learning Communities" with the support of mentors;
- interact with other educational organisations taking part in this project for further professional development;
- strengthen the status and authority of its educational organisation and the possibility of positioning itself as a participant of the innovative project, including at the international level.

Teachers of educational organisations had the opportunity to improve their competence in supporting the personal development of students and received tools for their personal professional development. Specifically, they improved their qualifications in supporting the personal development of children, including those with disabilities; gained knowledge on how to improve their personal potential and resist professional burnout and develop stress resilience by using the resources of the Personality Potential Development Programme; created pedagogical projects to support the personality development of children; included materials on the social-emotional development of children and adolescents and the development of their personality potential in educational and correctional programmes; solved their specific professional problems within the framework of the innovative technology "Professional Learning Communities", including with the support of mentors; improved the culture of interaction with colleagues, parents (legal representatives), representatives of local communities; obtained resources and tools for diagnosing the personal development of students and pupils of preschool general education institutions; took part in professional events to share best practices in the development of personal potential at the international level.

Schoolchildren and kindergarten pupils had the chance to study in an updated educational environment that promotes their self-fulfilment and development. Thus, they were given the opportunity to:

- be trained and educated in a renewed educational environment that provides more opportunities for self-fulfilment;
- acquire knowledge and skills on how to manage personal emotions, as well as to optimally use and develop personal resources to preserve and strengthen their health, subjective well-being here and now, as well as in their adult life;
- interact in the children's and adult communities of the participants of this project, which presented an opportunity to demonstrate their personal initiatives (not only to take part in changes in the environment of the educational organisation, but also to plan major events);
- expand opportunities to interact with their peers from other CIS countries.

The results of the programme implementation will also contribute to the satisfaction of a series of needs of parents, representatives of the local community, and local self-government bodies (in the zone of influence of the educational organisation). Specifically, parents and representatives of the local community will have the opportunity to take part in the life of the educational organisation to a greater extent; the culture of interaction between managers, teachers, children, and families and the community as a whole will increase due to the knowledge and educational resources of the project; educational organisations will be more active in public and socially useful events, will be empowered to take a leadership role in educating the population on issues of personal development, and will become resource centres with innovative knowledge and skills in the field of personality development and creating PDE.

Overall, the findings of the study confirmed that the creation of a personal development environment is a key factor in the successful development of personality potential (Yakimanskaya, 1996; Korotenko *et al.*, 2021). Integration of efforts of educational organisations, teachers, parents, and local community allows creating conditions in which each participant of the educational process can fully develop their potential (Baeva, 2005). The creation of PDE requires a systematic approach, including the development and implementation of corresponding educational programmes, training of teaching staff, creation of a favourable subject-space environment, and development of social-emotional skills in students (Dubrovina & Lubovsky, 2017). It is vital to factor in the specific cultural and social features of the region, as well as the needs of diverse social groups.

N. Muratalieva (2020) argued that the creation of personal development environment in educational institutions of Kyrgyzstan is a key factor for the development of adaptive, independent, and socially responsible citizens. In the context of modern challenges, such as globalisation, digitalisation, and economic transformation, educational systems must transform to not only transmit knowledge, but also to form students' ability to self-development, critical thinking, and social communication. Y. Yuan & L. Fang (2016) confirmed the researchers' opinion that PDE becomes a valuable tool in this process, combining psychological comfort, favourable educational climate and modern pedagogical approaches. One of the key aspects of PDE formation is the integration of national educational values with international standards. Incorporating elements of cultural identity into the educational process not only strengthens national self-awareness, but also helps students feel confident in the global community.

Modern technologies also play a significant role in the development of PDE. The use of digital platforms, interactive methodologies, and adaptive educational systems promotes individualisation of learning, enabling each student to develop at their own pace (Kiryanova, 2024). Online courses, virtual labs, simulations, and game-based learning methods expand opportunities for self-development and make learning more accessible and engaging. Furthermore, PDE involves active engagement of families, communities, and employers in the educational process. K. Polivanova (2020) stated that the creation of partnerships between schools, universities, businesses, and public organisations promotes the integration of education with real life and professional sphere.

The introduction of personal development environment requires a systematic approach, including training of teaching staff, development of the infrastructure of educational institutions, and creation of psychological support programmes. It is vital not only to form a space for learning, but also to ensure the social and psychological safety of students, helping them to handle emotional and personal challenges. In the long term, PDE contributes to the development of self-confident, independent, and socially active individuals who are ready for successful self-fulfilment in the modern world.

CONCLUSIONS

When educating teachers, training in the development of PDE helped to consider the socio-psychological regularity of cognitive activity, which became an opportunity for open interaction of all participants of educational relations and the development of professional competencies of teachers, the opportunity to implement professional ideas, plans for personal growth, the possibility of productive interaction, co-creation, the development of a creative environment. Furthermore, the training of heads of educational organisations on the development of PDE helped to improve the educational environment focused on the educational needs of students; to consider the criteria of personality-developing educational environment to create and form a creative environment, strengthening the characteristics of the educational environment: generalisation, activity, emotionality, sustainability, improvement of management concepts in the context of personal development of educational subjects; development of analytical and prognostic function of management, improvement of management technologies, management structure, creative management team, increasing the role of collegial bodies in decision-making.

The value of the idea for educational organisations lies in the creation of a coordinated, personality-oriented, personally-developing educational environment, adequate to the challenges of the time, where all components are systematically and purposefully connected: organisational and technological, subject-spatial, social, and inclusion. The launched project of creating inclusive education for students with disabilities has become the basis for the activities of educational organisations in the short and long term.

Prospects for further research in this area include investigating the effects of PDE on the development of concrete personality qualities such as creativity, critical thinking, and emotional intelligence. It is also of interest to investigate the effectiveness of different PDE models in various types of educational organisations and for different age groups. It is necessary to further explore the influence of sociocultural factors on the development of PDE and to develop methods for assessing the effectiveness of PDE. Furthermore, a promising area is the development of training programmes for teachers and heads of educational organisations to create and manage PDE.

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CONFLICT OF INTEREST

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Кыргыз Республикасында инсандык потенциалды өнүктүрүүнүн зарыл шарты катары жеке инсанды өнүктүрүүчү билим берүү чөйрөсү (ЖИӨББЧ)

Насиба Мураталиева
Психология илимдеринин кандидаты, доцент
Ж. Баласагын атындагы Кыргыз улуттук университети
720033, Фрунзе көч., 547, Бишкек ш., Кыргыз Республикасы
https://orcid.org/0000-0001-8654-1964

Рано Кутанова
Педагогика илимдеринин кандидаты, доцент
Ж. Баласагын атындагы Кыргыз улуттук университети
720033, Фрунзе көч., 547, Бишкек ш., Кыргыз Республикасы
https://orcid.org/0009-0003-1285-9410

Наталья Суходубова
Педагогика илимдеринин кандидаты, доцент
Ж. Баласагын атындагы Кыргыз улуттук университети
720033, Фрунзе көч., 547, Бишкек ш., Кыргыз Республикасы
https://orcid.org/0009-0000-8733-5716

Салима Базарканова
Башкы адис
Мугалимдердин квалификациясын жогорулатуу жана инклюзивдик билим берүү борбору
Ж. Баласагын атындагы Кыргыз улуттук университети
720033, Фрунзе көч., 547, Бишкек ш., Кыргыз Республикасы
https://orcid.org/0009-0008-0556-8785

Аннотация. Глобализация жана ички трансформациялар доорунда билим берүү системасы жаңы чакырыктарга ылайыктап, билимди берүү менен чектелбестен, адамдын жалпы өнүгүшүнө да өбөлгө түзүшү керек. Бул макаланын актуалдуулугу глобализация жана ички өзгөрүүлөр, ошондой эле Кыргызстандагы социалдык-экономикалык өзгөрүүлөр шартында адамдын потенциалын өнүктүрүү үчүн эффективдүү адамды өнүктүрүү билим берүү чөйрөсүн түзүү керектигинде. Макаланын максаты Кыргызстандын шартында адамдын потенциалын түзүү жана өнүктүрүүдө адамды өнүктүрүү билим берүү чөйрөсүнүн ролун аныктоо, ошондой эле ар түрдүү социалдык топтордогу жеке өсүш жана өзүн-өзү өнүктүрүүдө ийгиликтүү болууга таасир эткен негизги факторлорду аныктоо. Макалада убагына жараша, координацияланган, жеке багытталган билим берүү чөйрөсүн түзүү маселелери каралган, мында бардык компоненттер системдүү жана максаттуу түрдө байланыштырылган: уюштуруучулук-технологиялык, предметтик-мейкиндиктик жана социалдык. Билим берүү мекемелеринде адамды өнүктүрүүчү билим берүү чөйрөсүн түзүүнүн негизги багыттары жана ыкмалары ачылган. Жөнөкөй жана максаттуу ыкманы колдонуу маанилүүлүгү белгиленген, мында уюштуруучулук-технологиялык, предметтик-мейкиндиктик жана социалдык компоненттер бириктирилет. Изилдөөнүн жыйынтыктары билим берүү программаларын жана практикаларын жакшыртуу боюнча сунуштарды иштеп чыгуу үчүн колдонулушу мүмкүн, ал студенттердин жеке потенциалын өнүктүрүүгө багытталган. Макала билим берүү чөйрөсүнүн ролун түшүнүүгө өз салымын кошот жана замандын чакырыктарына ылайык ийгиликтүү жана адаптацияланган инсанды калыптандырууда маанилүү болуп саналат

Негизги сөздөр: жеке багытталган билим берүү чөйрөсү; ЖӨЧ компоненттери; билим берүү системасы; жеке өсүү; билим берүү чөйрөсү

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Насиба Мураталиева
Кандидат психологических наук, доцент
Кыргызский национальный университет имени Ж. Баласагына
720033, ул. Фрунзе, 547, г. Бишкек, Кыргызская Республика
https://orcid.org/0000-0001-8654-1964

Рано Кутанова
Кандидат педагогических наук, доцент
Кыргызский национальный университет имени Ж. Баласагына
720033, ул. Фрунзе, 547, г. Бишкек, Кыргызская Республика
https://orcid.org/0009-0003-1285-9410

Наталья Суходубова
Кандидат педагогических наук, доцент
Кыргызский национальный университет имени Ж. Баласагына
720033, ул. Фрунзе, 547, г. Бишкек, Кыргызская Республика
https://orcid.org/0009-0000-8733-5716

Салима Базарканова
Главный специалист
Центра повышения квалификации учителей и инклюзивного образования
Кыргызский национальный университет имени Ж. Баласагына
720033, ул. Фрунзе, 547, г. Бишкек, Кыргызская Республика
https://orcid.org/0009-0008-0556-8785

Аннотация. В эпоху глобализации и внутренних трансформаций образовательная система должна адаптироваться к новым вызовам, обеспечивая не только передачу знаний, но и способствуя целостному развитию личности. Актуальность данной статьи заключается в необходимости создания эффективной личностно-развивающей образовательной среды (ЛРОС) для развития личностного потенциала в условиях глобализации и внутреннего преобразования, социально-экономических изменений, происходящих в Кыргызстане. Цель статьи заключалась в определении роли личностно-развивающей образовательной среды в формировании и развитии личностного потенциала в контексте Кыргызстана, выявлении ключевых факторов, влияющих на успешность личностного роста и саморазвития в различных социальных группах. В статье рассмотрены вопросы создания согласованной, адекватной вызовам времени личностно-ориентированной образовательной среды, в которой системно и целенаправленно связаны все компоненты: организационно-технологический, предметно-пространственный, социальный. Раскрыты основные направления и способы создания личностно-развивающей образовательной среды образовательных организаций как открытой саморазвивающейся образовательной системы. В работе раскрыты основные направления и методы создания ЛРОС. Подчеркнута важность системного и целенаправленного подхода, объединяющего организационно-технологические, предметно-пространственные и социальные компоненты. Результаты исследования могут быть использованы для разработки рекомендаций по совершенствованию образовательных программ и практик, направленных на развитие личностного потенциала учащихся. Статья вносит вклад в понимание роли образовательной среды в формировании успешной и адаптивной личности, способной эффективно функционировать в условиях современных вызовов

Ключевые слова: личностно-ориентированная образовательная среда; компоненты ЛРОС; образовательная система; личностный рост; образовательная среда

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The teacher in the era of artificial intelligence

Zhanyl Nurueva*
Senior Lecturer
Jusup Balasagyn Kyrgyz National University
720033, 547 Frunze Str., Bishkek, Kyrgyz Republic
https://orcid.org/0009-0001-4069-4428

Rita Muktarbekova
Master, Senior Lecturer
Jusup Balasagyn Kyrgyz National University
720033, 547 Frunze Str., Bishkek, Kyrgyz Republic
https://orcid.org/0009-0001-7734-9441

Abstract. The era of artificial intelligence has transformed the role of the teacher and opened new horizons in the field of education. This article examined the key challenges and opportunities faced by future educators. It also presented examples of how artificial intelligence has been integrated into educational processes, the findings of studies on the impact of technologies on pedagogical practice, historical aspects of technological development in education, an analysis of the results of a teacher survey, and recommendations for the implementation of AI in educational institutions. As part of the study, a survey was conducted among 207 teachers in Kyrgyzstan to assess their experience with and attitudes towards the use of artificial intelligence tools. The results showed that 67% of teachers actively used such tools in their practice, while 76% were willing to further develop their expertise in this area. The study emphasised the potential of artificial intelligence to enhance teaching and student engagement. At the same time, it identified significant barriers such as the lack of access to education and digital inequality, which are particularly relevant in rural areas. These issues highlight the need for teacher training programmes, ethical use of technology, and equitable access to digital resources. The study illustrated the evolving demands placed on educational institutions in response to technological shifts in teaching and learning practices. The findings offer key insights for practitioners and policymakers in the education sector. They also provide a foundation for updating educational programmes and improving digital literacy

Keywords: era of artificial intelligence; education; teacher's role; educational technologies; challenges; educational environment

INTRODUCTION

The development of artificial intelligence (AI) has led to fundamental transformations in the education system. The role of the teacher has extended beyond the confines of traditional instruction to encompass mentorship and moderation. Therefore, it has become necessary to reconsider the training of future teachers in light of new challenges and opportunities (Dubovyk, 2024). The application of AI requires more than just technological proficiency; it also demands attention to ethical and pedagogical dimensions. Educators working with Generation Z and Alpha are expected to cultivate critical thinking and creativity while fostering respectful and collaborative relationships with learners. Mastery of digital tools and the appropriate use of AI technologies represent a significant responsibility for teachers.

Globally, the education system is undergoing large-scale transformation. In particular, the rapid development of AI technologies is altering the content, formats, and methodologies of teaching (Kiryanova, 2024). As noted by A. Vieriu & G. Petrea (2025), AI offers new opportunities in education such as automating information processing, enabling personalised instruction, real-time tracking of student progress, and enhancing the evaluation of learning outcomes. Although these technologies create the potential

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*Corresponding author

to improve quality, their successful application is directly linked to the preparedness and acceptance of teachers.

The rapid advancement of AI in the educational sector is redefining the role of the teacher. Statistics show the widespread integration of AI in educational practice: for instance, a study by ArtSmart (2024) indicated that 89% of students had used ChatGPT for exam preparation, while 50% of teachers had utilised AI tools for lesson planning. The growing use of AI in education compels educators to reconsider their adaptability and preparedness for such technologies. Recent studies demonstrate that AI is indeed reshaping the role of the teacher in education systems. For example, the World Economic Forum (2025) proposed viewing teachers as "architects of learning," collaborating with AI to provide individualised support for each student. Despite the fact that 50% of teachers reported using AI tools for lesson planning, 70% of them expressed concerns about AI's potential impact on deep understanding and spiritual values, such as those rooted in Platonism (ArtSmart, 2024). Similarly, Education Week (2023) evaluated both the capacity of AI to assist teachers and the risk that it might replace them. S. Grassini (2023) noted in his 2023 article that while ChatGPT can be useful in education, issues such as data confidentiality must not be overlooked.

In Kyrgyzstan, the use of AI remains at an early stage, making it particularly important to scientifically assess teachers' attitudes, practical experience, and willingness to engage with this technology. This study serves as a valuable source of information for educational institutions, policymakers, and stakeholders interested in implementing AI tools. The research focused on analysing teachers' readiness to use AI, their attitudes toward the technology, and their experiences of it. It also aimed to identify the main difficulties, benefits, and development prospects associated with AI use, thus assessing its impact on the educational system. The study addressed the following core issues: identifying the key challenges and opportunities associated with AI implementation in education; analysing examples of AI integration in different national education systems; exploring the impact of digital inequality on access to educational technologies; and offering recommendations for the effective use of AI in educational institutions.

LITERATURE REVIEW

A number of studies have been conducted in Kazakhstan concerning the integration of artificial intelligence technologies into the education system, analysing both their advantages and challenges. For example, A. Davletova (2024) in her research highlighted the role of AI in enhancing efficiency in education, enabling personalised instruction, and facilitating the development of innovative teaching methods. She also drew attention to ethical issues and the risk of diminishing interpersonal connections that may arise from the use of AI technologies. Another study by A. Mambetalieva & A. Turalbaeva (2022) explored the significance of applying AI elements in the context of primary education. The authors observed that, although many teachers possess theoretical knowledge of AI, they often experience difficulties in practical application. They emphasised that both the technical infrastructure of schools and the practical preparedness of teachers are critical factors for successful implementation of these technologies.

In Kyrgyzstan, interest in employing AI technologies in education has also grown, and special training courses for teachers have been introduced. For instance, in Bishkek and regional areas, lectures have been organised on how to apply AI in educational settings, with a focus on integrating new technologies into pedagogical practice (Ministry of Education, 2024). However, the lack of adequate training, weak infrastructure, and digital inequality continue to hinder full-scale implementation of AI. The research recommends ways to enhance teachers' competencies in working with AI and evaluates their readiness to adopt these tools. The article further analyses opportunities to improve teaching practices using AI while also mitigating associated risks.

Teachers are adopting various strategies to adapt to AI. In order to use AI tools effectively, they are acquiring both technical and pedagogical knowledge. For example, McKinsey (2020) recommended redefining teachers' roles as mentors and moderators, thus improving the quality of their work. Teachers have been using AI for lesson planning, student assessment, and tailoring instruction to individual needs. Their findings suggest that the use of AI has prompted a shift towards more personalised instructional approaches. Research by F. Karataş *et al.* (2024) confirmed that AI allows for greater flexibility in curriculum content. Nevertheless, ethical issues related to the application of AI in education remain a serious concern. These include the protection of personal data, the potential for biased outcomes, and inequalities in access to technology among teachers and students. Although N. Ghamrawi *et al.* (2023) acknowledged that AI can expand teachers' leadership capacities, their study also warned that over-reliance on such technologies could limit certain decision-making processes. They emphasised the need for a cautious and critical approach to AI use in education.

The above-mentioned studies confirm that the integration of AI into the education sector is closely linked to the evolving role and competencies of teachers. According to HolonIQ (2023), 25% of organisations successfully implemented AI in 2022; however, this trend demands specific training and the development of technological skills among educators. A study by RAND (2025) showed that one in four teachers in the United States had used AI in lesson planning, while the figure was significantly higher (60%) among school principals. These findings underscore the importance of providing teachers with sufficient methodological and technical support. Child Trends (2024) has promoted the use of AI as a valuable tool for forecasting student achievement but also highlighted that its effectiveness depends directly on the level of specialised training teachers receive.

Taken together, these findings indicate that improving teachers' technological literacy and ensuring continuous

support are essential for the successful integration of AI into the educational process. Current trends point to the need for high-quality teacher training and the provision of adequate technological resources. Therefore, it is vital for the education system to develop effective initiatives aimed at enhancing teachers' skills and knowledge. Such efforts should include updating curricula and improving digital infrastructure. Only under these conditions will teachers be able to fully leverage the potential of modern technologies and deliver high-quality education to students.

MATERIALS AND METHODS

This article employed a mixed-methods approach to analyse teachers' experiences with artificial intelligence. The research methodology was based on empirical principles and combined both qualitative and quantitative techniques. The primary research instrument was a survey (questionnaire), designed to assess teachers' readiness, experience, and attitudes towards the use of AI technologies, evaluate the impact of AI in education, and identify strategies for teacher adaptation to this technology. The central aim of the study was to investigate teachers' preparedness to use AI, their perceptions of the technology, and their hands-on experiences with it. The survey questions were developed to explore difficulties in using AI (such as digital inequality or data confidentiality), perceived conveniences, and developmental opportunities.

The survey was conducted between January and March 2025 among teachers working in educational institutions across various regions of Kyrgyzstan. It covered participants from a diverse range of educational settings – urban and rural schools, and institutions of primary, secondary, and higher education. A total of 300 teachers were invited to participate via email and social media, with 207 completing the survey in full, resulting in a 70% response rate. Participants were selected using a voluntary sampling method, with access obtained through professional networks and educational institutions. In addition to the survey, in-depth interviews were conducted with 12 teachers to provide a more nuanced understanding of individual experiences and recommendations.

The questionnaire was developed based on a review of the latest literature in the field of AI in education (Zawacki-Richter *et al.*, 2019; Holmes *et al.*, 2019). It consisted of ten questions: Likert-scale items measured teachers' attitudes towards AI, multiple-choice questions assessed current usage and future intentions, and open-ended questions were included to collect qualitative insights. The survey was administered electronically using the Google Forms platform. It was conducted during non-instructional hours (e.g., during teachers' free time). Participation was voluntary, with respondents being informed about the study's purpose and assured of the confidentiality of their data. Categorical responses were analysed using descriptive statistics via SPSS software. The responses to open-ended questions were examined through thematic analysis to identify the study's key topics. These methods enabled the achievement of the research objectives. The study was conducted in accordance with ethical standards for research involving human participants (ASA Code of Ethics, 2018). All participants were informed about the research objectives, guaranteed the confidentiality of their responses, and participated with full consent.

RESULTS AND DISCUSSION

Examples of AI application in educational practice

The development of educational technologies has progressed through several major stages (Table 1):

Table 1. *The main stages of development of educational technologies*

Stage	Technology	Impact
Emergence of printed materials	Books and printed materials	The integration of books and printed materials into the learning process marked the first significant step towards standardising education.
Use of audio and video materials	Films, audio recordings	By the mid-20th century, films and audio recordings began to be actively used as teaching tools.
Computer era	Computers, digital libraries	By the end of the 20th century, computers became an integral part of school and university life, enabling access to digital libraries and e-courses.
Internet and distance learning	Online courses, platforms	In the 2000s, online courses and platforms started being widely used for distance education.
AI in education	Artificial intelligence	Today, AI is used for personalised learning, data analysis, and automation of routine educational tasks.

Source: *compiled by the authors*

These developments demonstrate that technology has gradually become an integral part of the educational process and has helped to align teaching practices with contemporary demands. The integration of artificial intelligence into education is occurring on a global scale, with various countries developing implementation strategies tailored to their own cultural and economic contexts. These global examples may serve as a valuable reference for the development of effective strategies in Kyrgyzstan. In the United States, platforms such as Carnegie Learning and Khan Academy harness the power of AI to adapt to students' learning levels. For instance, the MATHia (n.d.) platform analyses student performance and automatically adjusts learning materials to match individual needs. In China, Squirrel AI (n.d.) uses AI to provide personalised tutoring services to millions of students, serving as a prime example of scalability. In Finland, AI is used to analyse student work and customise learning pathways accordingly

(Education in Finland, n.d.). In Kyrgyzstan, several schools have begun introducing experimental platforms aimed at distance education and student data analysis (Institute for Political Studies, 2025). In Russia, projects are actively being developed to introduce chatbots and automated assessment platforms to support student learning (Zenkina *et al.*, 2022). These examples demonstrate how different countries are adapting AI technologies to their educational systems while taking into account specific cultural and economic features.

Widespread examples of integrating AI into educational practice illustrate how the learning process is being transformed in several dimensions, improving efficiency and responsiveness to individual needs. For example, in the context of personalised learning, platforms such as Khan Academy, Moodle, and Google Classroom analyse students' assignments and activities to offer content that aligns with their learning levels. At the same time, systems like Quizizz, Kahoot, and Onlinetestpad automate routine tasks such as testing and grading, thereby allowing teachers to dedicate more time to creative and mentoring activities.

In many schools, virtual assistants powered by AI, such as ChatGPT or Gemini, are being used to respond promptly to students' questions regarding course materials. Additionally, AI technologies are used in content generation, automating the creation of tests, assignments, and essays, which helps adapt the learning process to the evolving needs of student groups and facilitates the development of personalised learning programmes. Furthermore, performance analysis systems powered by AI accurately identify students' strengths and weaknesses and can forecast their future performance based on prior data. These examples reflect the growing role of artificial intelligence in the education sector, illustrating its practical value in both personalising and automating the teaching and learning process.

Research on the impact of artificial intelligence on the educational process

A 2023 study conducted by Stanford University examined the impact of AI-powered adaptive platforms, particularly a tool called *Tutor CoPilot*, on student performance (Stanford's AI-Assisted Tutoring Study, 2023). The study involved more than 1,000 students and over 900 tutors and confirmed that tutors using AI increased students' mathematics achievement by 9%. This improvement was especially significant for students with lower initial academic performance, as they received personalised support. Studies conducted in Europe also confirmed the positive impact of AI in education, particularly its contribution to reducing educational disparities. For example, research by the Inspired Education Group (2023), conducted across five international schools, demonstrated that AI technologies improved student achievement by 8.12 percentage points – equivalent to a full grade level. The study also found that 84.50% of students believed their learning and development improved with AI support, while 80.18% of teachers agreed with this assessment.

AI has been recognised as a powerful tool for enhancing student engagement and learning outcomes. For instance, a meta-analysis conducted in 2025 by A. Tlili *et al.* (2025) demonstrated the positive effects of AI tools – particularly intelligent tutoring systems – on academic performance. These studies reported that AI is most effective when tailored to individual student needs. Most of the studies employed both quantitative and qualitative methods, including meta-analysis, systematic literature reviews, and randomised controlled trials (Table 2). For example, the Stanford study was a large-scale randomised controlled trial involving over 1,000 students, while the Inspired Education Group's analysis was based on data from five schools. Reports by the European Commission (2022) focused on ethical issues and the broader use of AI in education.

Table 2. *Comparative overview of studies*

Study Title	Institution	Year	Improvement in Achievement	Main Focus
Tutor CoPilot: Stanford's AI-Assisted Tutoring Study (2023)	Stanford University	2023	9%	Student achievement in mathematics
Inspired Education Group (2023)	Inspired Education Group	2023	8.12% (grade level equivalent)	Overall student academic performance
A. Tlili *et al.* (2025)	Academic Journal	2025	Positive impact, no exact %	Improvement of learning outcomes
European Commission (2022)	European Commission	2022	No exact %, positive impact	Ethical use and effectiveness of AI
C. Wan & Z. Hu (2023)	Academic publication	2023	Influence on creativity	Project-based learning with AI
X. Xie (2023)	Academic publication	2023	10% improvement	Effects of AI-driven visualisation on learning

Source: *compiled by the authors*

Studies from Russia and Kyrgyzstan have shown that the use of chatbots and adaptive systems can reduce teachers' workloads and increase student motivation (Nurkulova, 2021; Zenkina *et al.*, 2022). However, these developments are not without risks. Over-reliance on automated systems may lead to a decline in students' intrinsic motivation. Furthermore, ensuring the protection of student data and transparency of algorithms is essential, while unequal access to technology may exacerbate educational inequalities.

Digital inequality remains one of the core challenges in the era of artificial intelligence. In rural and remote areas, stable internet connections and modern devices are often lacking, creating disparities in access to technology. Not all families can afford to purchase computers or

subscribe to educational platforms. Additionally, the absence of technological skills among some students and teachers further intensifies the problem. Many educational platforms are developed exclusively in English, which limits accessibility for certain population groups. To overcome digital inequality, it is necessary to implement targeted support programmes for low-income families, improve digital infrastructure, and promote digital literacy training. These measures are crucial to ensuring equitable access to AI-driven educational opportunities across different social and geographic groups.

Preparing future teachers to work with AI

A modern teacher is expected to possess not only subject-specific knowledge but also digital literacy, critical thinking, and the ability to interact effectively with technology. Key aspects of the teacher's role now include mentorship, knowledge facilitation (moderation), and the support of students' emotional intelligence. Teachers help students develop their analytical and critical thinking skills by teaching them to interpret information accurately and make informed decisions. Moreover, teachers should foster students' interest in acquiring new knowledge and motivate them toward independent learning. AI training courses help teachers understand how AI systems function and how these systems can be effectively integrated into the teaching process. Training in digital ethics equips teachers with an understanding of data confidentiality and cybersecurity. Flexibility and adaptability are essential skills for preparing educators to cope with constant changes in both technologies and instructional methods. Future teachers must understand how to safeguard students' data and be able to critically evaluate and choose only reliable technologies. Ethical guidelines from the European Commission (2022) provide essential support in this area. It is also important to consider psychological dimensions, as AI must be used in a way that preserves student trust and motivation (European School Education Platform, 2024).

The findings of this study confirmed that teachers are generally well-prepared to use AI in the educational process. According to the survey, 67% of respondents supported the integration of AI tools into teaching, indicating a broad level of acceptance. Furthermore, 76% of teachers expressed a willingness to develop their expertise in this field, demonstrating their motivation for professional growth. The teachers' perceptions of their experience using AI were also largely positive: 59% reported that AI had made their work more engaging and easier while unlocking new opportunities. The ability to automate creative tasks was seen as a time-saving advantage, enabling teachers to devote more time to interacting with students. Considering the overall usefulness of AI, 85% of teachers believed that it introduced new methods, efficiencies, and improvements to education. These results demonstrate that teachers recognise the potential of AI and accept its growing role in the educational sphere (Table 3).

Table 3. *Survey on the use of artificial intelligence in education: teachers' perspectives and experiences*

Aspect	Percentage
I support the use of AI in making pedagogical decisions	67.3%
The teacher should act as a mentor and motivator when using AI	59%
I am willing to learn how to use AI	76.9%
The impact of AI on the future of education will bring benefits and improvements	84.6%
Courses and seminars on AI are needed	46.9%
I expect methodological guidelines and learning materials on AI	30.4%

Source: *compiled by the authors*

The results clearly demonstrate teachers' positive attitudes toward artificial intelligence, but also indicate the need for comprehensive training programmes to support their preparedness. The application of AI in education must be accompanied by strict adherence to ethical standards. Foremost among these is the demand for transparency in the logic and principles behind algorithmic operation, enabling every participant to understand the functionality and implications of the tools they use (Razin, 2019). Methodologies for evaluating effectiveness must strive to avoid bias and ensure fair assessment of rights and opportunities across different groups, thus ensuring the integrity and equity of educational outcomes.

Furthermore, for the effective and fair use of AI, the rights of all individuals within the educational system must be fully respected. This includes ensuring the safety and autonomy of students, teachers, and other participants. To implement these principles, developers and regulators must work together to create environments grounded in legal, technical, and pedagogical standards. Such coordinated efforts will enable AI to enhance fairness, transparency, and trust in educational processes (OECD, 2024). Digital inequality also requires careful attention: schools and regions with limited access to technology must be supported in order to successfully implement AI. Recommendations for educational institutions:

1. Needs assessment: conduct an analysis of the current state of teaching and identify areas where AI can provide the most benefit.

2. Teacher qualification enhancement: organise training programmes that combine technical competencies and pedagogical approaches to AI integration.

3. Ethical integration: promote discussion of ethical issues related to AI use, such as data confidentiality and algorithmic transparency.

4. Pilot projects: test AI solutions in selected classrooms or courses before broader implementation.

5. Feedback mechanisms: establish systems for collecting input from both teachers and students regarding their experiences with AI.

6. Bridging digital inequality: implement initiatives to support low-income families, improve digital infrastructure, and promote digital literacy.

In addition, the role of the teacher in the AI era is shifting towards that of mentor and moderator. Teachers must acquire digital literacy, critical thinking skills, and the ability to engage meaningfully with technology (Bozhovich, 2023). By addressing these challenges and implementing strategic measures, Kyrgyzstan can harness the potential of AI to improve educational quality and promote equity within its education system.

CONCLUSIONS

The era of artificial intelligence (AI) presents new challenges while simultaneously opening up significant opportunities for future educators. In the context of digital transformation, it is essential to reassess teaching methods and teacher training in order to ensure successful learning outcomes. Only the synergy between technology and humanistic values will allow the creation of a harmonious educational environment for the future. The preparation of future teachers must be oriented towards combining technological competence with humanitarian values, while their ability to work with AI must be grounded in principles of ethics, equity, and innovation. The findings of this study confirmed teachers' positive attitudes and readiness to use AI in education. However, the effective integration of AI into the education system requires the provision of additional resources and methodological support. The successful application of artificial intelligence in education depends on a harmonious balance between technological advancement and human-centred values. This balance is key to preparing future teachers to operate effectively in digitally transformed environments and to contribute to educational systems based on fairness, innovation, and inclusivity. AI represents a tool for unlocking educational potential, while the teacher remains the leader who uses this tool responsibly to shape future generations.

From a practical standpoint, the integration of AI into the education system calls for further support in terms of resources and pedagogical guidance. Teachers strive to align their professional experience with modern technologies through updated curricula, virtual training, and digital platforms. Previous statistical data and current research consistently highlight teachers' favourable attitudes towards the use of AI and demonstrate the practical significance of these technologies. AI has been shown to improve student outcomes and enhance the inclusiveness and versatility of educational systems. Moreover, future research should focus on a deeper analysis of the societal and ethical dimensions of AI technologies. This includes examining how teachers can optimise instructional strategies, address safety and equity concerns, and explore the ethical implications of technological deployment. The direction of future studies should centre on empowering teachers to enrich the educational process through innovative methods while preserving a balance between human values and technological advancements. The outcomes of this study offer practical guidance for education administrators and teachers, supporting the revision of strategies and the modernisation of teaching practices for the future.

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Жасалма интеллект доорундагы мугалим

Жаңыл Нуруева
Ага окутуучу
Ж. Баласагын атындагы Кыргыз улуттук университети
720033, Фрунзе көч., 547, Бишкек ш., Кыргыз Республикасы
https://orcid.org/0009-0001-4069-4428

Рита Муктарбекова
Магистр, ага окутуучу
Ж. Баласагын атындагы Кыргыз улуттук университети
720033, Фрунзе көч., 547, Бишкек ш., Кыргыз Республикасы
https://orcid.org/0009-0001-7734-9441

Аннотация. Жасалма интеллект доору мугалимдин ролун өзгөртүп, билим берүү тармагында жаңы горизонтторду ачып жатат. Бул макалада келечектеги мугалимдердин алдында турган негизги көйгөйлөр жана мүмкүнчүлүктөр каралат. Ошондой эле билим берүү процесстеринде жасалма интеллектти колдонуунун мисалдары, технологиялардын билим берүү практикасына тийгизген таасири боюнча изилдөөлөрдүн натыйжалары, билим берүүдөгү технологиялардын өнүгүүсүнүн тарыхый аспектилери жана мугалимдер арасында жүргүзүлгөн сурамжылоонун жыйынтыгына талдоо көрсөтүлүп, билим берүү мекемелерине жасалма интеллектти киргизүү боюнча сунуштар берилди. Изилдөөнүн алкагында Кыргызстандагы 207 мугалимдин арасында сурамжылоо жүргүзүлүп, алардын жасалма интеллекттин аспаптарын колдонуу тажрыйбасын жана мамилесин баалоо максатында жүргүзүлдү. Жыйынтыктар көрсөткөндөй, мугалимдердин 67% мындай аспаптарды өз практикасында активдүү колдонушат, ал эми 76% бул тармакта өз тажрыйбаларын өнүктүрүүгө даяр. Изилдөө жасалма интеллекттин окутууну жана студенттердин катышуусун жакшыртуу үчүн потенциалын баса белгилейт. Ошону менен бирге, билим алуу мүмкүнчүлүктөрүнүн жоктугу жана санариптик теңсиздик, өзгөчө айыл жергесиндеги тынчсыздануулар сыяктуу олуттуу тоскоолдуктар да аныкталды. Бул көйгөйлөр мугалимдерди даярдоо программаларын иштеп чыгуу, технологияларды этикалык колдонуу жана санариптик ресурстарга бирдей жеткиликтүү болуу зарылчылыгын көрсөтөт. Жүргүзүлгөн изилдөө учурдагы технологиялык өзгөрүүлөрдү сабак өтүүдө, практикада чагылдырып билим берүү мекемелерине болгон талаптардын өзгөрүшүн көрсөтөт. Макалада келтирилген натыйжалар практиктер жана билим берүү саясатын иштеп чыгуучулар үчүн маанилүү багыттарды сунуш кылат. Изилдөөнүн жыйынтыктары мугалимдерди жаңы шарттарда окутуу жана колдоо механизмдерин өнүктүрүү зарылдыгын көрсөтөт. Ошондой эле билим берүү программаларын жаңылоо жана санариптик сабаттуулукту жогорулатуу боюнча сунуштарды иштеп чыгууда колдонууга ылайыктуу

Негизги сөздөр: жасалма интеллект доору; билим берүү; мугалимдин ролу; билим берүү технологиялары; көйгөйлөр; билим берүү мейкиндиги

Учитель в эпоху искусственного интеллекта

Жаныл Нуруева
Старший преподаватель
Кыргызский национальный университет имени Ж. Баласагына
720033, ул. Фрунзе, 547, г. Бишкек, Кыргызская Республика
https://orcid.org/0009-0001-4069-4428

Рита Муктарбекова
Магистр, старший преподаватель
Кыргызский национальный университет имени Ж. Баласагына
720033, ул. Фрунзе, 547, г. Бишкек, Кыргызская Республика
https://orcid.org/0009-0001-7734-9441

Аннотация. Эпоха искусственного интеллекта трансформирует роль учителя и открывает новые горизонты в сфере образования. В данной статье рассмотрены основные проблемы и возможности, с которыми сталкиваются будущие учителя. Также были представлены примеры использования искусственного интеллекта в образовательных процессах, результаты исследований влияния технологий на образовательную практику, исторические аспекты развития технологий в образовании, анализ результатов опроса, проведенного среди педагогов, и даны рекомендации по внедрению искусственного интеллекта в образовательные учреждения. В рамках исследования был проведен опрос 207 учителей Кыргызстана с целью оценки их опыта и отношения к использованию инструментов искусственного интеллекта. Результаты показали, что 67 % учителей активно используют такие инструменты в своей практике, а 76 % готовы развивать свою экспертизу в этой области. В исследовании подчеркнут потенциал искусственного интеллекта для улучшения преподавания и вовлеченности студентов. В то же время были выявлены существенные препятствия, такие как отсутствие возможностей для получения образования и цифровое неравенство, что особенно актуально в сельской местности. Эти проблемы подчеркивают необходимость внедрения программ подготовки учителей, этичного использования технологий и равноправного доступа к цифровым ресурсам. Проведенное исследование продемонстрировало меняющиеся требования, которые предъявляются к образовательным учреждениям, отражающие текущие технологические изменения в преподавании и практике. Результаты, представленные в статье, предлагают важные направления для специалистов-практиков и тех, кто формирует политику в сфере образования. Результаты исследования свидетельствуют о необходимости разработки механизмов обучения и поддержки педагогов в новых условиях. Их также можно использовать при разработке рекомендаций по обновлению образовательных программ и повышению цифровой грамотности

Ключевые слова: эра искусственного интеллекта; образование; роль учителя; образовательные технологии; проблемы; образовательное пространство

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Influence of social networks on language norms and usage

Nurjamal Chonmurunova*
PhD in Philological Sciences, Associate Professor
Jusup Balasagyn Kyrgyz National University
720033, 547 Frunze Str., Bishkek, Kyrgyz Republic
https://orcid.org/0009-0005-3929-4207

Kyparisa Kulpoldieva
Senior Lecturer
Jusup Balasagyn Kyrgyz National University
720033, 547 Frunze Str., Bishkek, Kyrgyz Republic
https://orcid.org/0009-0006-8043-0845

Abstract. Modern trends in digital communication exacerbate the problem of changing language norms under the influence of social networks, making the investigation of this issue particularly relevant. The purpose of the preset study was to identify and analyse transformations in language norms and usage as a result of the active use of social networks as the primary means of everyday communication. The study employed methods of linguistic observation, content analysis, and comparative analysis. The study revealed stable changes in written and oral communication caused by Internet communication: active use of slang, emojis, abbreviations, and Anglicisms; the study recorded an expansion of usage due to norms formed within online communities. The linguistic features of popular platforms (WhatsApp, Instagram, TikTok, Telegram) were analysed, as well as differences in the speech behaviour of users depending on their age and social context. The study found that the norms of online communication often contradict conventional literary norms, thereby influencing the formation of linguistic norms among young people. The data obtained also indicated the development of specific communication strategies driven by technical limitations and the functionality of various platforms, which leads to unique linguistic manifestations in each online community. Furthermore, the analysis revealed that the intensity and nature of language changes directly correlated with the level of user involvement in interactive forms of communication, such as commenting and taking part in discussions. The practical significance of the study lies in the possibility of applying its findings in educational and media teaching practice – in the development of training courses on modern linguistics, media literacy, as well as in the field of editing and translation

Keywords: digital communication; media space; Anglicisms; Internet slang; speech variability; language transformation; youth parlance

INTRODUCTION

Contemporary researchers note: "The beginning of the 21st century will undoubtedly go down in the history of pedagogy as a pivotal stage in the development of educational content" (Bagicheva & Chonmurunova, 2024). This idea is true not only for education, but for all aspects of communication, especially language. One of the most powerful catalysts of language change is social media, which has become an integral part of the lives of millions of people around the world. These digital platforms have not only transformed the form and methods of communication, but also actively influence the content, style, vocabulary, syntax, and norms of language.

The relevance of the present study is driven by the growing influence of social media on all levels of the language system, from phonetics and orthography to semantics and pragmatics. Communication on social media is characterised by fast pace, conciseness, visual richness, and frequent violations of conventional language norms (Donii, 2023). In the new environment, language is subject to spontaneous democratisation, simplification, standardisation,

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*Corresponding author

and even aggressive expansion of Anglicisms. These processes are particularly pronounced among young people, which in the long term may influence national norms of usage. There is a need for a comprehensive understanding of the processes taking place from a linguistic standpoint, considering both internal and global contexts.

The problem of the influence of social networks on language has been the subject of close attention from researchers in various countries in recent years. G. McCulloch (2019) analysed the development of new digital language norms, arguing that the internet has become not just a platform, but a full-fledged language environment with its unique rules and culture of communication. The researcher emphasised that language on the internet is alive, flexible, and intricately linked to generational identity. British linguist C. Hutton (2009) emphasised that social networks give rise to new forms of discourse where the boundaries between formal and informal styles are blurred, and language norms become flexible and situational. Renowned linguists B. Miller & P. Mundey (2020) discussed the dual impact of social media on language, noting that "the use of social media has both positive and negative effects, but the negative effects predominate". The researchers attributed this to the simplification of linguistic structures, a decline in language literacy, and the spread of template speech patterns. A. Shamne (2014) examined the influence of the digital environment on the speech behaviour of schoolchildren and students, noting the active penetration of network jargon into the oral and written speech of students, as well as the formation of a new norm based on the practice of communication in messengers. The researcher emphasised that elements of network slang are actively becoming established in students' speech.

Polish researcher A. Niekrewicz (2021) analysed the influence of Facebook and TikTok on the grammatical norms of the Polish language. The data indicated a pronounced increase in the number of errors in public posts and comments, as well as a growth in society's tolerance for linguistic deviations. Nowadays, ignoring rules can be a form of linguistic entertainment or satire. L. Logi & M. Zappavigna (2021) conducted an interesting study, investigating the phenomenon of visual language – emojis, stickers, and GIF files – and their influence on the syntactic structure of text. According to the researchers, visual elements are gradually replacing lexical units and changing the perception of text, especially among teenagers, while emojis perform a syntactic function and influence the perception of text. Due to the prevalence of this phenomenon, the study of the influence of behavioural rituals characteristic of communication on social networks deserves special attention (Shmakov, 2020). One of the most noticeable changes caused by social networks is the emergence of new words and expressions. For instance, terms such as 'like', 'follow', and 'troll' have become part of everyday language.

O. Jackson (2023) emphasised that digital communication extensively transformed the ways in which people interact linguistically, while social media drastically changed the dynamics of language use, leading to the evolution of existing linguistic features and the emergence of new phenomena. E. Chernichenko (2023) expressed an analogous point of view, arguing that the most distinctive feature of social media language is the blurring of boundaries between written and spoken language. This hybridisation of communication forms leads to the emergence of new linguistic strategies, as evidenced by I. Romanova *et al.* (2024): "Social media platforms contributed to the emergence of new linguistic strategies, such as abbreviations and hashtags, reflecting the evolution of language in the digital age". The use of such strategies extends beyond everyday communication. For instance, L. Panjaitan & A. Patria (2024) noted that younger generations used abbreviations in academic and professional contexts, which may contribute to long-term changes in language norms. Expanding on this observation, S. Akhmedova (2024) addressed the role of digital platforms as carriers of new forms of linguistic expression: "Platforms such as Twitter, Instagram, and TikTok introduced new forms of communication, including abbreviations, emojis, and memes, which changed not only vocabulary but also grammar and syntax". S. Had Hamed (2023) also stressed the paradigm shift in language norms under the influence of the digital environment: "Social media contribute to the emergence of new linguistic conventions, such as hashtags, which influence the language attitudes and norms of the community". According to R. Huseynova *et al.* (2024), the internet and social media contributed to the development of new forms of expression and communication, influencing the evolution of the English language.

An analysis of contemporary scientific sources revealed that social media are substantially transforming language usage and norms. The key trends include the simplification of syntax, the expansion of abbreviations and emojis, a shift towards colloquial style even in formal contexts, and the development of 'digital dialects'. These processes point to the evolution of language in the digital environment and require a reconsideration of linguistic approaches to norms and usage in the 21st century. Thus, the academic community is increasingly inclined to recognise that digital communication technologies have not only changed language practice but also influenced the fundamental mechanisms of language norms and usage. All the studies cited above emphasise the multifaceted influence of social networks on language and testify to the need for further systematic analysis of these processes. A particular challenge is the study of network usage, a system of language preferences that emerge and become established in specific online communities, where norms are often formed not from the top down, but from within, through user practice. Considering the generalisation of existing scientific approaches, it can be concluded that the linguistic study of processes occurring in the modern digital environment is of great significance. These processes affect not only the formal aspects of language, but also sociolinguistic, communicative, and psycholinguistic parameters. The purpose of the

present study was to identify and analyse the principal areas of transformation of linguistic norms and usage under the influence of social networks, as well as to determine the characteristics of their manifestation in various online platforms and among diverse categories of users.

MATERIALS AND METHODS

This study employed a comprehensive approach based on a combination of qualitative and quantitative methods of scientific inquiry. The key methods were linguistic observation, content analysis, and comparative analysis. These methods were chosen due to the interdisciplinary nature of the topic, which requires analysis of both linguistic material and social communication practices. The linguistic observation method was employed at the initial stage to collect empirical material – texts, comments, posts, and dialogues published on popular social networks (WhatsApp, Instagram, TikTok, Telegram, VKontakte, X) between January 2023 and February 2025. The material was selected considering the representativeness of the sample, covering various types of content (public posts, private messages, comments, broadcasts), topics of discussion and communication formats inherent in each of the platforms under study. Particular attention was paid to the youth segment of users (aged 14-30), as the most susceptible to the influence of new language trends.

Content analysis was applied to systematise linguistic phenomena characteristic of online communication: the use of Anglicisms (direct borrowings and calques), emojis and other paralinguistic means, Internet slang (neologisms and specific meanings of existing words), acronyms and abbreviations, graphic violations of orthoepy and orthography (intentional and accidental), non-standard punctuation, and other deviations from conventional language norms. The analysis also included publications by popular bloggers and opinion leaders with a wide audience and the potential to influence the language preferences of their followers.

The comparative method helped to identify differences and similarities between the language norms presented in conventional media (news articles, literary works, official documents) and the speech practices dominant in social networks. Specifically, the study analysed messages written by the same users in distinct digital environments, varying in formality and target audience. The information base for the study included open posts and comments by social media users, scientific articles on the topic of linguistics and sociolinguistics of digital communication, as well as the results of linguistic surveys and Internet archives (Wayback Machine, Web Archive Telegram, etc.), which allow tracking the dynamics of language changes over time.

RESULTS AND DISCUSSION

Simplification and compression in modern online communication

One of the most noticeable changes brought about by social media is the emergence of new words and expressions. For instance, terms such as ‘like’, ‘follow’, and ‘troll’ have become part of everyday language. As T. Dembe (2024) noted, social media facilitates the rapid spread of new words, leading to their integration into the general lexicon. The language of social media has a series of distinctive features conditioned by the specific nature of online communication, and these phenomena are associated with the simplification and compression of words and the informal and colloquial style of communication.

Character limitations and the desire for speed and efficiency in communication lead to the use of abbreviations and acronyms (‘щас’ – сейчас (now), ‘пжлст’ – пожалуйста (please)), the omission of vowels and consonants (‘спс’ – спасибо (thanks), ‘норм’ – нормально (normal)) and the use of emoticons and emojis to convey emotions and intentions. Abbreviations and acronyms such as ‘LOL’ (laughing out loud) and ‘BRB’ (be right back) are also frequently used on social media, reflecting users’ desire to save time and space. All these examples demonstrate a tendency towards simplifying grammatical structures and adapting language to the conditions of rapid information exchange, especially in messengers and comments. People are looking for more and more new ways to express their thoughts succinctly. Interlocutors may interrupt each other or leave words unfinished. Such words include, for instance, ‘че’ (чего – why), ‘тя’ (тебя – you), ‘мя’ (меня – me), ‘дава’ (давай – let’s), ‘ясн’ (ясно – got it), ‘наверн’ (наверно – probably), ‘прям’ (прямо – right, straight) (Smirnova, 2015).

Visualisation – emojis, GIFs, and images are actively used to supplement text messages, convey emotions, and create a humorous effect. The emojis are used instead of words to express feelings, states, or even entire phrases. For example, using a laughing face emoji 😂 instead of the phrase ‘I’m laughing’ or a heart emoji ♡ instead of ‘I love you’. This illustrates how visual symbols are becoming full-fledged substitutes for linguistic units, changing the structure and functions of written language.

Disregard for norms – users often ignore spelling and punctuation rules, making mistakes and typos, which can lead to a decline in literacy. Deliberate spelling mistakes can be used to create a humorous or ironic effect. For example, ‘Привед медвед’ instead of ‘Привет, медведь’ (hello, bear) is a widespread expression used to imitate naïve or childish language, as well as to make an ironic comment on a situation. This example shows how spelling rules can be deliberately broken to express certain social or emotional meanings, especially in informal communication.

Social media also influences grammatical norms. Simplification of syntax and the use of colloquial forms are often observed. Sentences are becoming shorter, e.g., incomplete sentences are often used on social media, which can lead to a change in the perception of grammatical norms (Jebaselvi *et al.*, 2023). There is also the use of colloquial style, where forms that were previously considered informal are becoming more acceptable in written speech. Communication styles on social media also differ from

conventinal forms. Users often use emojis, GIFs, and other visual elements to express their emotions and thoughts. Visual elements are becoming a prominent part of communication, changing conventional ideas about style. The use of emojis helps convey the emotions and tone of a message, which can change the perception of the text (Tymoshenko & Savytska, 2020). An informal style of communication prevails on social media, which can influence formal written genres.

The influence of social media on language norms is multifaceted and ambiguous. On the one hand, the constant use of simplified and informal forms can contribute to the blurring of boundaries between standard and non-standard language. For instance, addressing strangers informally, using familiar expressions in business correspondence (e.g., in instant messengers).

This example illustrates how social media blurs the boundaries between formal and informal communication, contributing to the democratisation of language and a decrease in the level of formality in communication. Additionally, this includes the use of numerous exclamation marks, capital letters, and other means of expressing emotions. For example: 'I'M IN SHOCK!!! THIS IS JUST HORRIBLE!!!'. This shows how social networks contribute to the intensification of emotionality in written speech, compensating for the absence of non-verbal cues that are present in oral communication.

On the other hand, social media can serve as a platform for popularising new words and expressions that may eventually enter everyday language. There is a tendency towards simplifying grammatical structures, using short sentences, and actively employing nominative sentences. However, simplifying grammar can lead to a decline in the accuracy and expressiveness of speech. The frequent disregard for spelling and punctuation rules on social media raises concerns about a decline in the overall literacy of the population. However, some deviations from the norm may be a conscious choice aimed at creating a certain stylistic effect or expressing emotions.

Informality and colloquial style

The language of social media tends towards colloquial speech, characterised by the use of slang, jargon, and a familiar tone. Social media is a fruitful environment for the emergence of new words and expressions (neologisms) and for the development of specific Internet slang. Examples include words derived from Anglicisms ('like', 'share', 'hype') and new formations reflecting the realities of online life ('meme', 'trolling', 'bullying'). New words such as 'influencer' and 'meme' have become popular thanks to their spread on social media. In the modern globalised world, knowledge of foreign languages is becoming a prominent factor for success in various professional fields, considering that neologisms come from foreign languages (Ibraheem, 2021). Social networks actively generate neologisms and borrowings from other languages, primarily from English. Some of these words become established in the language, while others continue to be the prerogative of Internet slang. The spread of Internet memes and slang has led to the emergence of a new type of language, known as Internet slang. For example, 'жиза' (жизненно – relatable), 'ор выше гор' (a person who yells loudly, laughs, jokes about someone), 'сорян' (transliterated 'sorry' – 'сорри' – apology), 'кек' (kek – laughter, interchangeable with 'LOL'). This demonstrates how social networks create a favourable environment for the rapid spread and modification of slang, making it accessible to a wide audience and facilitating its penetration into everyday speech.

Active use of Anglicisms and their adaptation to Russian on social media. For example: 'хайп' (hype), 'чекнуть' (check), 'рофлить' ('to ROFL' – Roll On the Floor Laughing), 'кринж' (cringe). This example shows how social networks act as a catalyst for borrowings, especially from English-language Internet culture, and how these borrowings are integrated into usage, often acquiring new shades of meaning. Creation of new words and expressions that reflect the specifics of online communication. For example: 'загуглить' ('to google' – to look something up using the Google search engine), 'запостить' (to post text or other information on electronic media), 'залайкать' (to give somebody or something a positive rating by giving multiple likes'), 'зафолловить' (to follow, to subscribe to a particular person's blog). These examples demonstrate how language adapts to the latest technologies and activities, creating new verbs to describe actions related to the use of social media and the internet.

The generally accepted use of language units is also influenced by social media. The active use of internet slang and specific expressions on social media can lead to their penetration into everyday speech. Furthermore, social networks are shaping new norms of behaviour and communication, which are also reflected in language. For instance, the use of hashtags to tag topics and group content has become widespread beyond social networks.

The influence of social media on language has both positive and negative consequences. Positive consequences include expansion of vocabulary through neologisms and borrowings; development of creativity and language play; acceleration of the spread of information and new linguistic phenomena; creation of new forms of communication and self-expression. Negative consequences include a decline in literacy and the blurring of boundaries between standard and non-standard language; simplification of grammar and impoverishment of speech; the spread of aggressive and offensive content; and the risk of 'language segregation' between users of distinct social networks and age groups.

Various methods of linguistic analysis are used to investigate the influence of social networks on language:

- corporeal linguistics, where the analysis of large text arrays extracted from social networks allows identifying the frequency of use of certain words and expressions, as well as tracking changes in language over time;
- sociolinguistic surveys and interviews, where the study of the linguistic behaviour and attitudes of social

media users allows identifying the reasons and motives for the use of certain linguistic forms;

- experimental research, where experiments aimed at assessing the perception of various language styles and forms allow identifying the influence of social networks on language competence;
- discourse analysis, where the study of the structure and content of communication in social networks allows identifying social and cultural factors that influence language.

Thus, social networks have a considerable and multifaceted influence on language norms and usage. Simplification, compression, informality, and visualisation are key characteristics of social media language. These changes have both positive and negative consequences for language as a whole.

CONCLUSIONS

The study found that social media greatly affect language norms, which is reflected in the emergence of new words, expressions, and acronyms, as well as changes in language structure. One of the most noticeable effects is the use of abbreviations and acronyms, such as 'спс', 'щас', and 'пжлст', which is driven by the desire for faster information exchange. Neologisms are also actively developing, many of which are related to Internet culture, such as 'лайк, 'фолловить', and 'тролль', which have become an integral part of everyday speech. Furthermore, social networks contribute to the spread of Anglicisms and other borrowings. Words such as 'хайп', 'кринж', 'троллить', and 'рофлить' demonstrate how actively borrowings from English-language Internet culture are being adapted into Russian. These changes may lead to a blurring of the boundaries between standard and non-standard language, as well as the emergence of new norms in speech.

The use of social media contributes to changes in the grammatical and stylistic norms of language. There is a tendency towards simplification of syntax, shortening of sentences, and active use of nominative constructions. As a result, incomplete sentences are often found in texts posted on social media, which violates conventional grammatical structures. Furthermore, the use of colloquial style, slang, and colloquialisms on social media blurs the boundaries between formal and informal language. This can be observed, for example, in the use of informal forms of address to strangers, the use of familiar expressions in business correspondence and in communication via instant messengers. Such changes indicate the democratisation of language and a decrease in the level of formality in communication. Visual elements such as emojis and GIF files are becoming an essential part of communication, which also influences conventional ideas about language and style.

Social networks play a significant role in shaping new norms and standards of communication, as well as in the spread of Internet slang. The active use of terms such as 'загуглить', 'запостить', and 'зафолловить' has become part of everyday speech, which influences everyday language. Many words and expressions that originated on social media have entered widespread use, becoming part of the language, i.e., generally accepted norms of language use. However, not all changes are exclusively positive. For example, frequent disregard for spelling and punctuation rules, as well as simplification of grammar, raises concerns about the general literacy of the population. A decline in the accuracy and expressiveness of speech, especially in written form, can lead to a decrease in the level of language competence among social media users. Therewith, some deviations from the norms are a deliberate choice aimed at creating a certain stylistic effect or expressing emotions.

Thus, the influence of social media on language is a multifaceted and two-way process. On the one hand, social networks contribute to the emergence of new words and expressions, the expansion of vocabulary, the development of creativity and language play. On the other hand, they can lead to the simplification of grammatical structures, a decrease in the accuracy of speech, and the blurring of boundaries between formal and informal communication. The influence of social networks on usage is also evident in the spread of Internet slang and the development of new norms of behaviour and communication, which are gradually becoming part of everyday language. The findings of the study confirmed that social networks play a key role in the evolution of language, stimulating both its development and adaptation to new conditions of communication. Notably, changes in language are linked to the fast pace of life and the need to exchange information within a limited time frame, which leads to the emergence of new forms and trends in language. Further research is needed to gain a deeper understanding of the dynamics of language in the digital age and to develop effective strategies for preserving linguistic culture and improving literacy.

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CONFLICT OF INTEREST

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Социалдык тармактардын тил нормаларына жана узуска тийгизген таасирин изилдөө

Нуржамал Чонмурунова
Филология илимдеринин кандидаты, доцент
Ж. Баласагын атындагы Кыргыз улуттук университети
720033, Фрунзе көч., 547, Бишкек ш., Кыргыз Республикасы
https://orcid.org/0009-0005-3929-4207

Кипариса Кулболдиева
Улук окутуучу
Ж. Баласагын атындагы Кыргыз улуттук университети
720033, Фрунзе көч., 547, Бишкек ш., Кыргыз Республикасы
https://orcid.org/0009-0006-8043-0845

Аннотация. Заманбап санариптик коммуникациянын тенденциялары социалдык тармактардын тил нормаларына тийгизген таасири маселени курчууда, бул изилдөөнү өзгөчө актуалдуу кылат. Бул изилдөөнүн максаты – социалдык тармактар күнүмдүк баарлашуунун негизги каражатына айланганы менен байланыштуу тил нормалары менен узустун өзгөрүүлөрүн аныктоо жана талдоо. Иште лингвистикалык байкоо, контент-анализ, салыштырма анализ ыкмалары колдонулган. Изилдөөнүн жыйынтыгында интернет-баарлашууга байланыштуу жазуу жана оозеки коммуникацияда туруктуу өзгөрүүлөр аныкталган: жаргон сөздөрдүн, эмоцияларды чагылдырган сүрөтчөлөрдүн (эмодзи), кыскартуулар менен англицизмдердин активдүү колдонулушу; социалдык тармактардагы коомчулуктун ичинде калыптанган нормалар аркылуу узус кеңейгени белгиленген. WhatsApp, Instagram, TikTok, Telegram сыяктуу популярдуу платформалардын тилдик өзгөчөлүктөрү жана колдонуучулардын жаш курагы менен социалдык контекстине жараша сүйлөө жүрүм-турумундагы айырмачылыктар талданган. Изилдөөнүн жүрүшүндө социалдык тармактардагы сүйлөө нормалары көп учурда салттуу адабий нормалар менен карама-каршы келип, жаштардын тил нормасын калыптандырууга таасир берип жатканы аныкталган. Алынган маалыматтар ар бир социалдык коомчулукта техникалык чектөөлөр жана ар кандай платформалардын функцияларынан улам уникалдуу тил көрүнүштөрүн жараткан өзгөчө коммуникациялык стратегиялардын түзүлүп жатканын да көрсөтөт. Мындан тышкары, тил өзгөрүүлөрүнүн интенсивдүүлүгү менен колдонуучулардын комментарий жазуу жана талкууларга катышуу сыяктуу интерактивдүү коммуникация формаларына тартылуу деңгээлине түз байланыштуу экени аныкталган. Изилдөөнүн практикалык мааниси – анын жыйынтыктарын билим берүү жана медиа-педагогика практикасында, заманбап лингвистика, медиасабаттуулук боюнча окуу курстарын түзүүдө, ошондой эле редакциялык жана котормочулук ишмердикте колдонууга мүмкүн

Негизги сөздөр: санариптик коммуникация; медиамейкиндик; англицизмдер; интернет-жаргон; сүйлөө вариативдүүлүгү; тил трансформациясы; жаштар узусу

Изучение влияния социальных сетей на языковые нормы и узус

Нуржамал Чонмурунова
Кандидат филологических наук, доцент
Кыргызский национальный университет имени Ж. Баласагына
720033, ул. Фрунзе, 547, г. Бишкек, Кыргызская Республика
https://orcid.org/0009-0005-3929-4207

Кипариса Кулболдиева
Старший преподаватель
Кыргызский национальный университет имени Ж. Баласагына
720033, ул. Фрунзе, 547, г. Бишкек, Кыргызская Республика
https://orcid.org/0009-0006-8043-0845

Аннотация. Современные тенденции цифровой коммуникации обостряют проблему изменения языковых норм под влиянием социальных сетей, что делает изучение данного вопроса особенно актуальным. Целью настоящего исследования было выявление и анализ трансформаций языковых норм и узуса в результате активного использования социальных сетей как основного средства повседневного общения. В работе применялись методы лингвистического наблюдения, контент-анализа, сопоставительного анализа. В результате исследования были выявлены устойчивые изменения в письменной и устной коммуникации, вызванные интернет-общением: активное использование жаргонизмов, эмодзи, аббревиатур и англицизмов; зафиксировано расширение узуса за счет норм, формирующихся внутри сетевых сообществ. Были проанализированы языковые особенности популярных платформ (WhatsApp, Instagram, TikTok, Telegram), а также различия в речевом поведении пользователей в зависимости от возраста и социального контекста. Установлено, что нормы сетевого общения нередко вступают в противоречие с традиционными литературными нормами, при этом влияя на формирование языковой нормы у молодежи. Полученные данные также свидетельствуют о формировании специфических коммуникативных стратегий, обусловленных техническими ограничениями и функционалом различных платформ, что приводит к уникальным языковым проявлениям в каждом сетевом сообществе. Кроме того, анализ показал, что интенсивность и характер языковых изменений напрямую коррелируют с уровнем вовлеченности пользователей в интерактивные формы коммуникации, такие как комментирование и участие в дискуссиях. Практическая значимость исследования заключается в возможности применения его результатов в образовательной и медиапедагогической практике – при разработке учебных курсов по современной лингвистике, медиаграмотности, а также в сфере редакторской и переводческой деятельности

Ключевые слова: цифровая коммуникация; медиапространство; англицизмы; интернет-жаргон; речевая вариативность; языковая трансформация; молодежный узус

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Integration of physics and physiology in the study of the eye as an optical system

Aisuluu Egamberdieva*
PhD in Physical and Mathematical Sciences, Associate Professor
Jusup Balasagyn Kyrgyz National University
720033, 547 Frunze Str., Bishkek, Kyrgyz Republic
https://orcid.org/0009-0000-1478-4326

Mukhabbat Sadyrova
Associate Professor
Osh State University
723500, 331 Lenin Str., Osh, Kyrgyz Republic
https://orcid.org/0009-0009-6831-507X

Batmakan Kadenova
Associate Professor
Osh State University
723500, 331 Lenin Str., Osh, Kyrgyz Republic
https://orcid.org/0009-0004-2642-2006

Zhypargul Karimova
Lecturer
Osh State University
723500, 331 Lenin Str., Osh, Kyrgyz Republic
https://orcid.org/0009-0008-1358-6166

Kanzada Sagimbayeva
Senior Lecturer
Osh State University
723500, 331 Lenin Str., Osh, Kyrgyz Republic
https://orcid.org/0009-0008-0364-1029

Abstract. The relevance of studying the eye as a complex optical system, combining principles of physics and physiology, lies in the need for a thorough understanding of image formation processes and the mechanisms of visual perception. This study aimed to identify the interrelations between the physical characteristics of the eye's optical components and their physiological functions, which together ensure clear and accurate visual perception. The research employed methods of geometric optics to model the path of light rays through the eye's optical media, physiological methods to assess accommodation and visual acuity, as well as a comparative analysis of data obtained from both healthy and pathological eye models. The optical properties of the cornea, crystalline lens and vitreous body were examined, with aberrations introduced by each component analysed, and the effect of accommodation on image formation on the retina established. It was also found that deviations in the optical parameters of the eye, such as changes in the curvature of the cornea or crystalline lens, lead to visual impairments (myopia, hypermetropia, astigmatism) that affect daily functioning. The findings may be of use to ophthalmologists and optometrists in the diagnosis and correction of visual disorders, as well as in the development of new optical devices

Keywords: vision; refraction; accommodation; crystalline lens; myopia; hypermetropia; physiology

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*Corresponding author

INTRODUCTION

In today's world, where technology is rapidly advancing and the understanding of biological processes is growing, the integration of disciplines within natural and medical sciences is becoming a necessity. Traditionally, natural and medical sciences developed relatively independently. However, it is clear that progress in understanding health and disease, as well as in developing effective treatment methods, requires a deep integration of knowledge from various disciplines. Interdisciplinary integration facilitates the creation of hybrid models that contribute to broadening the horizons of knowledge and deepening the understanding of health and illness. The importance of such an approach has become particularly evident in recent years, as scientific progress demands more flexible, interconnected formats for learning and research (Sadyrova & Sagymbaeva, 2022). In this context, knowledge gained from different disciplines contributes to a more complete understanding of complex biological and medical processes and also fosters the development of innovative approaches to treating and preventing diseases. According to numerous contemporary studies, a key factor in successful interdisciplinary integration is the development of skills in critical thinking, creative problem-solving, and a scientific approach (Kolesnyk *et al.*, 2023; Egamberdieva *et al.*, 2024). These skills are essential for adapting to changes in science and technology and for solving complex problems that demand a comprehensive approach. Interdisciplinary integration allows students to perceive the interrelationships between different subject areas and to understand their mutual influence and interaction. As J. Schmitt *et al.* (2023) note, this fosters the development of a deep and comprehensive understanding of societal and natural science processes and also cultivates the ability to apply acquired knowledge in various situations.

In modern dictionaries, the term "integration" is most often defined as follows: integration (from Latin) – restoration, replenishment, the combining of parts into a whole (*integer* – whole), notable not as a mechanical connection, but as mutual penetration and interaction (Nurmatova *et al.*, 2022). Biophysics is an interdisciplinary field combining elements of natural sciences, such as biology, chemistry, and physics, with those of medical sciences – biochemistry, physiology, surgery, radiography, orthopaedics, and pharmacology. The biophysics course covers a range of problems absolutely necessary for the professional training of doctors (Aitkenova *et al.*, 2022).

T. Kreps (2019) and A. Ader *et al.* (2020) note that the integration of knowledge is of great significance in contemporary education and is becoming a key element, as it addresses the challenges faced by students and professionals in their activities. Interdisciplinary integration also contributes to the development of universal skills among students, such as critical thinking, creative problem-solving, communication, and collaboration. These skills are essential for successful adaptation to a rapidly changing world and for tackling complex tasks that require a comprehensive approach (Tiwen, 2023). In modern education, increasing attention is being paid to interdisciplinary projects and assignments that allow students to apply knowledge from various fields in practice. Such projects foster the development of creative thinking, independence, and research skills among learners. As L. Shestakova (2013) points out, from the perspective of contemporary requirements for the content of higher professional education, a future specialist must possess interdisciplinary professional mobility.

Students of medical specialities study the fundamentals of human body structure and function. One of the most vital sense organs is the eye, whose function is based on complex interactions between physical laws and physiological processes. Vision is one of the most important human senses, enabling the perception of information about the surrounding world. Studying the eye as an optical system requires a complex approach, combining knowledge from various fields of science, including physics and physiology. Physics provides an understanding of the optical principles governing the eye's operation, while physiology explains the processes occurring within biological tissues that facilitate the conversion of light into nerve impulses. Integrating these two disciplines allows for the formation of a more complete understanding of how vision works and its disorders.

In recent years, there has been a significant increase in interest in various aspects of integration. The problem of interdisciplinary integration is of key importance for both the theoretical development of pedagogy and the practice of teaching. It is linked to the necessity of structuring educational content and establishing systemic connections between disciplines. Educational components that reflect the trends of integrating scientific knowledge play a crucial role. It is precisely integration that shapes an individual's style of scientific thinking and worldview (Nurmatova *et al.*, 2022). This article aimed to explore the possibilities and significance of integrating the disciplines of physics and physiology when teaching medical students, specifically in the context of studying the eye as an optical system. The article investigated how principles of optical physics, such as light refraction, diffraction, and focusing, are interconnected with physiological processes occurring in the eyes, including accommodation, the perception of light and images, and the mechanisms of vision. The article underscored the importance of a multidisciplinary approach for a deeper understanding of eye function, its role in visual perception, and the development of effective methods for diagnosing and correcting vision disorders. It also considered how a comprehensive approach, combining fundamental knowledge from physics (optics, light phenomena) and physiology (eye anatomy, processes of light perception and visual information processing), contributes to a deeper and more comprehensive understanding of the visual organ's function. This will enable future doctors, particularly ophthalmologists, to better understand the mechanisms of vision, diagnose disorders, and develop effective treatment

methods. Prospects for improving the educational process in medical institutions through the implementation of interdisciplinary teaching approaches were also examined.

MATERIALS AND METHODS

In the research process, methods of theoretical analysis, empirical research, and comparative analysis were employed, allowing for a comprehensive approach to the issue of teaching optics and physiology of vision in medical universities. The method of theoretical analysis was used to study the physical principles of the visual apparatus, including the laws of optics (refraction, diffraction, focusing) and physiological processes (accommodation, nerve impulse transmission, image perception). It allowed for the justification of the necessity of integrating knowledge from physics and physiology for a deeper understanding of vision mechanisms and their disorders. Empirical research was used to collect data that helped to identify shortcomings in existing educational programmes and propose ways for their improvement.

A comparative analysis of the curricula of medical universities, including programmes in ophthalmology and anatomy, was conducted to evaluate existing educational approaches. Special attention was given to the integration of the disciplines of physics and physiology, as well as to the analysis of teaching materials used for student instruction. The comparative analysis allowed for the identification of the advantages and disadvantages of various teaching approaches and the proposal of recommendations for improving the educational process. Within the framework of theoretical analysis, existing models for teaching the physics and physiology of vision were examined, and scientific articles and monographs dedicated to the integration of these disciplines were studied. A systematisation and classification of the main physical and physiological concepts necessary for understanding the eye as an optical system were carried out. Particular attention was paid to analysing the interrelationship between the physical laws of optics and the physiological processes occurring in the eye. Textbooks and teaching aids on physics and physiology used in medical universities were analysed (Semenyuk, 2011; Leshchenko & Ilyich, 2012). Examples of lectures and practical classes dedicated to studying the eye as an optical system were also considered.

RESULTS AND DISCUSSION

Challenges in integrating the disciplines of physics and physiology in medical university curricula

Integrating the disciplines of physics and physiology in the education of medical university students is of key importance for a deeper understanding of the eye's function as a complex optical system. Physical laws, such as light refraction, focusing, and diffraction, combined with the physiological processes of the visual apparatus, form a unified picture of how the organ of vision functions. The eye can be viewed as an optical system where light rays pass through the cornea and the crystalline lens, and are then focused onto the retina. This process is closely linked to the physiological mechanisms of accommodation, whereby the eye changes the shape of the crystalline lens to focus on objects at different distances. Understanding these processes requires knowledge of both physical principles and physiological characteristics. For instance, it is important to understand how the angle of light refraction depends on the curvature of the cornea and crystalline lens, as well as how the muscles responsible for accommodation control the focusing of the image on the retina. These processes are connected to the accuracy of image perception and the analysis of light fluxes, which necessitates knowledge of both optics and neurophysiology.

Despite the clear advantages of integrating physics and physiology, the implementation of this approach in the educational process of medical universities faces several challenges. Firstly, there is a significant separation between disciplines within the curricula. Physics is often treated as a standalone subject, not always actively linked with medical subjects such as physiology or anatomy (Khabibulina, 2016). This separation leads to students having insufficient awareness of the interrelationship between physical and physiological processes in the eyes. Furthermore, in the teaching of physics, particularly at the level of medical universities, there is often insufficient attention paid to the biological aspects of eye function. Instruction is limited to basic laws of optics, without a deep explanation of how these laws directly influence physiological processes like accommodation, image perception, and the neurophysiology of vision. This creates gaps in students' understanding, which hinders the diagnosis and effective treatment of eye diseases. Teaching the physiology of vision also has its own peculiarities. While the physiological approach emphasises the biological side of the eye's function, the physical aspect, such as the principle of light focusing, often remains on the periphery of attention. Students studying physiology exclusively may underestimate the importance of physical processes in diagnosing diseases such as glaucoma, cataracts, or myopia, where intervention in the physics of light flow is crucial for developing effective treatment methods. Thus, for effective integration of disciplines, it is necessary not only to revise educational programmes but also to train educators to work in an interdisciplinary environment (Drake & Reid, 2018; Wang *et al.*, 2020). It is important to combine theoretical and practical approaches in teaching so that students can see the interrelationship between physical laws and the physiology of the eye, which will enable them not only to understand the visual system more deeply but also to improve the level of diagnosis and treatment of diseases.

Example of a lecture session taking into account the integration of physics and physiology

Currently, the generally accepted form of organising physics teaching in higher education is the lecture-practical format. The term "lecture-practical format" indicates that the main organisational forms of student learning are lectures

and practical sessions. For effective teaching and discipline integration in the first year, conducting joint lectures by physics and physiology lecturers can be utilised, where common topics are considered from the perspective of both disciplines. For example, a lecture topic might be: Light Refraction and Eye Accommodation: PhysicoPhysiological Integration. The aim of the lecture is to form a holistic understanding among students of the mechanisms of vision, integrating knowledge from physics and physiology; to demonstrate how physical laws of optics are reflected in the biological structures of the eye; and to explain the process of accommodation as a result of the interaction between physiological processes and physical principles. This will contribute to the development of students' critical thinking and their ability to use knowledge from different fields for a deep understanding of the visual system's function. A proposed lecture structure is presented below.

Introduction (10 minutes). The physiology lecturer briefly introduces students to the importance of vision as the primary sensory channel for perceiving the external world and the role of the eye as an optical device. They explain how light serves as a stimulus for visual perception. The physics lecturer highlights the significance of understanding the principles of light propagation and refraction for studying optical systems, including the eye. It is also emphasised that only through the integration of knowledge from both disciplines can one understand how physical and physiological mechanisms interact to achieve effective visual perception.

Theoretical part (main body of the lecture). For a deeper understanding of the eye's function as an optical system, it is important to explain in detail both the physical and physiological processes occurring during the perception of visual information. These processes can be divided into two main parts: the physics and the physiology of vision.

Physical basis of light refraction (20 minutes). Refraction is the change in the direction of light when it passes from one medium into another with a different density. For instance, light entering the eye is refracted as it passes through the cornea, aqueous humour, crystalline lens, and vitreous body. The physics lecturer explains the concept of the refractive index of a medium, formulates Snell's Law, and explains its application at the boundary between two media (1):

$$n_1 \cdot \sin\alpha = \sin\beta \cdot n_2, \quad (1)$$

where n_1, n_2 are the refractive indices of the first and second media, respectively; sin α, sin β are the sines of the angles of incidence and refraction of light.

For the eye, the refractive indices of different media (air, cornea, crystalline lens) are important, as is how a change in the angle of incidence affects the focal point of the image on the retina. When light passes through the optical elements of the eye, it is focused onto the retina. The primary focusing surface is the cornea, which refracts about 70% of the light, and the crystalline lens, which is responsible for the remaining 30%. The crystalline lens has the ability to change its shape to focus on objects at various distances (the process of accommodation). The lecturer explains the concept of a lens, its focal length, and optical power. They demonstrate how lenses form images and show the following examples, such as using simple lenses to illustrate light refraction and diagrams of light refraction when passing through a plane-parallel plate and a prism. The physics lecturer can use the thin lens equation to explain focusing (2):

$$\frac{1}{f} = \frac{1}{a_1} + \frac{1}{a_2}, \quad (2)$$

where f is the focal length; a_1 is the distance from the object to the lens; a_2 is the distance from the lens to the image (retina).

If the eye has ideal optics, the image will always be clear on the retina. In the case of vision defects (myopia, hypermetropia), focusing occurs not on the retina, but in front of or behind it.

The optical system of the eye (20 minutes). The eye consists of several optical elements, each playing a role in focusing light: the cornea – the eye's first refractive surface, which focuses light; the crystalline lens – an adjustable lens that changes its shape to focus the image on the retina; the vitreous body – a transparent substance that transmits light to the retina. The physics lecturer describes the optical characteristics of the cornea and crystalline lens (refractive indices, radii of curvature). They explain that the eye represents a complex lens system that focuses the image on the retina. They demonstrate how lenses with different characteristics influence image formation. Here, the lecturers provide examples: diagrams of light passing through various structures of the eye and a comparison of the optical power of the cornea and crystalline lens. The physiology lecturer describes the structure of the eye, highlighting the main elements of the optical system: the cornea, crystalline lens, anterior and posterior chambers, and vitreous body. They emphasise the role of the cornea and crystalline lens in light refraction. They explain how light is focused on the retina. They mention that the shape of the crystalline lens can change.

Accommodation of the eye: physiology and physics (30 minutes). The physiology lecturer explains the physiological processes of accommodation and perception, that is, the mechanism of accommodation. Accommodation is the eye's ability to change the shape of the crystalline lens to focus on objects at various distances. This process is regulated by the ciliary muscle, which, upon contraction, loosens the tension on the crystalline lens ligaments, allowing the crystalline lens to become more convex for focusing on near objects. When an object moves further away, the ciliary muscle relaxes, the ligaments tighten, and the crystalline lens becomes flatter, focusing light on the distant object. The mechanism of accommodation itself consists of the following: 1) for near objects, the ciliary muscle contracts, allowing the crystalline lens to become more convex, which increases its refractive power; 2) for distant objects, the ciliary muscle relaxes, the crystalline

lens becomes flatter, which decreases its refractive power and focuses the image on the retina. The physics lecturer explains that the change in the curvature of the crystalline lens leads to a change in its optical power and demonstrates using diagrams how the change in the crystalline lens's optical power allows the image to be focused on the retina at different object distances. They also explain how the focal length of a lens changes with its curvature.

When the distance to an object changes, the eye automatically adjusts to maintain focus. In the case of vision defects, images of distant objects, when the eye is relaxed, can be focused either in front of the retina – myopia (short-sightedness) – or behind the retina – hypermetropia (long-sightedness). The most common vision defects include myopia (short-sightedness) and hypermetropia (long-sightedness), which are associated with excessive or insufficient convexity of the crystalline lens.

If the crystalline lens is excessively convex, the optical power of the eye exceeds the norm. In this instance, the position of the posterior focal point, when the ciliary muscle is relaxed, falls in front of the retina (Fig. 1a). Such an eye cannot clearly see distant objects. Even with a small degree of myopia, the far point of accommodation decreases to a few tens of centimetres (for a normal eye, it is infinity). The near point of accommodation also decreases in this case. A person with myopia is better at performing tasks requiring close vision than someone with normal sight. If the convexity of the crystalline lens is insufficient, the optical power of the eye is less than normal. In this case, the position of the posterior focal point, when the ciliary muscle is relaxed, falls behind the retina (Fig. 1b). A hypermetropic eye can only clearly see distant objects by tensing the ciliary muscle (which quickly leads to fatigue). The near point of accommodation in hypermetropia significantly exceeds 25 cm. Consequently, the linear limit of resolution increases. The person loses the ability to perform tasks requiring fine vision, and difficulties arise when reading. To compensate for hyperopia, convex lenses are used in glasses.

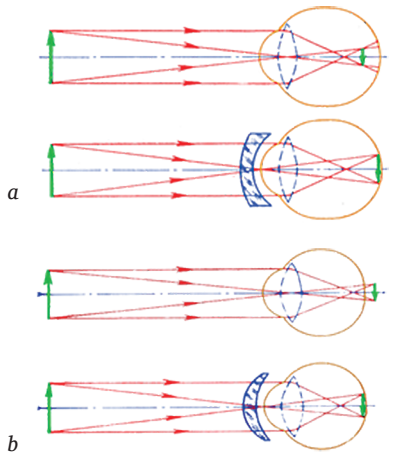

Figure 1. *Compensation of myopia (a) and hypermetropia (b)*
Source: *authors' development*

After the image is focused on the retina, it is converted into electrical signals that are transmitted to the brain. The physiology lecturer explains the function of the retinal photoreceptors (rods and cones), which are responsible for the perception of light and colour. Rods are sensitive to dim light and are responsible for vision in low illumination. Cones perceive light in bright conditions and are responsible for colour perception. When light acts upon the photoreceptors, a chemical reaction occurs, resulting in the generation of nerve impulses. These impulses are transmitted through a network of retinal neurons, then along the optic nerve to the brain. Retinal neural pathways (e.g., ganglion cells) transmit electrical impulses to the visual cortex of the brain, where image interpretation takes place. The brain integrates and processes visual information, extracting shapes, colours, motion, and depth, which enables humans to perceive the surrounding world in high resolution and detail.

Conclusion (10 minutes). Both lecturers jointly summarise the lecture, emphasising the integration of physical principles and physiological mechanisms and highlighting the importance of understanding the mechanisms of refraction and accommodation for comprehending the visual system's function. Questions for independent study are proposed.

Advantages of integrating knowledge from two disciplines

To enhance students' academic and cognitive engagement, interest, and motivation to study the eye's optical system, interactive elements are incorporated into the educational process (Tsvetikova, 2013). Simple experiments involving a laser pointer and lenses are used to demonstrate light refraction, alongside animations illustrating the change in crystalline lens shape during accommodation, diagrams showing images focusing on the retina at different crystalline lens positions, and calculations of the change in the crystalline lens's optical power during accommodation. Discussion, by posing questions to students to prompt debate, is also utilised.

A joint lecture combining physics and physiology represents an effective teaching method that contributes to a more complete and holistic understanding of the visual system's function (Leshchenko & Ilyich, 2012). Integrating knowledge from the two disciplines allows students to more deeply grasp the connection between the physical principles of optics and the physiological processes that occur in the eye:

1. Knowledge integration. Students see how the physical laws of optics interact with physiological processes in the eyes. This helps them realise that the mechanisms of vision do not exist in isolation but constitute a complex, interconnected system.

2. Increased interest. Joint lectures delivered by two lecturers make the material more engaging and dynamic. This allows for a more lively and vivid presentation of the topic, which in turn increases student motivation and interest in the subject matter.

3. Deep understanding. Students gain not only knowledge but also an understanding of how the mechanisms of vision function. This approach facilitates the assimilation of material at a deeper level, as students begin to understand not only "what" but also "why" certain physiological processes occur in the eyes.

4. Development of critical thinking. Students learn to apply knowledge from different disciplines when analysing complex biological systems such as the visual system. This contributes to the development of critical thinking and the ability to integrate information from various fields, which is an important skill for a medical professional.

Joint lectures help to form a holistic understanding of vision, emphasising the importance of an interdisciplinary approach in medicine (Sadyrova *et al.*, 2024). Students see how knowledge from physics and physiology is combined to solve complex medical problems. This approach not only improves the understanding of physiological processes but also prepares students for solving medical problems in real-world practice, where integration of knowledge from different areas is often required.

Based on the analysis of the data obtained during the research, it can be concluded that medical university students need to be taught the interrelationship between the optical properties of the visual apparatus and its physiological functions. This will enable them to understand more fully how the visual organ adapts to different conditions, how image perception occurs, and how various pathologies can affect the system's functionality. Including this knowledge in the educational programmes of medical universities provides an opportunity for students to perceive the eye as a complex biophysical instrument, rather than simply as an organ responsible for light perception.

CONCLUSIONS

Integrating interdisciplinary approaches into the process of teaching physics not only improves educational outcomes but also enhances students' motivation to learn, which is important for their comprehensive development and preparation for future education. An integrated approach to teaching, including joint lectures, creates an effective educational environment that promotes deep mastery of the material and the development of important skills for students' future professional activities. This approach underscores the importance of interdisciplinary analysis in medicine, where knowledge of physical laws and physiological processes is necessary for accurate diagnosis and effective treatment.

The prospects for improving the integration of physics and physiology into medical curricula are quite extensive. Firstly, changes are needed in teaching approaches, whereby the physics and physiology of the eye will be viewed as complementary disciplines. For this purpose, more integrated courses can be used, covering both the physics of optics and the physiological aspects of the visual organ's function. This approach will allow students not only to understand the fundamental physical principles but also to see their practical application in medicine. Secondly, it is important to implement new technologies and teaching methods into the educational process, such as visual apparatus simulators and virtual laboratories. This will enable students to study practically how various physical and physiological parameters influence visual perception. Virtual simulations can be used for modelling processes like accommodation, light refraction, and the diagnosis of visual disorders, providing students with a unique opportunity for hands-on study of complex biophysical processes. Furthermore, an important aspect is enhancing the qualifications of lecturers working in the interdisciplinary field. Professional development programmes aimed at preparing lecturers for interdisciplinary teaching will help to make education more effective and relevant. Close collaboration between physics and physiology lecturers is also necessary so that they can jointly develop educational materials that will cover both aspects of the eye's function.

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CONFLICT OF INTEREST

None.

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Физика жана физиология дисциплиналарынын көздү оптикалык система катары изилдөөдөгү интеграциясы

Айсулуу Эгамбердиева
Физика-математика илимдеринин кандидаты, доцент
Ж. Баласагын атындагы Кыргыз улуттук университети
720033, Фрунзе көч., 547, Бишкек ш., Кыргыз Республикасы
https://orcid.org/0009-0000-1478-4326

Мухаббат Садырова
Доцент
Ош мамлекеттик университети
723500, Ленин көч., 331, Ош ш., Кыргыз Республикасы
https://orcid.org/0009-0009-6831-507X

Батмакан Каденова
Доцент
Ош мамлекеттик университети
723500, Ленин көч., 331, Ош ш., Кыргыз Республикасы
https://orcid.org/0009-0004-2642-2006

Канзад Сагымбаева
Улук окутуучу
Ош мамлекеттик университети
723500, Ленин көч., 331, Ош ш., Кыргыз Республикасы
https://orcid.org/0009-0008-0364-1029

Жыпаргул Каримова
Окутуучу
Ош мамлекеттик университети
723500, Ленин көч., 331, Ош ш., Кыргыз Республикасы
https://orcid.org/0009-0008-1358-6166

Аннотация. Көздү жөнөкөй оптикалык система катары изилдөө, физика жана физиологиянын принциптерин бириктирип, сүрөт түзүлүшү процессин жана көздү кабыл алуу механизмдерин терең түшүнүүнүн зарылдыгы менен белгиленет. Бул иштин максаты – көздүн оптикалык элементтеринин физикалык мүнөздөмөлөрү менен алардын физиологиялык иштешинин ортосундагы байланыштарды аныктоо, бул болсо так жана туура көрүү процесстерин камсыз кылат. Иште геометриялык оптика методдору колдонулду, көздүн оптикалык чөйрөлөрү аркылуу нурлардын өтүшүн моделдөө үчүн, физиологиялык ыкмаларды колдонуу менен аккомодацияны жана көздүн ачуулугун баалоо жүргүзүлдү, ошондой эле ден-соолуктагы жана патологиялык көздүн моделдеринен алынган маалыматтардын салыштырмалуусу жүргүзүлдү. Роговица, линза жана айнек кумурскасынын оптикалык касиеттери изилденди, ар бир элементтин киргизген аберрациялары талданды жана аккомодациянын сетчатканы сүрөттөгөнгө таасирин ачып көрсөтүлдү. Ошондой эле, көздүн оптикалык параметрлериндеги кемчиликтер, мисалы, роговицанын же линзанын ийилгендигинин өзгөрүшү, көздүн көз карашына (миопия, гиперметропия, астигматизм) таасир берип, адамдын күнүмдүк иш-аркетин өзгөртөт деп аныкталды. Иштин натыйжалары офтальмологдорго жана оптометристтерге көздүн көрүнүшүн диагностикалоо, оңдоо жана жаңы оптикалык аспаптарды иштеп чыгууда колдонулушу мүмкүн

Негизги сөздөр: көрүү; сынуу; аккомодация; хрусталик; миопия; гиперметропия; физиология

Интеграция дисциплин физики и физиологии при изучении глаза как оптической системы

Айсулуу Эгамбердиева
Кандидат физико-математических наук, доцент
Кыргызский национальный университет имени Ж. Баласагына
720033, ул. Фрунзе, 547, г. Бишкек, Кыргызская Республика
https://orcid.org/0009-0000-1478-4326

Мухаббат Садырова
Доцент
Ошский государственный университет
723500, ул. Ленина, 331, г. Ош, Кыргызская Республика
https://orcid.org/0009-0009-6831-507X

Батмакан Каденова
Доцент
Ошский государственный университет
723500, ул. Ленина, 331, г. Ош, Кыргызская Республика
https://orcid.org/0009-0004-2642-2006

Канзада Сагымбаева
Старший преподаватель
Ошский государственный университет
723500, ул. Ленина, 331, г. Ош, Кыргызская Республика
https://orcid.org/0009-0008-0364-1029

Жыпаргул Каримова
Преподаватель
Ошский государственный университет
723500, ул. Ленина, 331, г. Ош, Кыргызская Республика
https://orcid.org/0009-0008-1358-6166

Аннотация. Актуальность изучения глаза как сложной оптической системы, сочетающей принципы физики и физиологии, обусловлена необходимостью глубокого понимания процессов формирования изображения и механизмов зрительного восприятия. Целью данной работы было выявление взаимосвязей между физическими характеристиками оптических элементов глаза и их физиологическим функционированием, обеспечивающим четкое и адекватное зрительное восприятие. В работе использованы методы геометрической оптики для моделирования хода лучей через оптические среды глаза, физиологические методы для оценки аккомодации и остроты зрения, а также сравнительный анализ данных, полученных на здоровых и патологических моделях глаза. Были исследованы оптические свойства роговицы, хрусталика и стекловидного тела, проанализированы аберрации, вносимые каждым элементом, и установлено влияние аккомодации на формирование изображения на сетчатке. Также было выявлено, что отклонения в оптических параметрах глаза, такие как изменение кривизны роговицы или хрусталика, приводят к нарушениям зрения (миопия, гиперметропия, астигматизм), влияющим на повседневную деятельность человека. Результаты работы могут быть использованы офтальмологами и оптометристами для диагностики, коррекции нарушений зрения и разработки новых оптических приборов

Ключевые слова: зрение; преломление; аккомодация; хрусталик; миопия; гиперметропия; физиология

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Адрес редакции:
Кыргызский национальный университет имени Жусупа Баласагына
720033, проспект Манаса, 66, г. Бишкек, Кыргызская Республика
E-mail: info@balasagynbulletin.com
https://balasagynbulletin.com/ru