

opportunities were investigated. The collected data were processed using statistical analysis, which allowed for the formulation of scientific conclusions.

The main objective of the research methodology was to develop an effective model for the use of artificial intelligence technologies in preparing future technology teachers and to justify its pedagogical effectiveness in the conditions of digital manufacturing.

Results and Discussion. In order to determine the effectiveness of using artificial intelligence technologies in preparing future technology teachers under the conditions of digital manufacturing, experimental research was conducted. The study involved 120 students from the 2nd to 4th years of the “Technology Education” program and 18 university professors and instructors.

At the initial stage, the participants’ knowledge and practical skills related to the use of artificial intelligence technologies were examined. The questionnaire results showed that 32% of students regularly used AI tools, 41% used them partially, and 27% had little or no experience with such technologies. These findings indicated the necessity of a systematic pedagogical approach in this area.

During the experiment, virtual laboratories, adaptive learning platforms, simulation software, and AI-based assessment systems were integrated into the educational process. These tools were especially effective in modeling technological processes and visually explaining production systems. Students demonstrated greater interest and engagement during practical lessons supported by digital simulations. The following table presents the results before and after the experiment.

Table 1

The following table presents the results before and after the experiment

Indicators	Before Experiment (%)	After Experiment (%)
High level of digital competence	28	67
Effective use of AI tools	32	74
Independent design skills	36	71
Innovative thinking level	41	78

As shown in the table, significant improvement was observed in all indicators after the experimental implementation. In particular, the effective use of AI tools increased from 32% to 74%, confirming the practical value of artificial intelligence technologies in teacher preparation.

Interviews conducted with university instructors also revealed positive opinions regarding the implementation of AI technologies. According to them, adaptive learning systems strengthen individualized instruction, while virtual laboratories reduce the need for extensive material and technical resources. In addition, automated assessment systems save time and improve the objectivity of evaluating students' learning outcomes.

The analysis demonstrated that the use of artificial intelligence technologies in preparing future technology teachers not only improves professional competencies but also enhances the quality of education, strengthens practical training, and supports the preparation of pedagogical specialists who meet the demands of modern digital manufacturing.

At the same time, several challenges were identified. These include insufficient technical infrastructure in some higher education institutions, limited digital competence among teachers, and the lack of specialized methodological support. Addressing these issues remains an important direction for future research and educational reform.

Conclusion. The use of artificial intelligence technologies in preparing future technology teachers in the context of digital manufacturing is one of the most relevant and promising directions of modern education. The rapid development of automation, robotics, digital control systems, and the widespread implementation of the Industry 4.0 concept require significant modernization of technology education and teacher training systems.

The results of the study demonstrated that AI-based virtual laboratories, simulation software, adaptive learning platforms, and automated assessment systems significantly contribute to the development of professional competencies among future technology teachers. In particular, these technologies positively influence digital competence, independent design skills, innovative thinking, and practical training. Experimental results confirmed that the integration of AI tools improves both the effectiveness and quality of the educational process.

Furthermore, artificial intelligence technologies support individualized learning, optimize time and educational resources, and strengthen the connection between education and real production

environments. This creates favorable conditions for preparing competitive, creative, and professionally competent technology teachers who can meet the demands of modern industry.

However, some challenges remain, including insufficient technical infrastructure in higher education institutions, limited methodological support, and the inadequate digital readiness of some teaching staff. These factors hinder the full implementation of AI technologies in teacher education.

In the future, it is necessary to improve AI-based educational environments in universities, enhance the digital competence of pedagogical staff, and develop innovative teaching methodologies adapted to digital manufacturing conditions. This will ensure the preparation of highly qualified and modern technology teachers capable of contributing effectively to the development of society and industry.

References

1. Paulo Blikstein. *Digital Fabrication and Making in Education: The Democratization of Invention*. New York, 2018.
2. Eshnazarova, M., Begmatova, N., Marasulova, Z., Ibroximov, M., & Turdaliyeva, N. (2026, March). Current trends in technologies for creating infographics in education. In AIP Conference Proceedings (Vol. 3390, No. 1, p. 070016). AIP Publishing LLC.
3. Ruslanovna, M. J., & Mukhtasar, T. (2022). Using Information Technologies in Technological Education on the Example of Foreign Experiences. *Galaxy International Interdisciplinary Research Journal*, 10(4), 174-179.
4. Michael Fullan. *The New Meaning of Educational Change*. New York: Teachers College Press, 2016.
5. Tulabayevna, Z. G. (2025). *The oretical basis of students'metacognitive activities in teaching technology in general education schools*. shokh library, 1(11).
6. John Anderson. *Artificial Intelligence in Education: Promises and Implications for Teaching and Learning*. Washington, 2019.
7. UNESCO. *Artificial Intelligence and Education: Guidance for Policy-makers*. Paris, 2021.
8. R.H. Jo'rayev. *Foundations of Vocational Pedagogy*. Tashkent: O'qituvchi, 2010.

**SUN'YI INTELLEKT - TEXNOLOGIK TA'LIM VA ISHLAB CHIQRISH O'RTASIDAGI
KO'PRIK SIFATIDA**

J.R.Muxitdinova, NamDPI, p.f.f.d.(PhD)

S.E.Tojaxmedova, NamDPI, talaba

DOI: <https://doi.org/10.5281/zenodo.20215856>

***Annotatsiya.** Ushbu maqolada raqamli ishlab chiqarish sharoitida bo'lajak texnologiya o'qituvchilarini kasbiy tayyorlash jarayonida sun'iy intellekt texnologiyalaridan samarali foydalanishning istiqbollari tahlil qilinadi. Zamonaviy ishlab chiqarish tizimlarida avtomatlashtirish, robototexnika, ma'lumotlarni qayta ishlash va aqlli boshqaruv tizimlarining keng joriy etilishi texnologiya ta'limi mazmunini yangilashni talab etmoqda. Shu nuqtai nazardan, bo'lajak o'qituvchilarning raqamli kompetensiyasi, innovatsion fikrlashi hamda sun'iy intellekt vositalaridan pedagogik va amaliy faoliyatda foydalanish ko'nikmalarini shakllantirish muhim ahamiyat kasb etadi. Maqolada sun'iy intellekt asosidagi ta'lim platformalari, virtual laboratoriyalar, simulyatsion dasturlar va adaptiv o'qitish tizimlarining afzalliklari yoritilgan. Shuningdek, ularning texnologiya fanini o'qitishda samaradorlikni oshirish, individual yondashuvni ta'minlash va ta'lim sifatini yaxshilashdagi o'rni asoslab berilgan.*

***Kalit so'zlar:** raqamli ishlab chiqarish, sun'iy intellekt, texnologiya ta'limi, bo'lajak o'qituvchi, kasbiy tayyorgarlik, raqamli kompetensiya, innovatsion pedagogika, virtual laboratoriya, adaptiv ta'lim, simulyatsion dasturlar*

**ARTIFICIAL INTELLIGENCE AS A BRIDGE BETWEEN TECHNOLOGICAL
EDUCATION AND PRODUCTION**

J.R.Mukitdinova, NamSPI, p.f.f.d.(PhD)

S.E.Tojakhmedova, NamSPI, student

***Abstract:** This article analyzes the prospects of effective use of artificial intelligence technologies in the professional training of future technology teachers in the context of digital manufacturing. The rapid development of modern production systems, including automation, robotics, data processing, and intelligent control systems, requires the updating of the content of technology education. In this regard, the formation of future teachers' digital competence, innovative thinking, and practical skills in using artificial intelligence tools in pedagogical and professional*

activities is of great importance. The article highlights the advantages of AI-based educational platforms, virtual laboratories, simulation software, and adaptive learning systems. It also substantiates their role in improving the effectiveness of teaching technology subjects, ensuring an individualized approach, and enhancing the quality of education.

Keywords: digital manufacturing, artificial intelligence, technology education, future teacher, professional training, digital competence, innovative pedagogy, virtual laboratory, adaptive learning, simulation software.

ИСКУССТВЕННЫЙ ИНТЕЛЛЕКТ, КАК МОСТ МЕЖДУ ТЕХНОЛОГИЧЕСКИМ ОБРАЗОВАНИЕМ И ПРОИЗВОДСТВОМ

Ж.Р.Мухитдинова, НамГПИ, д.п.ф.н.(PhD)

С.Э.Тожиахмедова, НамГПИ, студентка

Аннотация. В данной статье анализируются перспективы эффективного использования технологий искусственного интеллекта в процессе профессиональной подготовки будущих учителей технологии в условиях цифрового производства. Быстрое развитие современных производственных систем, включая автоматизацию, робототехнику, обработку данных и интеллектуальные системы управления, требует обновления содержания технологического образования. В этой связи особое значение приобретает формирование цифровой компетентности будущих педагогов, их инновационного мышления, а также практических навыков использования технологий искусственного интеллекта в педагогической и профессиональной деятельности. В статье рассматриваются преимущества образовательных платформ на основе искусственного интеллекта, виртуальных лабораторий, симуляционных программ и адаптивных систем обучения. Также обосновывается их роль в повышении эффективности преподавания технологических дисциплин, обеспечении индивидуального подхода и улучшении качества образования.

Ключевые слова: цифровое производство, искусственный интеллект, технологическое образование, будущий учитель, профессиональная подготовка, цифровая компетентность, инновационная педагогика, виртуальная лаборатория, адаптивное обучение, симуляционные программы.

Kirish. Bugungi kunda jahonda raqamli texnologiyalarning jadal rivojlanishi ishlab chiqarishning barcha sohalariga chuqur kirib bormoqda. Ayniqsa, sanoatning raqamlashtirilishi,

“Industry 4.0” konsepsiyasining keng joriy etilishi, robototexnika, avtomatlashtirilgan boshqaruv tizimlari va sun'iy intellekt texnologiyalarining amaliyotga tatbiq etilishi ta'lim tizimi oldiga yangi vazifalarni qo'yimoqda. Bu jarayon, ayniqsa, texnologiya ta'limi yo'nalishida bo'lajak pedagog kadrlarni tayyorlash mazmunini tubdan takomillashtirishni talab etadi.

Raqamli ishlab chiqarish sharoitida texnologiya o'qituvchisi nafaqat an'anaviy texnik bilimlarga, balki zamonaviy axborot-kommunikatsiya texnologiyalari, sun'iy intellekt vositalari, raqamli loyihalash va ishlab chiqarishni boshqarish ko'nikmalariga ham ega bo'lishi zarur. Chunki kelajak mutaxassislarini tayyorlaydigan pedagogning o'zi innovatsion tafakkurga, raqamli savodxonlikka va texnologik yangiliklarni tez o'zlashtirish qobiliyatiga ega bo'lishi lozim.

Sun'iy intellekt texnologiyalari ta'lim jarayonida individual yondashuvni kuchaytirish, o'quv materiallarini moslashtirish, bilimlarni avtomatik baholash, virtual laboratoriyalarni tashkil etish va simulyatsion modellar orqali murakkab jarayonlarni tushuntirish imkonini beradi. Bu esa bo'lajak texnologiya o'qituvchilarining nazariy bilimlarini amaliyot bilan integratsiyalashga xizmat qiladi.

O'zbekiston Respublikasida ham oliy ta'lim tizimini modernizatsiya qilish, raqamli ta'lim muhitini yaratish va pedagog kadrlar tayyorlash sifatini oshirish davlat siyosatining ustuvor yo'nalishlaridan biri hisoblanadi. Shu sababli, bo'lajak texnologiya o'qituvchilarini tayyorlashda sun'iy intellekt texnologiyalaridan samarali foydalanishning ilmiy-pedagogik asoslarini ishlab chiqish dolzarb masala sifatida namoyon bo'lmoqda.

Mazkur maqolada raqamli ishlab chiqarish sharoitida bo'lajak texnologiya o'qituvchilarini tayyorlashda sun'iy intellekt texnologiyalaridan foydalanishning pedagogik imkoniyatlari, afzalliklari hamda istiqbolli yo'nalishlari tahlil qilinadi.

Adabiyotlar sharhi va metodologiya. Raqamli ishlab chiqarish va sun'iy intellekt texnologiyalarining ta'lim tizimiga integratsiyalashuvi bugungi kunda ko'plab xorijiy va mahalliy olimlar tomonidan keng o'rganilmoqda. Ayniqsa, “Industry 4.0” sharoitida pedagog kadrlarni tayyorlash, raqamli kompetensiyalarni shakllantirish va ta'lim jarayoniga intellektual texnologiyalarni joriy etish masalalari ilmiy tadqiqotlarning muhim yo'nalishiga aylangan.

Xorijiy olimlardan Klaus Shvab raqamli iqtisodiyot va to'rtinchi sanoat inqilobi sharoitida ta'lim tizimini modernizatsiya qilish zarurligini asoslab bergan. Uning fikricha, zamonaviy mutaxassis faqat nazariy bilim emas, balki raqamli boshqaruv, tahliliy fikrlash va innovatsion qaror qabul qilish kompetensiyalariga ham ega bo'lishi kerak. J. Anderson, M. Fullan, P. Blikstein kabi

tadqiqotchilar esa sun'iy intellektning ta'lim jarayonidagi adaptiv o'qitish, individual yondashuv va interaktiv o'quv muhitini yaratishdagi rolini yoritib berganlar.

Tahlillar shuni ko'rsatadiki, sun'iy intellekt texnologiyalaridan foydalanish bo'lajak texnologiya o'qituvchilarining kasbiy tayyorgarligini oshirishda samarali vosita hisoblanadi. Biroq aynan raqamli ishlab chiqarish sharoitida ushbu texnologiyalarning pedagogik integratsiyasi yetarli darajada chuqur o'rganilmagan bo'lib, bu mazkur tadqiqotning dolzarbligini belgilaydi.

Mazkur tadqiqotda ilmiy bilishning nazariy va empirik metodlaridan foydalanildi. Nazariy metodlar sifatida pedagogik, psixologik va metodik adabiyotlarni tahlil qilish, ilmiy maqolalar va xorijiy tajribalarni o'rganish, qiyosiy tahlil va umumlashtirish usullari qo'llanildi. Ushbu metodlar orqali sun'iy intellekt texnologiyalarining texnologiya ta'limidagi o'rni va imkoniyatlari aniqlashtirildi.

Empirik metodlar sifatida kuzatish, so'rovnoma, suhbat va tajriba-sinov ishlari amalga oshirildi. Oliy ta'lim muassasalarida texnologiya ta'limi yo'nalishida tahsil olayotgan talabalar va professor-o'qituvchilar ishtirokida sun'iy intellekt vositalaridan foydalanish darajasi, mavjud muammolar va istiqbolli yo'nalishlar o'rganildi. Olingan natijalar statistik tahlil asosida qayta ishlanib, ilmiy xulosalar shakllantirildi.

Tadqiqot metodologiyasining asosiy maqsadi — bo'lajak texnologiya o'qituvchilarini tayyorlashda sun'iy intellekt texnologiyalaridan foydalanishning samarali modelini ishlab chiqish va uning pedagogik samaradorligini asoslashdan iborat.

Natijalar va tahlil. Tadqiqot jarayonida raqamli ishlab chiqarish sharoitida bo'lajak texnologiya o'qituvchilarini tayyorlashda sun'iy intellekt texnologiyalaridan foydalanish samaradorligini aniqlash maqsadida tajriba-sinov ishlari olib borildi. Tadqiqotda oliy ta'lim muassasasining "Texnologiya ta'limi" yo'nalishida tahsil olayotgan 2–4-bosqich 120 nafar talaba hamda 18 nafar professor-o'qituvchi ishtirok etdi.

Dastlabki bosqichda respondentlarning sun'iy intellekt texnologiyalaridan foydalanish bo'yicha bilim va ko'nikmalari o'rganildi. So'rovnoma natijalariga ko'ra, talabalarning 32 foizi sun'iy intellekt vositalaridan muntazam foydalanishi, 41 foizi qisman foydalanishi, 27 foizi esa deyarli foydalanmasligi aniqlandi. Bu esa mazkur yo'nalishda tizimli pedagogik yondashuv zarurligini ko'rsatdi.

Tajriba davomida virtual laboratoriyalar, adaptiv o'qitish platformalari, simulyatsion dasturlar va sun'iy intellekt asosidagi baholash tizimlari o'quv jarayoniga joriy etildi. Ayniqsa, texnologik jarayonlarni modellashtirish va ishlab chiqarish tizimlarini vizual tushuntirishda ushbu vositalarning samaradorligi yuqori bo'ldi. Quyidagi jadvalda tajribadan oldin va tajribadan keyingi natijalar ko'rsatilgan (1-jadvalga qarang).

1-jadval

Tajribadan oldin va tajribadan keyingi natijalar

Ko'rsatkichlar	Tajriba boshida (%)	Tajribadan keyin (%)
Raqamli kompetensiya darajasi yuqori	28	67
Sun'iy intellekt vositalaridan samarali foydalanish	32	74
Mustaqil loyihalash ko'nikmasi	36	71
Innovatsion fikrlash darajasi	41	78

Jadval natijalaridan ko'rinib turibdiki, tajribadan keyin barcha ko'rsatkichlar bo'yicha sezilarli o'sish kuzatildi. Ayniqsa, sun'iy intellekt vositalaridan samarali foydalanish ko'rsatkichi 32 foizdan 74 foizga oshgani ushbu texnologiyalarning amaliy ahamiyatini tasdiqlaydi.

Professor-o'qituvchilar bilan o'tkazilgan suhbatlar natijasida ham sun'iy intellekt texnologiyalarining afzalliklari qayd etildi. Ularning fikricha, adaptiv ta'lim tizimlari individual yondashuvni kuchaytiradi, virtual laboratoriyalar esa moddiy-texnik bazaga bo'lgan ehtiyojni qisqartiradi. Shuningdek, avtomatik baholash tizimi vaqt tejallishiga va o'quv natijalarining aniqligiga xizmat qiladi.

Tahlillar shuni ko'rsatdiki, raqamli ishlab chiqarish sharoitida bo'lajak texnologiya o'qituvchilarini tayyorlashda sun'iy intellekt texnologiyalaridan foydalanish nafaqat kasbiy kompetensiyalarni rivojlantiradi, balki ta'lim sifatini oshirish, amaliy tayyorgarlikni kuchaytirish va zamonaviy ishlab chiqarish talablariga mos pedagog kadrlarni shakllantirishga xizmat qiladi.

Shu bilan birga, ayrim muammolar ham aniqlandi. Jumladan, ayrim oliy ta'lim muassasalarida texnik infratuzilmaning yetarli emasligi, professor-o'qituvchilarning raqamli tayyorgarligi pastligi va maxsus metodik ta'minotning cheklanganligi sun'iy intellekt texnologiyalarini to'liq joriy etishga to'sqinlik qilmoqda. Mazkur muammolarni bartaraf etish kelgusidagi tadqiqotlarning muhim yo'nalishi hisoblanadi.

Xulosa. Raqamli ishlab chiqarish sharoitida bo'lajak texnologiya o'qituvchilarini tayyorlash jarayonida sun'iy intellekt texnologiyalaridan foydalanish bugungi ta'lim tizimining dolzarb va istiqbolli yo'nalishlaridan biri hisoblanadi. Zamonaviy sanoatning avtomatlashtirilishi, robototexnika, raqamli boshqaruv tizimlari va "Industry 4.0" konsepsiyasining jadal rivojlanishi texnologiya ta'limi mazmunini yangilashni talab etmoqda.

Tadqiqot natijalari shuni ko'rsatdiki, sun'iy intellekt asosidagi virtual laboratoriyalar, simulyatsion dasturlar, adaptiv ta'lim platformalari va avtomatik baholash tizimlari bo'lajak texnologiya o'qituvchilarining kasbiy kompetensiyalarini sezilarli darajada rivojlantiradi. Ayniqsa, raqamli kompetensiya, mustaqil loyihalash, innovatsion fikrlash va amaliy ko'nikmalar shakllanishida ushbu texnologiyalarning samaradorligi yuqori ekanligi tajriba-sinov ishlari orqali tasdiqlandi.

Shuningdek, sun'iy intellekt texnologiyalari individual yondashuvni ta'minlash, ta'lim sifatini oshirish, vaqt va resurslarni tejash hamda ishlab chiqarish bilan ta'lim integratsiyasini kuchaytirishda muhim omil bo'lib xizmat qiladi. Biroq, texnik infratuzilmaning yetarli emasligi, metodik ta'minotning cheklanganligi va professor-o'qituvchilarning raqamli tayyorgarlik darajasidagi kamchiliklar ushbu jarayonni to'liq amalga oshirishga to'sqinlik qilmoqda.

Kelgusida oliy ta'lim muassasalarida sun'iy intellektga asoslangan o'quv muhitini yanada takomillashtirish, pedagog kadrlarning raqamli kompetensiyasini oshirish va innovatsion metodikalarni ishlab chiqish muhim vazifa bo'lib qoladi. Shu asosda zamonaviy ishlab chiqarish talablariga mos, raqobatbardosh va kreativ texnologiya o'qituvchilarini tayyorlash imkoniyati kengayadi.

Foydalanilgan adabiyotlar:

1. Shvab K. To'rtinchi sanoat inqilobi. – Toshkent: Innovatsion rivojlanish nashriyoti, 2021.
2. Fullan M. The New Meaning of Educational Change. – New York: Teachers College Press, 2016.
3. Blikstein P. Digital Fabrication and Making in Education: The Democratization of Invention. – New York, 2018.
4. Anderson J. Artificial Intelligence in Education: Promises and Implications for Teaching and Learning. – Washington, 2019.



5. UNESCO. Artificial Intelligence and Education: Guidance for Policy-makers. – Paris, 2021.
6. Ruslanovna, M. J. (2022). *O'quvchi talabalar ijodiy fikrlash faolligini rivojlantirishda texnologiya ta'limining o'rni va metodlari*. современное образование (узбекистан), (7 (116)), 21-33.
7. Abdurasulovna, X. G. Z., & Qizi, M. O. G. M. (2025). O'quv didaktik ta'minot orqali bo'lajak professional ta'lim mutaxassislarini kasbiy tayyorgarligini takomillashtirish. Research Focus, 4(Special Issue 3), 329-331.
8. Bakhromovna, T. S. Characteristics of the Teacher of the Future Technological Education. JournalNX, 7(05), 170-173.