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Artificial Intelligence in Master's Education as A Driver of Transformation in The Educational Process: Pedagogical, Analytical, And Ethical Issues

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Abstract: This article examines the impact of artificial intelligence (AI) technologies on the transformation of master's-level education, with a focus on changes in cognitive, research, and pedagogical processes. It is demonstrated that modern generative models are shifting from an instrumental function toward the role of a cognitive intermediary in students' scientific activities.

The empirical part of the study is based on a survey of 198 master's students and 24 faculty members using a structured checklist questionnaire. The results indicate a high level of AI integration into educational and research activities, including data analysis (80.6%), text generation (74.3%), and table creation (77.9%).

It was found that 87.8% of respondents reported improved performance in academic tasks; however, 17.6% identified errors in AI outputs, highlighting the need to develop critical digital literacy.

The study concludes that a hybrid "human–artificial intelligence" model is emerging in master's education, where technology functions as an enhancer rather than a substitute for cognitive activity.

Keywords: Artificial intelligence, master's education, generative models, digital pedagogy, learning analytics, hybrid intelligence, empirical study.

Introduction: The current stage of higher education development is characterized not merely by digitalization but by a profound transformation of educational logic. Artificial intelligence (AI) is gradually transitioning from an auxiliary technology to a structural component of the educational environment, influencing cognitive processes, scientific thinking, and pedagogical practices.

This transformation is particularly significant in master's education, where the primary learning outcome is the development of research autonomy, critical thinking, and the ability to generate new knowledge.

The emergence of large language models has changed the nature of students' interaction with information. Unlike traditional digital systems, modern AI is capable

not only of providing information but also of participating in its interpretation, structuring, and the generation of scientific texts. This creates a new educational reality in which the boundaries between a tool and a participant in the cognitive process are becoming increasingly blurred.

Theoretical Framework

AI in education can be conceptualized as a cognitive infrastructure influencing three key levels:

Enhancement of research thinking

1. AI accelerates literature search, hypothesis generation, and scientific data analysis; however, it requires well-developed critical evaluation skills.

Acceleration of epistemic cycles

2. A shift occurs from a linear scientific process to iterative cycles of analysis, explanation, and data refinement.

Delegation of cognitive functions

3. Certain analytical operations (structuring, summarization, initial interpretation) are delegated to AI, increasing the importance of self-regulation.

The "Instructor–Student–AI" Interaction Model

A three-component model is emerging within the educational system:

- the instructor as the designer of the learning environment and scientific mentor
- the master's student as an active subject of cognition
- AI as a cognitive tool and analytical intermediary

This model reflects a transition from knowledge transmission to its co-construction.

METHODS

The empirical study aimed to identify the features of artificial intelligence use in master's education and teaching practice.

Research method: a survey using a structured checklist questionnaire (binary response format: "yes/no", "+/-").

Study sample:

- residents (master's students) – 198
- faculty members – 24
- total – 222 participants

Data collection covered the following thematic blocks:

- experience and frequency of AI use
- educational and research functions
- work with texts and data
- effectiveness assessment
- identification of risks associated with AI use

Operationalization of Variables (Questionnaire Format)

Participants were asked to respond to statements using "+ / –":

- I have used AI for more than 1 year / less than 1 year
- I use AI daily
- I use AI to search for literature
- I use AI to explain topics
- I use AI to create summaries
- I use AI to generate texts
- I use AI for translation and paraphrasing
- I use AI for data analysis
- I use AI for clinical case discussions (for residents)
- I use AI to create tables
- I use AI for statistical analysis
- AI improves my performance
- AI contains errors

RESULTS

Table 1. Survey results on the use of artificial intelligence in educational and research activities

Indicator	Residents n (%)	Faculty n (%)	Total n (%)
AI use >1 year	143 (72.2%)	6 (25.0%)	149 (67.1%)
Daily AI use	198 (100%)	11 (45.8%)	209 (94.1%)
AI for literature search	76 (38.4%)	9 (37.5%)	85 (38.3%)
AI for explaining complex topics	121 (61.1%)	0 (0%)	121 (54.5%)
AI for note-taking	68 (34.3%)	13 (54.2%)	81 (36.5%)
AI for text generation	148 (74.7%)	17 (70.8%)	165 (74.3%)
AI for translation/paraphrasing	137 (69.2%)	15 (62.5%)	152 (68.5%)
AI for data analysis	164 (82.8%)	15 (62.5%)	179 (80.6%)
AI in clinical case discussions	106 (53.5%)	—	106 (47.7%)
AI for table creation	157 (79.3%)	16 (66.7%)	173 (77.9%)

AI for statistical analysis	132 (66.7%)	12 (50.0%)	144 (64.9%)
Improved performance	175 (88.4%)	20 (83.3%)	195 (87.8%)
AI errors reported	34 (17.2%)	5 (20.8%)	39 (17.6%)

DISCUSSION

The survey results indicate a high level of artificial intelligence integration into the educational and research activities of both master's students and faculty. It was found that 100% of students use AI on a daily basis, while among faculty this figure is 45.8%, reflecting a more moderate but stable pattern of technological adoption in teaching practice. Overall, 67.1% of participants have more than one year of experience using AI, indicating the establishment of sustained interaction with generative systems.

Functional analysis showed that the most common AI use cases are analytical and text-related tasks. Specifically, data analysis is performed by 80.6% of participants, table generation by 77.9%, text generation by 74.3%, translation and paraphrasing by 68.5%, and statistical processing by 64.9%. This suggests that AI is used not only as a learning support tool but also as a means of conducting research and applied tasks.

In the educational domain, AI is actively used for explaining learning material (54.5%), searching for scientific literature (38.3%), and preparing summaries (36.5%). Master's students demonstrate higher engagement in using AI for explaining complex topics and structuring information, whereas faculty more frequently use it for preparing teaching materials and summaries.

Particular attention should be paid to the use of AI in research and professional activities. More than half of the students (53.5%) use AI in clinical case discussions, reflecting its importance in applied professional training. Overall, the results show that AI is no longer merely an auxiliary tool but is becoming an active participant that supports scientific analysis and the organization of the educational process.

The evaluation of effectiveness revealed that 87.8% of participants report improved performance in academic and research tasks due to AI use. At the same time, 17.6% indicate the presence of errors in AI-generated responses, highlighting the persistent risk of uncritical acceptance of information and the need to develop verification skills.

Discussion of Results

The obtained data suggest that artificial intelligence in master's education is acquiring a system-forming role, moving beyond the scope of an auxiliary digital tool. Its application encompasses both routine educational tasks and complex research processes, including data analysis, scientific text generation, and decision-making support.

The high frequency of AI use in text generation and analytical tasks indicates a transition toward a cognitive augmentation model, in which part of intellectual operations is delegated to algorithmic systems. However, this process is accompanied by risks associated with the development of dependency on automated solutions and a potential decline in the depth of independent analysis.

Particular importance should be attributed to the identified imbalance between the high level of trust in AI outputs and the relatively low rate of error detection. This finding highlights the need to develop critical digital literacy, including skills for evaluating the reliability of information and understanding the limitations of generative models.

Comparative analysis of the groups shows that master's students demonstrate more intensive and versatile use of AI, whereas faculty members apply it more selectively, primarily for instructional preparation and optimization of the educational process. This reflects differences in functional roles and levels of technological integration into professional activity. Overall, the empirical findings confirm a transformation in the role of artificial intelligence in master's education—from a tool of automation to an element of intellectual infrastructure supporting research, analytical, and educational activities. At the same time, the need emerges for developing new competencies related to the critical use of AI and quality control of generated information.

General Discussion

The results confirm that artificial intelligence in master's education no longer serves exclusively as a supportive tool but has become a structural component of both educational and research activities. Its application spans a wide range of functions—from information retrieval and processing to scientific text generation, data analysis, and decision-making support.

The most significant finding is the transition from instrumental use of AI to cognitive interaction with it. This is reflected in the fact that a substantial proportion of participants use AI not only for technical tasks but also for solving research problems, including

hypothesis formulation, data structuring, and interpretation of results. Thus, artificial intelligence effectively becomes integrated into the cycle of scientific thinking as an external cognitive module.

At the same time, the findings reveal a notable contradiction. On the one hand, there is a high level of trust in AI outputs and broad recognition of its positive impact on academic performance (87.8%). On the other hand, only a small proportion of participants (17.6%) systematically identify errors in its outputs. This indicates a risk of developing an uncritical dependence on algorithmically generated information.

Group comparison shows that residents (master's students) use AI significantly more actively in everyday academic and research activities, whereas faculty members apply it more selectively, primarily for methodological and preparatory purposes. This asymmetry reflects differences in educational roles and levels of digital integration.

Key Interpretations

The findings allow the identification of three key transformational processes:

Cognitive integration of AI

1. AI becomes part of the intellectual process, participating in the analysis, interpretation, and generation of knowledge.

Transformation of the structure of learning activities

2. The educational process shifts from knowledge acquisition to its co-construction using intelligent systems.

Formation of hybrid thinking

3. A "human–artificial intelligence" interaction model emerges, in which cognitive functions are distributed between the subject and the system.

Study Limitations

It should be noted that the study is predominantly descriptive and empirical in nature and is based on self-reported data, which may affect the accuracy of assessing the actual intensity of AI use. In addition, the sample is limited to an academic environment, which restricts the direct generalizability of the findings to other professional contexts.

CONCLUSIONS

The study allows the following key conclusions to be drawn:

1. Artificial intelligence is an actively integrated element of master's education, used by the majority of students and faculty in everyday practice.

2. The most common use cases involve data analysis, text generation, and information processing, indicating a transition toward a cognitive augmentation model.

3. The effectiveness of AI application is highly rated by participants; however, it is accompanied by an insufficient level of critical evaluation of outputs.

4. The findings confirm the emergence of a new educational model based on human–AI interaction, in which technology acts not as a substitute but as an enhancer of cognitive activity.

Thus, artificial intelligence in master's (residency-level) education should be considered a factor of profound transformation of the educational environment, affecting both the structure of the learning process and the nature of scientific thinking. Its effective use requires not only technical accessibility but also the development of new competencies, including critical thinking, digital literacy, and the ability to verify information.

Future prospects are associated with the increasing role of hybrid cognitive systems, in which the interaction between humans and artificial intelligence becomes the foundation of educational and research activities.

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