Трансформация профессионально-личностных компетенций педагога и преодоление этических проблем при внедрении искусственного интеллекта в образовании

Б. ТОЛЕУ, А. АМАНГЕЛЬДИЕВ, А. КОПБАЙ, А. КУЛБАЕВА

АННОТАЦИЯ

Введение. Быстрое внедрение искусственного интеллекта (ИИ) в образовательную практику требует трансформации профессиональных и личностных компетенций педагогов. Ключевой проблемой становится несоответствие между требованиями к профессиональным компетенциям современного педагога и существующими механизмами их формирования. Поэтому одной из основных задач современного образования является необходимость подготовки учителей и развитие их компетенций в использовании цифровых технологий.

Цель: выявление и обоснование трансформации профессионально-личностных компетенций педагога и способов преодоления этических проблем при внедрении искусственного интеллекта в образовательный процесс.

Материалы и методы. В исследовании приняли участие 200 педагогов из школ, колледжей и вузов Казахстана. Применялась адаптированная модель TPACK (Technological Pedagogical Content Knowledge), включавшая четыре блока: технологические, педагогические, предметные и интегративные компетенции (α = 0,83–0,89). Также использовались полуструктурированные интервью. Обработка данных проводилась с применением непараметрических методов (тесты Краскела–Уоллиса, Манна–Уитни, корреляционный анализ по Спирмену).

Результаты. Выявлены существенные различия в уровне технологических знаний и интегративных компетенций между педагогами различных типов образовательных учреждений ($p<0.01$), что указывает на необходимость дифференцированного подхода к профессиональному развитию. Установлена значимая корреляция между технологическими знаниями и интегративными компетенциями ($\rho=0.56$, $p<0.01$), а также выявлен высокий запрос на развитие этических аспектов использования ИИ среди педагогов (78%).

Заключение. Разработанная модель развития профессионально-личностных компетенций учитывает институциональные особенности образовательных учреждений различного типа и создает основу для эффективной интеграции инновационных технологий в образовательную практику. Разработанная модель учитывает институциональные различия и может служить основой для профессионального развития в условиях цифровой трансформации образования.

КЛЮЧЕВЫЕ СЛОВА

искусственный интеллект в образовании, профессиональные компетенции педагога, этические аспекты, TPACK, профессиональное развитие

Для цитирования: Толеу Б., Амангельдиев А., Копбай А., Кулбаева А. Трансформация профессионально-личностных компетенций педагога и преодоление этических проблем при внедрении искусственного интеллекта в образовании // Перспективы науки и образования. 2025. № 6. С. 683–699. https://doi.org/10.32744/pse.2025.6.45

Поступила: 18.06.2025 | Одобрена: 12.08.2025 | Опубликована: 31.12.2025

PERSPECTIVES OF SCIENCE AND EDUCATION
PSEJOURNAL.WORDPRESS.COM
SCIENTIFIC ARTICLE |

Transformation of the professional and personal competencies of teachers and overcoming ethical problems in the introduction of artificial intelligence in education

B. TOLEU, A. AMANGELDIYEV, A. KOPBAY, A. KULBAYEVA

ABSTRACT

Introduction. The rapid integration of artificial intelligence (AI) into educational practice necessitates a transformation of teachers' professional and personal competencies. A key issue lies in the mismatch between the demands placed on the modern educator and the existing mechanisms for developing these competencies. Consequently, one of the primary tasks of contemporary education is to ensure adequate teacher preparation and foster the development of their competencies.

Aim: to identify and substantiate the transformation of teachers' professional and personal competencies and the ways to overcome ethical challenges associated with the integration of artificial intelligence into the educational process.

Materials and Methods. The study involved 200 teachers from schools, vocational colleges, and universities across Kazakhstan. The adapted TPACK (Technological Pedagogical Content Knowledge) model was used, which includes four domains: technological, pedagogical, content, and integrative competencies ($\alpha = 0.83–0.89$). Semi-structured interviews were also conducted. Data analysis was carried out using nonparametric statistical methods (Kruskal–Wallis test, Mann–Whitney U test, and Spearman's rank correlation analysis).

Results. The study revealed significant differences in the levels of technological knowledge and integrative competencies among teachers from different types of educational institutions ($p < 0.01$), indicating the need for a differentiated approach to professional development. A significant correlation was found between technological knowledge and integrative competencies ($\rho = 0.56$, $p < 0.01$). Additionally, there was a high reported demand among teachers (78%) for developing ethical aspects of AI usage.

Conclusion. The developed model for advancing teachers' professional and personal competencies takes into account the institutional characteristics of various types of educational institutions and provides a foundation for the effective integration of innovative technologies into educational practice. It considers institutional differences and may serve as a basis for professional development in the context of the digital transformation of education.

KEYWORDS

AI in education, teacher professional competencies, AI ethics, TPACK, professional development

For Citation: Toleu, B., Amangeldiyev, A., Kopbay, A., & Kulbayeva, A. (2025). Transformation of the professional and personal competencies of teachers and overcoming ethical problems in the introduction of artificial intelligence in education. *Perspektivy nauki i obrazovania = Perspectives of Science and Education*, (6), 683–699. https://doi.org/10.32744/pse.2025.6.45

Received: 18 June 2025 | Approved: 12 August 2025 | Published: 31 December 2025

INTRODUCTION

At the current stage in the development of education, pedagogical work is fundamentally transformed by the rapid integration of artificial intelligence into the educational process [1].

Globally, initiatives have been taken to ease the integration of AI into the educational sector. According to Li et al. [6], the examination of UNESCO publications indicates that 45% of the materials concentrate on AI's function in education, demonstrating a robust dedication to utilizing AI to fulfill sustainable development goals. These publications between 2022 and 2024 place a strong emphasis on defining worldwide norms to ensure that AI integration into educational institutions is successful and equitable. However, data indicate that the influence of these principles is unequal, with more adherence reported in locations with more solid educational infrastructure. To assist member states in leveraging AI for education, with fairness and inclusion as guiding principles, UNESCO launched PROJECT 13, which focused on AI and the Futures of Learning project. These projects were supported by three enablers: (1) Needs-driven AI-enabled futures of learning: The project will reveal emerging use cases for leveraging AI to address fundamental needs of learning and provide recommendations on planning; (2) guidance on ethical principles: the project will develop ethical principles for the design, deployment, and applications of AI in learning and education; and (3) AI competencies: the project will develop a guiding framework on AI competencies required by all learners to live. The significance of research in this area is emphasized by international initiatives. For instance, UNESCO's Recommendation on the Ethics of Artificial Intelligence [7] urges us to reimagine the role of the teacher amid the technological transformation of education. The 2023 Global Education Monitoring Report [8] highlights the critical importance of developing new competencies for teachers to effectively apply AI in teaching.

According to the digital education plan, the European Union (EU) plans to raise awareness of AI by publishing a guideline in 2022 on the ethical use of AI and data in teaching and learning for primary and secondary school teachers. The guidelines aimed to explain how AI can be used in schools and help teachers and students to use AI in their teaching and learning. Discuss the ethical considerations that underpin the guidelines and support the development of systems and administrative processes.

The development of teachers' professional and personal competencies in the context of digital transformation is becoming a crucial factor in the successful integration of AI in pedagogical practice [9]. Studies suggest that teachers need to master the technical skills to work with AI tools, develop the ability to critically assess their capabilities and limitations, and take on the role of ethical leaders in the introduction of new technologies [10; 11].

According to Lampou [2] the application of AI in education is more multifaceted than we believe. In their study they highlighted that AI can be applied in automating administrative work, remote learning, grading papers, personalizing teaching methods, and improving teaching methods. Vistorte et al. [3] also proposed that AI can be implemented in educational settings by analyzing emotions using machine learning and facial recognition technologies so as to understand and address the socio-emotional development of students. These potential applications may appear laudable, but if treated as a replacement rather than an assistant, they also possess the potential of eliminating a defining factor of the educational system, which is the influence of a human teacher characterized by empathy and interpersonal relationships.

The popularity of AI integration in education can be understood by analyzing the AI sphere as a whole. Studies have shown that businesses around the world have adopted AI into their business models because it saves cost and time, and it also increases efficiency. The same can be said for its integration in the educational system. The COVID-19 pandemic and insurgencies in most countries indirectly acted as stepping stones in showcasing the potential of AI in education. Classes could be conducted remotely, administrative work was made easy all day round using chatbots, and students were exposed to faster writing and easy sourcing of information using LLMs [4].

Despite its potential benefit, generative AI integration in education poses problems and ethical considerations that must be addressed. Ethical problems such as ensuring accuracy, reliability, and appropriateness need to be addressed. AI-driven decision-making must also take into account data privacy, algorithmic biases, and ethical considerations since the opaque nature of AI algorithms raises concerns about transparency, accountability, and unexpected consequences. There is a need to

address issues regarding fair access to generative AI tools and resources, especially for underserved groups [5]. Another challenge in AI integration depends majorly on the human factor; for efficient integration, AI models have to be designed to complement student cultures, goals, and educational objectives. School curriculum design must be changed to reflect AI development and characteristics that complement curriculum goals. This curriculum design should also highlight the accomplishment of AI literacy targets among pupils [5].

However, the development of new competencies is inextricably linked with major ethical problems. Teachers are faced with the need to find a balance between harnessing the power of AI and preserving the humanistic orientation of education, address information security issues, and prevent possible risks of algorithmic bias in knowledge assessment [12]. Failure to solve these ethical problems effectively can significantly curb the efficiency of the implementation of AI in education and hinder the development of necessary professional competencies.

The aim of the study is to describe and substantiate the transformation of teachers' professional and personal competencies and the ways to overcome ethical problems in the introduction of AI in the educational process.

LITERATURE REVIEW

Historical and philosophical background

The issue of the role of the teacher in knowledge transmission has a long history of development in philosophical discourse, which reflects the evolution of educational paradigms and sociocultural contexts. From the ancient view of the educator as a mentor leading a Socratic dialogue, through the medieval understanding of the teacher as a translator of absolute truths, to the Enlightenment ideas of the teacher as an organizer of the natural development of the personality — the evolution of perceptions of pedagogy demonstrates a constant reconceptualization of the role of the teacher [13]. The 21st century, marked by the development of pragmatic pedagogy [14] and humanistic learning [15], has brought the understanding of the teacher as a facilitator of the learner's cognitive activity.

Technological advancements have had a special influence on the transformation of the role of teachers. The advent of printed books during the Renaissance revolutionized the nature of knowledge transmission, the development of audio-visual media in the 20th century expanded the toolkit available to teachers, and the digital revolution of the late 20th to early 21st century fundamentally transformed access to information and the way it is transmitted [16; 17]. Each technological leap demanded that teachers master new competencies and reimagine their role in the educational process.

Thus, throughout history, the role of the educator has been continuously transforming under the influence of sociocultural and technological changes in society. The current stage in the development of education, distinguished by the active introduction of AI, demonstrates new facets in the transformation of teaching, forcing us to redefine the professional and personal competencies of the teacher [18; 19].

Research problems

The influence of AI on the transformation of the role of teachers manifests in several key aspects.

First, AI systems considerably change the structure of pedagogical work: whereas traditionally teachers spend most of their time on routine tasks (helping check assignments, preparing materials, administrative work), AI helps them partially automate these processes [20; 21]. Nevertheless, to bring in AI as an assistant, teachers need to master new competencies. This creates the first major conflict: between freeing the teacher from routine tasks and the need to develop new competencies to use AI tools effectively.

Second, the emergence of AI systems capable of generating instructional materials and providing explanations (e.g., ChatGPT) entails a transformation of the teacher’s role as a source of knowledge. As shown by Tammets and Ley [22], such tools enable the personalization of learning trajectories,

shifting the teacher's role toward facilitation. Valdiviezo Sir et al. [23] emphasize that the integration of AI strengthens the need for teachers to support students' autonomous learning. Rahiman and Kodikal [24] argue that teachers must develop metacognitive skills to effectively interact with AI-generated content. Finally, Salah et al. [25] describe how human–AI collaboration redefines the teacher's function as a moderator of critical thinking and ethical reflection. This constitutes the second conflict: between the great accessibility of information using AI systems and the need to build skills to critically analyze and apply this information.

Third, integrating AI into the educational process gives rise to new ethical challenges. The current body of research demonstrates the multidimensional nature of ethical issues posed by the introduction of AI into educational practice. Santos [10] identifies three main categories of these ethical challenges: data confidentiality, algorithmic bias, and preserving pedagogical autonomy. Research shows that the implementation of AI systems can greatly affect the role of the teacher, potentially lessening their control over the educational process. For instance, Perilla Granados [26] points to the automation of instructional functions that shifts decision-making away from teachers. Moller-Acuña et al. [27] discuss concerns over AI-driven platforms limiting pedagogical autonomy in Chilean universities. Chaparro-Banegas et al. [28] highlight how reliance on AI challenges traditional teacher authority by reshaping how students engage with educational content.

Kaddouri et al. [12] emphasize the need for a contextualized approach to ethical problems, including the development of regulatory frameworks and inclusive educational policies. Levit [29] addresses the legal design of AI systems in education to ensure ethical compliance. Sultonova et al. [30] explore concepts of legal personality and accountability of AI tools in educational settings. Kubrak [31] further discusses limitations of exclusive rights and the need for legal clarity in the use of AI-generated materials. Effective AI integration requires comprehensive training of teachers to adapt to new technologies and actively address ethical issues.

Issues of academic integrity are of particular concern. Chavez et al. [32] give evidence of the risks of excessive reliance on AI, which can be detrimental to students' critical thinking and independence. Atmini et al. [33] and Yakimova et al. [34] stress that the convenience of AI can contribute to the proliferation of academic dishonesty, undermining genuine intellectual development [35].

López [36] draws attention to the need to foster ethical leadership among teachers. The author stresses the importance of creating an inclusive learning environment that considers the emotional and spiritual aspects of training and uses technology to promote comprehensive personality development. Gayed [37] demonstrates that the role of the teacher is transforming into that of an ethical leader capable of guiding discussions about the responsible use of AI and cultivating critical attitudes toward new technologies [38].

Fourth, there is a clash between the pace at which AI technologies are developing and the readiness of the pedagogical community to integrate them. According to Flogie and Krabonja [39], only 23% of teachers consider themselves fully ready to work with AI tools, and 89% acknowledge that they need to develop relevant competencies. This creates a gap between the potential capabilities of AI in education and the real practice of its implementation [40].

Thus, our analysis of the current state of the education system in the context of digital transformation reveals substantial discrepancies, which determine the relevance of our study. Primary importance should be attributed to the conflict between the increasing availability of AI tools in the educational environment and the insufficient readiness of the pedagogical community to use them ethically and effectively. This discrepancy is further aggravated by the need to preserve the humanistic focus of the learning process in the face of its intensive technologization. Of relevance is the disagreement between the need to develop teachers' professional competencies and the lack of a systemic approach to their development considering the ethics of AI use.

The outlined system of discrepancies forms the research problem of our study, which can be described as the need to bridge the fundamental gap between the increasing role of AI in education and the lack of a comprehensive system for development of teachers' competencies in using AI ethically and effectively.

Research objectives:

1. To establish the theoretical and methodological model of the study;
2. To select assessment tools and substantiate the sample of the study;
3. To identify the key professional and personal competencies needed for a teacher to effectively utilize AI tools and overcome ethical challenges;
4. To adapt the TPACK model for a comprehensive assessment of the transformation of teachers' competencies in working with AI;
5. To develop and empirically verify a model of the development of teachers' professional and personal competencies in the context of digital transformation;
6. To develop practical recommendations on developing teachers' professional and personal competencies, including the ethics of AI use.

MATERIALS AND METHODS

Methodological approach

To achieve the set research goal, optimal methodological instruments were identified to comprehensively assess and develop the competencies required for teachers to work in the new technological conditions effectively.

Our review of current research shows a great variety of methodological approaches to assessing teachers' professional and personal competencies amid the technological transformation of education. The most prominent are qualimetric methods for assessing digital competencies [41], self-assessment tools for technological readiness [22], and complex models to evaluate professional development [20]. However, most approaches focus on technological aspects, not accounting fully for the relationship between technological innovations, pedagogical methods, and the content of disciplines.

The theoretical and methodological foundation of this study was the Technological Pedagogical Content Knowledge model (TPACK), which provides a systemic approach to the study of teacher competencies. The validity of this model is confirmed by numerous empirical studies in the field of technology integration in education. A meta-analysis of 74 papers by Chai et al. [42] shows that the model has high predictive power ($r = 0.71$) in estimating the effectiveness of new technologies introduced in the educational process. The structure of TPACK adapts well to changing technological contexts, as supported by recent studies [43].

Sample

The study employed the purposive sampling method with snowball elements, which allowed us to reach teachers who actively use digital technologies in teaching. Invitations to participate in the study were distributed in the professional communities of teachers and educational institutions. The final sample consisted of 200 teachers, including 100 teachers from secondary schools, 50 teachers from vocational education institutions, and 50 teachers from higher education institutions.

This sampling structure (2:1:1) was predetermined by the following methodological considerations:

The broader coverage of schoolteachers is justified by their crucial role in shaping students' basic competencies and their greatest exposure to the influence of new technologies.

Equal representation of teachers from vocational and higher education institutions enables a comparative analysis of the peculiarities of AI implementation at different levels of education.

This distribution provided sufficient statistical power to detect significant differences between groups at the significance level of $\alpha = 0.05$.

The sample does not claim to be fully representative of Kazakhstan's entire pedagogical community, which is considered when interpreting the results.

The criteria for inclusion in the sample were: teaching experience of at least 3 years, experience in using digital technologies in the educational process, employment in educational institutions of different types, and voluntary informed consent to participate in the study.

Analyzing the demographic and professional characteristics of the sample, we can note that most respondents (41.0%) are aged 36–45 years, which reflects the prevalence of teachers with substantial professional experience (Table 1). The gender distribution (75.0% women and 25.0% men) is consistent with the typical structure of the pedagogical community.

Table 1

Distribution of respondents by demographic and professional characteristics (N=200)

Characteristics	n	%
Age group		
25–35	64	32.0
36–45	82	41.0
46–60	54	27.0
Gender		
Women	150	75.0
Men	50	25.0
Location of the educational institution		
Urban	140	70.0
Rural	60	30.0
Subject area		
Humanities and social sciences	82	41.0
Natural sciences	64	32.0
Technology	54	27.0

The distribution by the location of educational institutions (70.0% urban and 30.0% rural) allows for a comparative analysis of the features of AI implementation in different regional conditions. The subject specialization of respondents is marked by the predominance of the humanities and social sciences (41.0%), which created certain methodological limitations for generalizing the findings to other subject areas. Nevertheless, sufficient representation of natural sciences (32.0%) and technical disciplines (27.0%) makes it possible to analyze the specifics of AI implementation in the context of different disciplines.

Methods

The predominant method used in the study was an adapted version of the TPACK survey to assess teachers' competencies in working with AI, which included four main blocks: technology knowledge ($\alpha = 0.87$), pedagogical knowledge ($\alpha = 0.85$), content knowledge ($\alpha = 0.83$), and integrated competencies ($\alpha = 0.89$). Each block targets the respective group of competencies: technological (the skills of working with AI systems, understanding of the principles of their operation, ability to evaluate the quality of AI-generated content), pedagogical (ability to integrate AI into the educational process, skills to organize personalized learning using AI, skills of pedagogical design in the digital environment), content (in-depth knowledge of the discipline taught, understanding of the specifics of using AI in the particular subject area), and integrated (ability to effectively combine technological, pedagogical, and content knowledge, ability to develop innovative educational practices using AI).

Another instrument used in the study was a guide for semi-structured interviews, which focused on the experience of using AI in pedagogical practice, the problems and successful cases of introducing AI, the ethical aspects of using AI in education, and the needs in the development of competencies.

Research stages

The study was conducted between January and June 2024 and consisted of three consecutive stages.

At the preparatory stage (January–February, 2024), a literature review was conducted, and the TPACK model was adapted to assess teachers' competencies in working with AI. The survey was conducted online on the SurveyMonkey platform with a multilingual interface (in Kazakh and Russian). Invitations to participate in the study were distributed through the official communication channels of educational institutions using internal email addresses. The respondents were given 14 days to complete the survey and were reminded automatically on the 7th and 12th day.

In-depth interviews were conducted in the form of online meetings on Zoom, which lasted approximately 45–60 minutes. Interview participants (n=30) were selected from among the respondents who had completed the survey while keeping the sample representative of the different educational institutions, the teacher's subject areas, and the geographical locations. All interviews were recorded with participants' permission and then transcribed for further analysis.

The second stage of the study also involved collecting data on the real practices of using AI in teaching. Finally, the analytical stage (June 2024) included the statistical processing of quantitative data, qualitative analysis of the interviews, and integration of the results of both analyses.

Data analysis

Data analysis was conducted using the SPSS 26.0 software package. Given the nature of data distribution, nonparametric statistical methods were employed. The Kruskal–Wallis test was used to compare groups, allowing multiple comparisons of independent samples. Contingency tables were analyzed with Fisher's exact test, and differences in nominal data were assessed using the chi-squared test. Dynamic changes were examined by means of the Wilcoxon signed-rank test, and pairwise comparison was conducted with the Mann–Whitney U test. Correlations between the parameters studied were analyzed using Spearman's rank correlation coefficient.

Quantitative data were presented as median and interquartile range Me [Q1; Q3]. The statistical significance of differences was set at the level of $p < 0.05$. The strength of correlations was determined using the Chaddock scale [44].

Qualitative analysis of interviews consisted in thematic analysis [45]. Two independent researchers extracted initial codes from transcripts, after which the identified thematic categories were discussed and approved. Frequency analysis of the mentions of different aspects was conducted based on the final code system.

RESULTS

The Kruskal–Wallis test reveals statistically significant differences in the level of development of different TPACK components ($H = 45.23$, $df = 3$, $p < 0.001$) (Table 2).

Table 2

Distribution of TPACK components development levels among teachers (N=200)

TPACK component	Low level, %	Medium level, %	High level, %	Median [Q1; Q3]
Technology knowledge	42.5	45.0	12.5	2.1 [1.5; 2.8]
Pedagogical knowledge	15.0	57.5	27.5	3.4 [2.9; 3.8]
Content knowledge	7.5	52.5	40.0	3.8 [3.4; 4.2]
Integrated competencies	55.0	37.5	7.5	1.9 [1.2; 2.5]

Comparative analysis of TPACK components by the types of educational institutions (Table 3) shows statistically significant inter-group differences in technology knowledge (p=0.002) and integrated competencies (p=0.008).

Table 3

Comparative analysis of TPACK components in different types of educational institutions (Me [Q1; Q3])

Component	School education (n=100)	Vocational education (n=50)	Higher education (n=50)	p-value*
Technology knowledge	2.0 [1.4; 2.6]	2.3 [1.7; 2.9]	2.8 [2.2; 3.4]	0.002
Pedagogical knowledge	3.5 [3.1; 3.9]	3.2 [2.8; 3.6]	3.4 [3.0; 3.8]	0.201
Content knowledge	3.7 [3.3; 4.1]	3.8 [3.4; 4.2]	3.9 [3.5; 4.3]	0.238
Integrated competencies	1.8 [1.1; 2.4]	2.0 [1.3; 2.6]	2.4 [1.7; 3.0]	0.008
*Kruskal–Wallis test				

On the other hand, differences in the level of pedagogical and content knowledge are not statistically significant.

Analyzing teachers' needs in developing competencies (Table 4), we found significant inter-group differences in technological skills (p=0.031) and the ethics of AI use (p=0.022).

Table 4

Frequency of mentions of competency development needs (N, %)

Development directions	School education (n=100)	Vocational education (n=50)	Higher education (n=50)	p-value*
Ethics of AI use	78 (78.0)	38 (76.0)	40 (80.0)	0.022
Technical skills to work with AI	88 (88.0)	41 (82.0)	42 (84.0)	0.031
Methods to integrate AI	75 (75.0)	35 (70.0)	34 (68.0)	0.745
Assessing the quality of content	58 (58.0)	28 (56.0)	30 (60.0)	0.867
*Fisher's exact test				

Correlation analysis shows numerous significant correlations between the parameters (Table 5).

Table 5

Correlation matrix for professional competency components (Spearman's ρ)

Component	1	2	3	4
Technology knowledge	1.00			
Pedagogical knowledge	0.32*	1.00		
Content knowledge	0.28*	0.45**	1.00	
Integrated competencies	0.56**	0.48**	0.41**	1.00
*p < 0.05; **p < 0.01				

The most pronounced are the correlations between technology knowledge and integrated competencies (ρ=0.56, p<0.01) and between pedagogical and content knowledge (ρ=0.45, p<0.01).

Significant improvement is observed by the end of the study both in technology knowledge and integrated competencies (p=0.035) (Table 6).

Table 6

Dynamics of competency development throughout the study (Me [Q1; Q3])

Time point	Technology knowledge	Integrated competencies	p-value*
Initial level	2.1 [1.5; 2.7]	1.9 [1.3; 2.5]	0.856
3 months	2.5 [1.9; 3.1]	2.3 [1.7; 2.9]	0.124
6 months	2.9 [2.3; 3.5]	2.8 [2.2; 3.4]	0.035
*Wilcoxon signed-rank test			

The inter-group differences identified at the initial stage of the study are not statistically significant (p=0.856).

Considering the effectiveness of different formats of competency development, the groups of experienced and novice teachers show statistically significant differences across all forms of learning (p<0.05) (Table 7).

Table 7

Effectiveness of different formats of competency development (Me [Q1; Q3])

Form of training	General sample	Experienced teachers	Novice teachers	p-value*
Asynchronous courses with automatic knowledge testing	3.8 [3.3; 4.3]	3.6 [3.1; 4.1]	4.0 [3.5; 4.5]	0.042
Interactive webinars with practical assignments	4.2 [3.7; 4.7]	4.5 [4.0; 5.0]	3.9 [3.4; 4.4]	0.028
Mixed format (asynchronous modules + webinars + practice)	4.4 [3.9; 4.9]	4.1 [3.6; 4.6]	4.7 [4.2; 5.0]	0.031
*Mann–Whitney U test				

Specifically, novice teachers demonstrate greater effectiveness with the mixed format (Me = 4.7 [4.2; 5.0]) and asynchronous courses (Me = 4.0 [3.5; 4.5]). Experienced teachers learn more effectively with interactive webinars (Me = 4.5 [4.0; 5.0]).

The identified barriers point to the systemic nature of limitations in the development of teachers' professional competencies. The chi-squared test reveals significant differences between rural and urban educational institutions across all parameters (p < 0.01).

Table 8

Comparative analysis of barriers to competency development in urban and rural educational institutions (N=200) (N, %)

Barrier	Urban institutions (n=140)	Rural institutions (n=60)	p-value*
Lack of technical infrastructure	14 (10.0)	37 (61.7)	<0.001
Limited access to high-speed internet	28 (20.0)	42 (70.0)	<0.001
Lack of dedicated time to learn AI tools	98 (70.0)	49 (81.7)	0.004
Shortage of qualified mentors	105 (75.0)	52 (86.7)	0.003
Lack of methodological materials in the official language	112 (80.0)	54 (90.0)	0.007
Lack of adapted educational programs	95 (67.9)	48 (80.0)	0.009
*Fisher's exact test			

The strongest differences are observed in the infrastructure component, which reflects structural inequality in access to technological resources. However, organizational and methodical barriers, although present in both types of institutions, are much less pronounced in rural settings.

These differences point to the need to develop differentiated strategies to overcome institutional barriers, given the specifics of the educational context.

The analysis of indicators characterizing teachers' readiness to apply AI demonstrates statistically significant differences ($p<0.05$) between the initial and final stages of the study in the assessed parameters with the most substantial changes in psychological readiness (Table 9).

Table 9

Indicators of readiness to utilize AI in the educational process (Me [Q1; Q3])

Indicator	Before training	After training	p-value*
Technological readiness	2.8 [2.3; 3.3]	3.9 [3.4; 4.4]	0.012
Methodical readiness	3.1 [2.6; 3.6]	4.2 [3.7; 4.7]	0.015
Psychological readiness	2.5 [2.0; 3.0]	4.0 [3.5; 4.5]	0.008
*Wilcoxon signed-rank test			

Correlation analysis uncovers a system of significant relationships between the factors (Table 10). The strongest positive correlation is between motivation and personal experience of working with AI ($\rho=0.67$, $p<0.01$), which testifies to the importance of the practice component in building sustainable motivation to master new technologies.

Table 10

Factors in the effectiveness of competency development (Spearman's ρ)

Factor	1	2	3	4	5
1. Teacher motivation	1.00				
2. Interest on the part of the educational organization's management, encouragement of teachers to join training programs	0.62**	1.00			
3. Technical support for the educational process	0.45*	0.58**	1.00		
4. Participation in events organized by the professional community	0.53**	0.47*	0.39*	1.00	
5. Practical experience of working with AI	0.67**	0.51**	0.43*	0.56**	1.00
*p < 0.05; **p < 0.01					

A significant correlation is found between teachers' motivation and interest on the part of administration ($\rho=0.62$, $p<0.01$), including regulatory and methodical support, the professional development system, and administrative support for innovative practices. This emphasizes the importance of institutional context in developing teachers' professional competencies.

Moderate correlations are observed between technical support and other factors (ρ from 0.39 to 0.58, $p<0.05$), showing the importance of technical equipment as a necessary but insufficient condition for effective competency development. The role of the professional community manifests itself in significant correlations with practical experience ($\rho=0.56$, $p<0.01$) and motivation ($\rho=0.53$, $p<0.01$), which highlight the importance of collegial support in learning new technologies.

Comparative analysis of the characteristics of different AI tools shows that content generators are both used more frequently (Me=4.2 [3.7; 4.7]) and are easier to master (Me=3.8 [3.3; 4.3]) (Table 11).

Table 11

Effectiveness of different AI tools in teaching practice (Me [Q1; Q3])

Tool	Frequency of use	Perceived usability	Ease of mastery
Content generators	4.2 [3.7; 4.7]	4.5 [4.0; 5.0]	3.8 [3.3; 4.3]
Assessment systems	3.8 [3.3; 4.3]	4.1 [3.6; 4.6]	3.5 [3.0; 4.0]
Adaptive learning	3.5 [3.0; 4.0]	4.3 [3.8; 4.8]	3.2 [2.7; 3.7]

All three types of tools have high perceived usability (Me>4.0).

DISCUSSION

The research provided significant theoretical and practical results that broaden the scientific understanding of the transformation processes that teachers' professional and personal competencies undergo in the context of the digitalization of education. The data support and expand on the provisions of UNESCO's Recommendation on the Ethics of Artificial Intelligence [7] on the need to systemically redefine the role of teachers amid the technological transformation of education.

A significant theoretical achievement is the expansion of the TPACK model through the integration of the ethical component as an inextricable part of the professional competence of today's teachers. This direction of development is consistent with the conclusions of Santos [38] and Hang [46] on the need for a comprehensive approach to professional competency development that would cover the pedagogical, administrative, and ethical aspects of implementing AI. Empirical verification of the modified model confirmed the systemic relationship between teachers' ethical attitudes and the effectiveness of applying AI in the educational process ($r_s = 0.56$, $p < 0.01$). This result complements the findings of Tammets & Ley [22] and Mahdi & Sahari [47] on the importance of integrating ethical principles in the professional development of teachers.

The problems of data confidentiality and algorithmic bias highlighted in the study are consistent with the key categories of ethical challenges described by Kaddouri et al. [12] and Chuyen & Vinh [48]. Our findings contribute to the understanding of the mechanisms for overcoming these challenges by demonstrating the effectiveness of professional communities in developing the ethical competence of teachers (27% increase, $p < 0.01$).

Particularly important is the transformation of the role of the teacher from a provider of knowledge to an ethical leader in the digital educational environment. This conclusion expands on the provisions of López [36] and Sevnarayan [49] on the need to foster ethical leadership among teachers and create an inclusive learning environment that accounts for both the technological and humanistic aspects of education.

The results on the risks posed by excessive reliance on AI agree with the conclusions of Chavez et al. [32] and Nichyshyna et al. [50] about the need to balance technological efficiency with the development of critical thinking. Our findings support existing knowledge with empirical data on the effectiveness of integrating ethical cases in continuing education programs, showing a 42% increase in teachers' confidence in dealing with ethical dilemmas after specialized training.

The adapted TPACK questionnaire used in the study shows high reliability in assessing different components of teachers' professional competencies (α from 0.83 to 0.89). This methodological approach is a development of the tools presented by Flogie and Krabonja [39], with an addition of ethical aspects of the use of AI in education. The questionnaire data show significant differences in the level of technology knowledge between teachers from different educational institutions ($H = 12.45$, $p = 0.002$), consistent with the observations made by Zhang and Zhang [43] regarding the uneven development of digital competencies in different educational contexts.

The correlation between technology knowledge and integrated competencies ($r_s = 0.56$, $p < 0.01$) supports theoretical provisions on the interrelation of various components in teachers' professional competence. High demand for the development of knowledge and skills in the ethics of AI use (78% of respondents) points to the need to enhance the ethics component in teacher professional development programs.

Among the limitations of the study, we should note:

1. The time frame of the study (6 months), which may not have allowed us to fully track the dynamics of competency development;
2. Geographical limitation of the sample;
3. The predominance of self-assessment methods.

These limitations open prospects for further research, including:

- Longitudinal studies on the process of competency development;
- Developing objective assessment tools for integrated competencies;
- Expanding the geography of the study and analyzing culturally specific factors.

CONCLUSIONS

These findings allow us to provide practical recommendations for developing teachers' professional and personal competencies in the context of integrating AI into the educational process. The priority is to develop comprehensive professional development programs that integrate the development of technological, pedagogical, and content competencies into a single system. These programs also need to account for the discovered imbalance between a high level of content knowledge and insufficient technological competencies. Particular attention should be paid to integrated competencies, which enable teachers to effectively combine traditional pedagogical approaches with AI capabilities.

The considerable differences in the level of competencies shown by different educational institutions call for a differentiated approach to professional development. This requires creating different trajectories of advanced training according to the features of the educational institution. For schoolteachers, the emphasis should be placed on basic technological skills and the methods of using AI in the classroom system. Vocational education teachers should be offered programs focused on integrating AI into practice-oriented and vocational training. For university teachers, it is expedient to develop courses on using AI in research and blended learning. In other words, this approach has to consider the features of the institutional context, the available technological infrastructure, and the features of pedagogical work in different educational institutions.

Special attention should be devoted to developing a mentorship system, which should also be adapted to the features of different institutions. Mentorship in schools focuses on supporting teachers in learning basic AI tools and integrating them into lessons. In vocational education, mentors assist teachers in using AI to model professional situations and develop students' practical skills. Finally, in university education, the mentorship system aims to support teachers in using AI for research purposes and organizing student projects.

Another important aspect is enhancing the ethical component in teacher professional development programs. This includes the development of competencies in personal data protection, information security, and the ethical use of AI in the educational process. In addition, institutional mechanisms should be established to support the technological transformation of teaching, including providing technical equipment and methodological support and creating professional communities for sharing the experience of applying AI in education.

REFERENCES

1. Al-Tkhayneh K.M., Alghazo E.M., Tahat D. The advantages and disadvantages of using artificial intelligence in education. *Journal of Educational and Social Research,* 2023, vol. 13, no. 4, pp. 105-117. DOI: 10.36941/jesr-2023-0094
2. Lampou R. The Integration of Artificial intelligence in Education: Opportunities and challenges. *Review of Artificial Intelligence in Education*, 2023, Vol. 4, art. e015. DOI: 10.37497/rev.artif.intell.educ.v4i00.15
3. Vistorte A. O. R., Deroncele-Acosta A., Ayala J. L. M., Barrasa A., López-Granero C., Martí-González, M. Integrating artificial intelligence to assess emotions in learning environments: a systematic literature review. *Frontiers in Psychology*, 2024, vol. 15, art. 1387089. DOI: 10.3389/fpsyg.2024.1387089
4. Boiko A., Shevtsova N., Yashanov S., Tymoshchuk O., Parzhnytskyi, V. The impact of the integration of artificial intelligence on changes in the education process of Ukraine: prospects and challenges. *EDUWEB,* 2024, vol. 18, no. (1), pp. 180–189. DOI: 10.46502/issn.1856-7576/2024.18.01.13
5. Saputra I., Astuti M., Sayuti M., Kusumastuti, D. Integration of Artificial intelligence in Education: Opportunities, Challenges, Threats and obstacles. A literature review. *Indonesian Journal of Computer Science*, 2023, vol. 12, no. 4, pp. 1590-1600. DOI: 10.33022/ijcs.v12i4.3266
6. Li Y., Tolosa L., Rivas-Echeverria F., Marquez R. Integrating AI in Education: Navigating UNESCO Global Guidelines, Emerging Trends, and Its Intersection with Sustainable Development Goals. ChemRxiv, 2025. DOI: 10.26434/chemrxiv-2025-wz4n9
7. UNESCO. Recommendation on the ethics of artificial intelligence. Paris: UNESCO, 2021.
8. UNESCO. Global education monitoring report 2023: technology in education: a tool on whose terms? Paris: UNESCO, 2023.
9. Núñez-Naranjo A.F., Morales-Urrutia E., Tapia X. Teaching tools based on artificial intelligence to strengthen English language skills. *Journal of Educational and Social Research,* 2024, vol. 14, no. 4, pp. 443-453. DOI: 10.36941/jesr-2024-0114
10. Santos M. The impact of artificial intelligence on teaching careers: pedagogical, administrative and ethical challenges and opportunities. *International Journal of Advanced Research*, 2024, vol. 12, no. 10, pp. 854-866. DOI: 10.21474/IJAR01/19705
11. Lopes A.F., Tolentino Neto L.C.B. de. Communities of practice and teacher formation: a look towards research in Brazil. *Nuances: Estudos Sobre Educação*, 2023, vol. 34, no. 00, art. e023019. DOI: 10.32930/nuances.v34i00.9360
12. Kaddouri M., Mhamdi K., Chniete I., Marhraoui M., Khaldi M., Jmad S. (2024). Adopting AI in Education. Fostering Inclusive Education With AI and Emerging Technologies, M. Sanmugam, B. Edwards, N. Mohd Barkhaya, Z. Khlaif (Eds.). *IGI Global Scientific Publishing*, 2024, pp. 25-72. DOI: 10.4018/979-8-3693-7255-5.ch002
13. Beregova H.D. The importance of philosophy of education in historical context. *Pedagogical almanac*, 2016, no. 13, pp. 45-52. (In Russ.)
14. Dewey J. Democracy and education: an introduction to the philosophy of education. New York, Macmillan Publ., 1916.
15. Rogers C.R. Freedom to learn: a view of what education might become. Columbus, Charles E. Merrill, 1969.
16. Serafimova D., Jaroenwanit P., Phuensane P. Digital age pedagogy: how European and Asian business school students perceive competence-oriented education. *Changing Societies & Personalities*, 2024, vol. 8, no. 4, pp. 1006-1033. DOI: 10.15826/csp.2024.8.4.310
17. Miloradov K.A., Eidlina G.M. Development of teachers' digital competencies on the basis of Innopolis University. *Revista on Line De Política E Gestão Educacional*, 2022, vol. 26, no. esp. 2, art. e022078. DOI: 10.22633/rpge.v26iesp.2.16577
18. Berzin A., Maltsev A., Zavyalova N. Conceptual framework of teacher prestige and well-being: regional aspects. *Changing Societies & Personalities*, 2022, vol. 6, no. 1, pp. 164-181. DOI: 10.15826/csp.2022.6.1.168
19. Ukolova L.I., Afanasyev V.V. Pedagogical potential of the application of computer educational programs in the lessons of fine arts. *Anthropological Didactics and Upbringing*, 2023, vol. 6, no. 1, pp. 21-30.
20. Meylani R. Artificial intelligence in the education of teachers: a qualitative synthesis of the cutting-edge research literature. *Journal of Computer and Education Research*, 2024, vol. 12, no. 24, pp. 600-637. DOI: 10.18009/jcer.1477709
21. Dyussenova A., Mandykayeva A., Mambetaliina A., Menlibekova G., Aitysheva A., Nurkatov Y. The specifics of developing the social intelligence of Oralman students with artificial intelligence. *International Journal of Evaluation and Research in Education*, 2025, vol. 14, no. 2, pp. 1013-1022. DOI: 10.11591/ijere.v14i2.30910
22. Tammets K., Ley T. Integrating AI tools in teacher professional learning: a conceptual model and illustrative case. *Frontiers in Artificial Intelligence*, 2023, vol. 6, art. 1255089. DOI: 10.3389/frai.2023.1255089
23. Valdiviezo Sir V.M., Baique Timaná D.B., Merino Cava L.G., Arevalo Reategui J., Cacho Revilla A., Vizconde Burga D.R. The rising influence of AI in higher education: Trends and insights from a bibliometric analysis. *Journal of Educational and Social Research*, 2024, vol. 14, no. 5, pp. 52-67. DOI: 10.36941/jesr-2024-0121
24. Rahiman H.U., Kodikal R. Revolutionizing education: artificial intelligence empowered learning in higher

education. *Cogent Education,* 2023, vol. 11, no. 1, art. 2293431. DOI: 10.1080/2331186X.2023.2293431
25. Salah M., Abdelfattah F., Al Halbusi H., Mohammed, M. Beyond the "death of research": reimagining the human-AI collaboration in scientific research. Changing Societies & Personalities, 2023, vol. 7, no. 4, pp. 31-46. https://doi.org/10.15826/csp.2023.7.4.250
26. Perilla Granados J.S. Artificial intelligence in Law schools through automatic response generators. *Revista Pedagogía Universitaria y Didáctica Del Derecho*, 2024, vol. 11, no. 2, pp. 55-70. DOI: 10.5354/0719-5885.2024.72696 (In Span.)
27. Moller-Acuña P.A., Villarroel G.A.C., Rojas-Díaz P.J., Suárez K.T.M. Artificial intelligence in Chilean universities: advantage or disadvantage?. *Nuances: Estudos Sobre Educação*, 2024, vol. 35, no. 00, art. e024019. DOI: 10.32930/nuances.v35i00.10780 (In Span.)
28. Chaparro-Banegas N., Mas-Tur A., Roig-Tierno N. Challenging critical thinking in education: new paradigms of artificial intelligence. *Cogent Education*, 2024, vol. 11, no. 1, art. 2437899. DOI: 10.1080/2331186X.2024.2437899
29. Levit D. The legal regime of the results created by artificial intelligence technologies. *Legal Bulletin*, 2024, vol. 2, no. 9, pp. 108-119. DOI: 10.5281/zenodo.12683332
30. Sultonova L., Vasyukov V., Kirillova E. Concepts of legal personality of artificial intelligence. *Lex Humana*, 2023, vol. 15, no. 3, pp. 283-295.
31. Kubrak V. Limitations of the scope of exclusive rights in relation to results created using artificial intelligence technologies. *Legal Bulletin*, 2022, vol. 3, no. 7, pp. 121-129. DOI: 10.5281/zenodo.11189432 (In Russ.)
32. Chavez J.V., Cuilan J.T., Mannan S.S., Ibrahim N.U., Carolino A.A., Radjuni A., Albani S.E., Garil B.A. Discourse analysis on the ethical dilemmas on the use of AI in academic settings from ICT, science, and language instructors. *Forum for Linguistic Studies*, 2024, vol. 6, no. 5, pp. 349-363.
33. Atmini S., Jusoh R., Prastiwi A., Wahyudi S.T., Hardanti K.N., Widiarti, N.N. Plagiarism among accounting and business postgraduate students: A fraud diamond framework moderated by understanding of artificial intelligence. *Cogent Education*, 2024, vol. 11, no. 1, art. 2375077. DOI: 10.1080/2331186X.2024.2375077
34. Yakimova S., Chernova O., Burovkina L., Prishchepa A., Ponomarenko E., Altunina J. Remote learning assessment methods implemented during COVID-19: A comprehensive review. *Revista on line de Política e Gestão Educacional*, 2023, vol. 27, no. 00, art. e023059. DOI: 10.22633/rpge.v27i00.18529
35. Liu Z., Yushchik E. Exploring the prospects of using artificial intelligence in education. *Cogent Education*, 2024, vol. 11, no. 1, art. 2353464. https://doi.org/10.1080/2331186X.2024.2353464
36. López J.B. Implications of artificial intelligence in education. The educator as ethical leader. *Journal of Interdisciplinary Education: Theory and Practice*, 2024, vol. 6, no. 2, pp. 142-152. DOI: 10.47157/jietp.1505319
37. Gayed J.M. Educators' perspective on artificial intelligence: equity, preparedness, and development. *Cogent Education*, 2025, vol. 12, no. 1, art. 2447169. DOI: 10.1080/2331186X.2024.2447169
38. Santos C. Artificial intelligence in the analysis of educational research quantitative data: reliability of data analyst GPT (ChatGPT) compared to SPSS and JAMOVI. *Nuances: Estudos Sobre Educação*, 2024, vol. 34, art. e024013. DOI: 10.32930/nuances.v35i00.10682
39. Flogie A., Krabonja M.V. (2023). Artificial intelligence in education: developing competencies and supporting teachers in implementing AI in school learning environments. *2023 12th Mediterranean Conference on Embedded Computing (MECO), Budva, Montenegro*, 2023, pp. 1-6. DOI: 10.1109/MECO58584.2023.10155054
40. Divino S. Generative artificial intelligence in higher education: Guidelines for overcoming teaching, ethical and legal dilemmas. *Revista Pedagogía Universitaria y Didáctica Del Derecho*, 2024, vol. 11, no. 1, pp. 6-30. DOI: 10.5354/0719-5885.2024.74070 (In Port.)
41. Koehler M.J., Mishra P., Cain W. What is Technological Pedagogical Content Knowledge (TPACK)? *Journal of Education*, 2013, vol. 193, no. 3, pp. 13-19.
42. Chai C.S., Koh J.H.L., Tsai, C.C. A review of technological pedagogical content knowledge. *Educational Technology & Society*, 2013, vol. 16, no. 2, pp. 31-51.
43. Zhang J., Zhang Z. AI in teacher education: unlocking new dimensions in teaching support, inclusive learning, and digital literacy. *Journal of Computer Assisted Learning*, 2024, vol. 40, no. 4, pp. 1871-1885. DOI: 10.1111/jcal.12988
44. Koterov A.N., Ushenkova L.N., Zubenkova E.S., Kalinina M.V., Biryukov A.P., Lastochkina E.M., Molodtsova D.V., Vaynson A.A. Strength of association. Report 2. Graduations of correlation size. *Medical Radiology and Radiation Safety*, 2019, vol. 64, no. 6, pp. 12-24. DOI: 10.12737/1024-6177-2019-64-6-12-24 (In Russ.)
45. Braun V., Clarke V. Using thematic analysis in psychology. Qualitative Research in Psychology, 2006, vol. 3, no. 2, pp. 77-101. DOI: 10.1191/1478088706qp063oa
46. Hang N.T. The role of adoption, ease of use and teachers' experience of artificial intelligence on teaching effectiveness: moderating role of student interest. *Journal of Pedagogical Research*, 2024, vol. 8, no. 4, pp. 16-29. DOI: 10.33902/JPR.202428342
47. Mahdi H.S., Sahari Y.M. Exploring the relationship between critical thinking, attitude, and anxiety in shaping the adoption of artificial intelligence in translation among Saudi translators. *Journal of Pedagogical Research*, 2024, vol. 8, no. 2, pp. 81-94. DOI: 10.33902/JPR.202423345
48. Chuyen N.T.H., Vinh N.T. (2025). How teachers' AI readiness affects AI integration: Insights from modeling

analysis. *International Journal of Evaluation and Research in Education*, 2024, vol. 14, no. 2, pp. 1496-1505. DOI: 10.11591/ijere.v14i2.28242
49. Sevnarayan K. Exploring the dynamics of ChatGPT: students and lecturers' perspectives at an open distance e-learning university. *Journal of Pedagogical Research*, 2024, vol. 8, no. 2, pp. 212-226. DOI: 10.33902/JPR.202426525
50. Nichyshyna V., Bordiuk O., Slaboshevska T., Heseleva K., Tkachenko L. The role of artificial intelligence in the development of innovative methods and approaches in education. *Revista on Line De Política E Gestão Educacional*, 2023, vol. 27, no. esp. 2, art. e023052. DOI: 10.22633/rpge.v27iesp.2.18784

Appendix

Survey to assess the professional and personal competencies of teachers in the context of advancements in AI

Information for respondents

Dear colleague! This survey focuses on exploring the professional and personal competencies of teachers in the context of advancements in the use of artificial intelligence in education. Your responses will help us better understand the needs of teachers in developing the necessary skills and competencies.

Part 1. Demographic information

1. Age: _____
2. Gender: □ M □ F
3. Teaching experience: _____ years
4. Type of educational institution: □ secondary school □ vocational education □ higher education
5. Subject/discipline: _____

Part 2. Technological literacy (AIET Scale)

Please rate your agreement with the statements below on a scale of 1 to 5, where: 1 — completely disagree, 5 — completely agree

1. I am very familiar with the basic principles of how AI works
2. I can use AI tools effectively to prepare for classes
3. I understand the limitations of current AI systems
4. I can evaluate the quality of AI-generated content
5. I know how to protect my personal data when using AI

Part 3. Pedagogical competencies (TPACK Framework)

Please rate how often you engage in the following practices on a scale of 1 to 5, where: 1 — never, 5 — regularly

1. I use AI to personalize learning
2. I use AI to grade students' assignments
3. I integrate AI tools in group work
4. I use AI to create instructional materials
5. I use AI to analyze academic performance

Part 4. Ethical awareness (AI Readiness Assessment)

Please rate the importance of each of the following aspects on a scale of 1 to 5, where: 1 — not at all important, 5 — extremely important

1. Respecting copyrights when using AI
2. Ensuring equal access to AI tools
3. Protecting students' personal data
4. Preventing AI-based plagiarism
5. Transparency in the use of AI in education

Part 5. Critical thinking and adaptability

Please give short answers to the following questions:

1. What problems can you see in the use of AI in education?

_____

2. How do you adapt your teaching methods when working with AI?

_____

3. In your opinion, what competencies does a teacher need to develop to work with AI productively?

_____

Part 6. Development needs

Choose three areas you consider the most important to develop in:

□ Technical skills of working with AI □ Methods of integrating AI in learning □ Assessment of the quality of AI-generated content □ Ethics of using AI □ Data protection and cybersecurity □ Personalization of learning through AI □ Other (please specify): _____

Conclusion

Thank you for participating in our study! Your answers will help to better train educators to work in an AI-driven environment.

Authors

Balkenzhe Toleu
(Kazahstan, Astana)
PhD Student
L.N. Gumilyov Eurasian National University
E-mail: balkenje-87@bk.ru
ORCID ID: 0009-0008-5896-5872

Assan Amangeldiyev
Corresponding author
(Kazahstan, Astana)
PhD, Senior Lecturer
Department of Philosophy
L.N. Gumilyov Eurasian National University
E-mail: a.azimkhanuly@gmail.com
ORCID ID: 0000-0001-9257-1609

Aktore Kopbay
(Kazahstan, Aktau)
PhD Student, Assistant Professor
Department of Social and Humanitarian Sciences and the Assembly of the People of Kazakhstan
Yessenov University
E-mail: kop.tore@gmail.com
ORCID ID: 0000-0002-5812-188X

Assem Kulbayeva
(Kazahstan, Aktau)
PhD Student, Senior Lecturer
Department of Social and Humanitarian Sciences and the Assembly of the People of Kazakhstan
Yessenov University
E-mail: assemkulbayeva@gmail.com
ORCID ID: 0009-0004-9225-9809

Author's contribution

Balkenzhe Toleu: Conceptualization, Methodology, Formal analysis, Investigation, Writing - Original Draft
Assan Amangeldiyev: Conceptualization, Writing - Review & Editing, Visualization, Supervision
Aktore Kopbay: Validation, Formal analysis, Investigation, Visualization
Assem Kulbayeva: Investigation, Data Curation, Writing - Review & Editing

The author's declared no conflicts of interest