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METHODS OF USING ARTIFICIAL INTELLIGENCE TO PREPARE MASTER'S STUDENTS FOR PROFESSIONAL AND RESEARCH ACTIVITIES (EXPERIENCE OF DEVELOPED COUNTRIES AND UZBEKISTAN

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Abstract

This article analyses the main approaches to employing artificial intelligence (AI) technologies to prepare master's students for professional and research activities in higher education. Drawing on the experience of developed countries and Uzbekistan, it examines the role of AI-based adaptive learning systems, digital educational platforms, educational analytics, virtual laboratories, and simulation environments in the development of advanced professional and research competencies. Special attention is paid to the use of AI in research seminars, project-based learning, the supervision of master's theses and applied research projects. The article also considers the ethical, legal and pedagogical constraints associated with AI use, issues of the digital divide, and the necessity of enhancing university teachers' digital and professional competences in order to support AI-based learning for master's students.

Keywords

master's students; professional and research training; artificial intelligence; higher education; developed countries; Uzbekistan; adaptive learning; educational analytics; virtual laboratory; AI tutor; digital competence; professional competencies.

Introduction

In the New Uzbekistan, special attention is devoted to supporting education as the greatest investment in the future. As the President has stated, improving the quality of education is the only true path to the progress of New Uzbekistan. Within this context, the training of highly qualified master's graduates who are capable of independent research, innovative thinking and leadership in their professional fields becomes a strategic priority. State programmes aimed at

increasing youth participation in social and economic processes also demand a qualitative leap in the master's level of higher education.

In graduate education, alongside the digital learning environment, learning management systems (LMS), distance learning and electronic resources, AI-based software tools, chatbots and adaptive learning systems are being introduced step by step. This trend increases the need to train master's students – especially those in pedagogical, economic and technical programmes – in skills for working with artificial intelligence, AI literacy, digital ethics and the practical application of these competences in both professional and research contexts. Today's master's student, as a future specialist and researcher, works in a digital environment, processes large streams of data, and provides professional services and research outcomes through digital platforms. Therefore, the process of preparing master's students for professional and research activity in higher education institutions must encompass digital competences, knowledge and skills in information security and ethics, and a culture of working with AI tools.

Since the second decade of the 21st century, AI technologies have been regarded as a strategic direction not only in information and communication systems but also in higher education in developed countries. In policy documents and reports of major organisations such as UNESCO, the OECD, the European Commission and the U.S. Department of Education, AI is explicitly interpreted as an important means of developing advanced professional competencies, research skills aligned with labour market demands, and the concept of lifelong learning. UNESCO's guidelines on artificial intelligence and education note that AI contributes to students' professional preparation in the following areas: adaptive and personalised teaching; adapting teaching strategies based on learning analytics; developing digital and AI literacy; and enhancing creativity, critical thinking and problem-solving skills required for professional and research activity.

Therefore, when analysing the advanced experiences of the United States, Europe and Asia, the use of AI in master's programmes is examined from three perspectives: its integration into curricula and pedagogy at the graduate level; its impact on readying master's students for careers and research in the "AI age"; and how ethical and legal boundaries are being established in education policy regarding AI. The experience of Uzbekistan is analysed in comparison with these trends, taking into account national development strategies and current reforms in higher education.

Artificial Intelligence and Master's Students' Professional and Research Training in the U.S. Higher Education System

In 2023, the U.S. Department of Education's Office of Educational Technology published a report titled "Artificial Intelligence and the Future of Teaching and Learning". This report outlines three key principles for introducing AI into education: teacher augmentation – strengthening the teacher's role and authority in education without replacing the teacher with AI; protecting students' well-being and rights; and developing skills that prepare students for the AI-era labour market. For master's programmes, these principles are reflected in the design of AI-enhanced curricula, research training components and support services for graduate students.

The report directly links the use of AI technologies to career preparation and graduate education programmes. Colleges and universities are preparing master's students for the labour market and for research careers through AI-based learning analytics, career guidance platforms, virtual research environments and micro-credentials focused on data analysis, machine learning and AI ethics. According to recent systematic research, a significant proportion of students in U.S. higher education use generative AI tools during their studies, while many professors and instructors consult AI tools for course design, research supervision and assessment planning. These figures indicate that AI has become a normal part of educational practice in U.S. higher education, and imagining the professional and research preparation of master's students without AI is increasingly difficult.

The main directions of using AI in professional and research training in U.S. master's programmes include: enhancing academic success through adaptive learning and learning analytics; AI-driven research support (searching literature, analysing large datasets, modelling and simulation); AI-based career services; integration of AI in technical fields such as engineering, IT, medicine and business analytics; and AI-enabled apprenticeships and work-based learning developed in cooperation with industry partners. In many universities, AI tools are embedded in research seminars and thesis supervision processes, where students use AI to refine research questions, design methodologies and interpret empirical data under the guidance of academic supervisors.

These practices form a tripartite collaboration model among the master's student, AI and the supervisor or employer, and allow students to perceive AI as an integral component of their future professional and research roles. At the same time, U.S. universities emphasise the importance of academic integrity, critical evaluation of AI-generated content and transparency in the use of AI in coursework and theses.

Artificial Intelligence and Master's Students' Training in the European Education System

The European Union has traditionally focused on establishing a strong legal and ethical foundation for AI in education. The 2021–2027 Digital Education Action Plan identifies AI as a priority technology for the digital transformation of education and sets the goal of developing key AI competencies for both teachers and students at all levels, including master's programmes. In addition, the European Commission has developed specific ethical guidelines for teachers on the use of AI and data, which require adherence to principles of transparency, fairness and non-discrimination, security and privacy, and the protection of learners' rights.

The EU Artificial Intelligence Act classifies certain AI systems used in education as "high-risk", imposing additional requirements for transparency, auditing and risk management on AI platforms that make decisions in areas such as assessment, admissions and guidance. For master's students, this has two important consequences. First, graduate programmes in law, public policy, computer science and related fields increasingly incorporate AI regulation, data protection and AI ethics into their curricula. Second, universities are obliged to ensure that AI-based tools used for selection, monitoring and evaluation of master's students meet strict legal and ethical standards.

Key developments in Europe include the recognition of digital and AI literacy as core competences, national initiatives such as Estonia's "AI Leap", integration of AI into dual vocational and professional master's programmes in partnership with employers, and the use of AI in universities to support flexible learning and to develop new master's programmes in AI ethics, AI law and data protection. Many European universities are also creating interdisciplinary master's programmes that combine AI with education, healthcare, business, engineering and the social sciences, thus preparing graduate students for complex professional roles in an AI-rich environment.

In terms of research training, AI is widely used in European master's programmes to support data collection and analysis, modelling and forecasting, and collaborative research projects. Virtual laboratories and simulation environments allow students to conduct experiments and test hypotheses that would be difficult or expensive in traditional settings, while AI-based tools help to visualise results, detect patterns and generate new research questions.

Artificial Intelligence and Master's Students' Training in Asian Countries

The East and Southeast Asia region is among the most dynamic in applying AI in education. UNESCO's analyses note that generative AI is fundamentally transforming education systems, although disparities in resources and

preparedness have led to significant differences among countries. In many Asian higher education systems, master's programmes play a key role in training highly qualified specialists for rapidly developing digital economies.

In Singapore, higher education and vocational training policies are pursued in concert with the Smart Nation and AI Singapore initiatives. Universities use AI to personalise learning in graduate programmes, enhance research capacity and direct master's students towards innovative start-ups and new AI-based careers. AI-enhanced learning management systems analyse student engagement and recommend appropriate resources, while AI laboratories and "AI Clinics" involve students from various fields in interdisciplinary AI projects that often become the basis for master's theses.

In the Republic of Korea and Japan, AI and automation are actively introduced into manufacturing, logistics, the automotive industry, robotics and related sectors. Education systems support this shift by enriching STEM and STEAM curricula with AI and data science, nurturing a culture of working with AI, and establishing university–industry laboratories and "living labs". Master's students in engineering, computer science, design and business are involved in applied research projects where AI is used to optimise production, design smart devices or develop new digital services.

In populous countries such as China, India and Indonesia, AI is widely applied through MOOCs, adaptive learning platforms, smart campuses and analysis of students' online activity. Master's students actively use these platforms to deepen subject knowledge, develop programming and data analysis skills, and participate in large-scale research collaborations. However, analyses also point to risks related to data privacy, excessive surveillance and over-reliance on AI in assessment. Consequently, ethical and legal debates about AI use are intensifying in Asia, and particular emphasis is placed on hybrid models that combine personalised AI-based instruction with teacher oversight and pedagogical decision-making, especially in supervising graduate research.

Comparative Analysis of U.S., European and Asian Experiences

Analysis of experiences in the USA, Europe and Asia reveals common trends: AI is becoming a new infrastructure for professional and research training; AI literacy is recognised as a core competence for master's students; the teacher's role is being transformed but not replaced; there is a strong focus on ethical and legal issues; and lifelong learning, reskilling and upskilling are prioritised. In all these regions, AI is embedded not only in undergraduate education but also in master's programmes, where the complexity of tasks and the level of independence expected from students are higher.

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At the same time, there are significant differences in approach. The USA follows a market and innovation-driven model, introducing AI primarily through start-ups, EdTech companies and university–industry collaborations. Master's programmes often cooperate directly with technology companies to provide access to cutting-edge AI tools and real-world datasets. Europe applies a normative, ethical and legal approach, regulating AI in education through instruments such as the EU Artificial Intelligence Act and the General Data Protection Regulation. As a result, European master's programmes place strong emphasis on responsible and human-centred AI. Asian countries pursue rapid digitisation and cultural integration, seeking to align AI technologies with traditional educational values and strong state involvement in education. In this context, master's students are often involved in large-scale national projects in the fields of smart cities, e-government and digital industry.

Comparative Analysis: Developed Countries and Uzbekistan

In developed countries, AI is introduced into the education system through national strategies and long-term programmes. In the USA this is driven mainly by market mechanisms, EdTech companies and university–industry collaboration, whereas in the EU it is regulated within a strong legal-ethical framework. In Asia – particularly in Singapore, Korea, Japan and China – the state plays a strong role, and rapid digitisation initiatives are priorities. In all these contexts, master's programmes are viewed as an important level for training specialists capable of leading AI-based transformations in the economy and society.

In Uzbekistan, a regulatory and legal framework for AI has been rapidly taking shape in recent years. Within the "Digital Uzbekistan – 2030" strategy, comprehensive measures have been defined to develop digital infrastructure and implement digital technologies in public administration and education. Specific decrees and strategic documents on artificial intelligence aim to apply AI widely in the economy and social sectors, and to rank Uzbekistan among the world's leading AI countries by 2030. The "5 Million AI Leaders" initiative plans to train millions of students, teachers and public servants in AI, which opens up new opportunities for master's programmes in various fields.

A digital ecosystem for higher education management has been built around platforms such as HEMIS and my.edu.uz, which improve academic administration, transparency of assessment and data accuracy. For master's students, these platforms create conditions for more flexible individual learning trajectories, monitoring of research progress and integration with digital libraries and databases. However, deep integration of AI into master's programmes is still at an early stage. Initiatives such as the partnership with NVIDIA to develop AI

infrastructure and supercomputers, and the establishment of tax-free zones for AI and data centres, demonstrate the creation of a technical base for extensive use of AI in higher education and research, including graduate studies.

Uzbekistan is paying special attention to the ethical and safe use of AI, working with UNESCO's Readiness Assessment Methodology to develop national approaches for responsible AI deployment in education, science and public administration. At present, this work is largely at the level of strategic intent and preparation, while Europe and a number of other developed countries have already implemented detailed regulatory mechanisms. For Uzbek universities, including those implementing master's programmes in pedagogy, economics, engineering and other fields, the main task is to turn these strategies into concrete curricula, courses and research projects that develop AI literacy, digital ethics and advanced professional competences among graduate students.

In this regard, it is advisable to develop specialised master's modules and courses on AI tools in teaching and research; to integrate AI into thesis supervision and research seminars; to establish university–industry laboratories and centres of competence; and to organise continuous professional development in AI and digital pedagogy for academic staff. Such measures will help to ensure that master's graduates of Uzbek universities are competitive in both national and international labour markets and capable of contributing to the development of an AI-based economy.

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