

## **ETHICAL DILEMMA OF THE USE OF ARTIFICIAL INTELLIGENCE IN SCIENTIFIC RESEARCH AND INNOVATION**

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Artificial intelligence (AI) is becoming an important component of modern scientific research and innovation. Its implementation provides new opportunities for automation of complex processes, analysis of large volumes of data, optimization of resources and acceleration of discoveries in various fields of science [1]. AI allows scientists to conduct experiments faster, model complex processes, and generate new hypotheses that could have gone unnoticed without its help [2]. However, along with the potential benefits of using AI, there are also new ethical challenges related to researcher autonomy, responsibility for scientific results, transparency of algorithms, and risks of model bias. This makes the analysis of ethical dilemmas related to the use of AI in science and innovation critically important for the development of science and society in general.

The main goal of this article is to analyze the key ethical dilemmas that arise in the process of applying AI in scientific research and innovation. The article discusses the issues of responsibility for the results of scientific research performed using AI, the transparency of algorithms and models, issues of data confidentiality, as well as possible risks of bias arising from unethical or uncontrolled use of AI. In addition, the prospects and challenges related to the regulation of the implementation of AI in scientific activity are analyzed.

Today, AI is actively used in many fields of science – from biology and medicine to physics, engineering and social sciences. In particular, machine learning technologies make it possible to identify patterns in large volumes of data that are difficult to analyze using traditional methods. This contributes to new scientific discoveries, especially in the field of genetics, materials science, ecology and medicine. In innovation, AI helps develop new products and optimize production processes, leading to increased efficiency and reduced costs. However, along with these achievements, new ethical issues arise related to human autonomy,

responsibility for AI decision-making, transparency of models, and impact on social inequalities [3].

AI is not only changing scientific research, but also accelerating innovation processes in many industries. In industry, artificial intelligence helps optimize production processes, create new products and services, reducing development time and time to market. In the automotive, pharmaceutical, technological and other fields, AI is used for modeling, optimization, analysis of big data and even creation of innovative prototypes. For example, in the field of technology, AI helps speed up the research of new materials or the development of artificial proteins in biology, which previously took years.

One of the main advantages of using AI is its ability to increase the accuracy of scientific research and innovation [4]. Automated AI algorithms can provide more accurate results, minimizing the impact of human factors and errors (table 1). This is especially important in fields where accuracy is critical, such as medicine or environmental research. Another important advantage is a significant reduction in research time – thanks to the processing of huge amounts of information, AI can quickly find correlations and trends that a person could not detect in such a short time. Finally, AI opens new opportunities in data analysis, allowing to find new patterns and derive new hypotheses, which can become the basis for further scientific discoveries and innovations.

One of the main ethical dilemmas is that excessive automation of scientific research and innovation processes can reduce the autonomy of the scientist. Using AI to automate large parts of research can lead to a loss of creative control and human involvement at critical stages. This raises the question of whether scientists can trust the decisions made by algorithms, and whether this will reduce the value of human experience and intuition in scientific and innovative activities.

**Table 1.** Individual and collective benefits of AI in research from thematic analysis of (n = 25) participants [5]

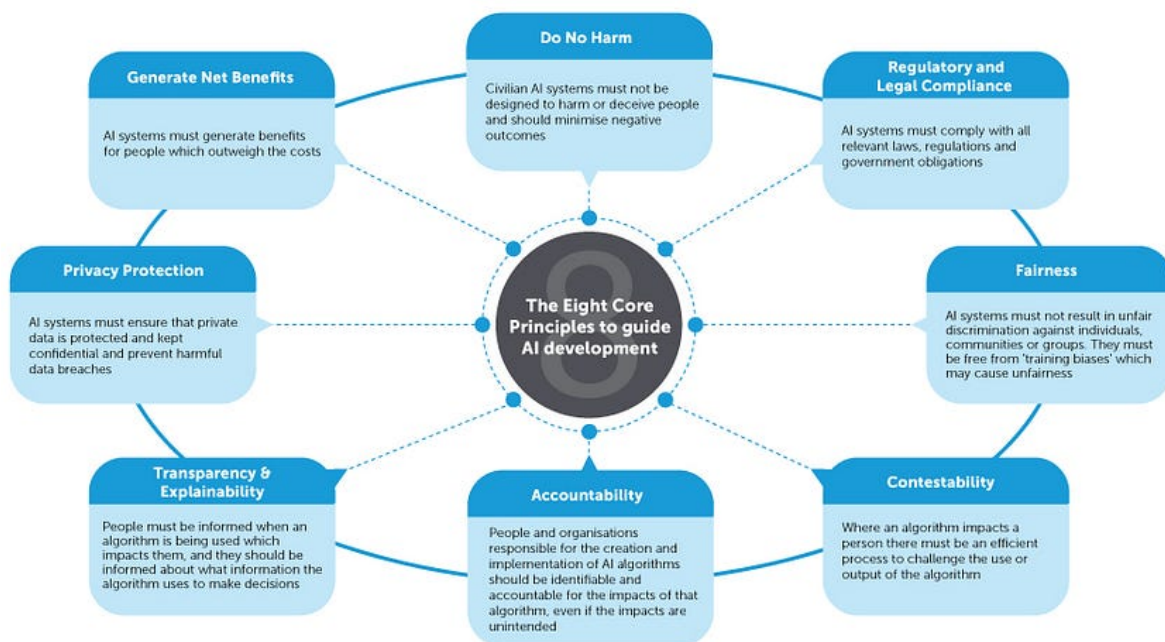
Individual Benefits	Collective Benefits
Help with narrow mundane tasks	Support impact and engagement
Boost research productivity	Build connections for interdisciplinarity
Increase speed and access to big data	Stakeholder benefit: publics, partners and learners
Boost academic promotion through greater productivity and access to large datasets	Support research informed teaching
Improve knowledge navigation and information retrieval	Promote open innovation
Speed up decision-making	Highlight cultural and access issues and biases
Freedom for blue skies research	Invoke values and principles

Another dilemma concerns the question of responsibility for the results obtained with the help of artificial intelligence. If AI makes a mistake or leads to wrong conclusions in a scientific study or innovation process, the question arises: who is responsible – the developers of the algorithms, the researchers who used the

AI, or the companies that implemented it in their work? This is especially important in industries where even minor mistakes can have serious consequences, such as medicine or pharmaceuticals.

In the case of innovations created with the help of AI, complex questions arise regarding intellectual property. If an AI algorithm is able to generate new inventions or innovations without direct human intervention, it is not clear who is the author – the developer of the algorithm, the user who launched it, or the system itself. This raises legal and ethical questions about the ownership and rights of inventions created with the help of artificial intelligence and requires a new approach to the regulation of intellectual property in the context of modern technologies.

With the use of AI in scientific research, an important ethical dilemma arises – whether research participants should give separate consent to the use of artificial intelligence algorithms to process their data. Traditional ethical norms require informed consent, but in the case of AI, participants may not understand the full extent of the use of their data and the possible risks associated with automated information processing (fig. 1). Participants must be clearly informed about exactly how their data will be used by artificial intelligence, what decisions will be made based on their data, and what risks this may pose to them.

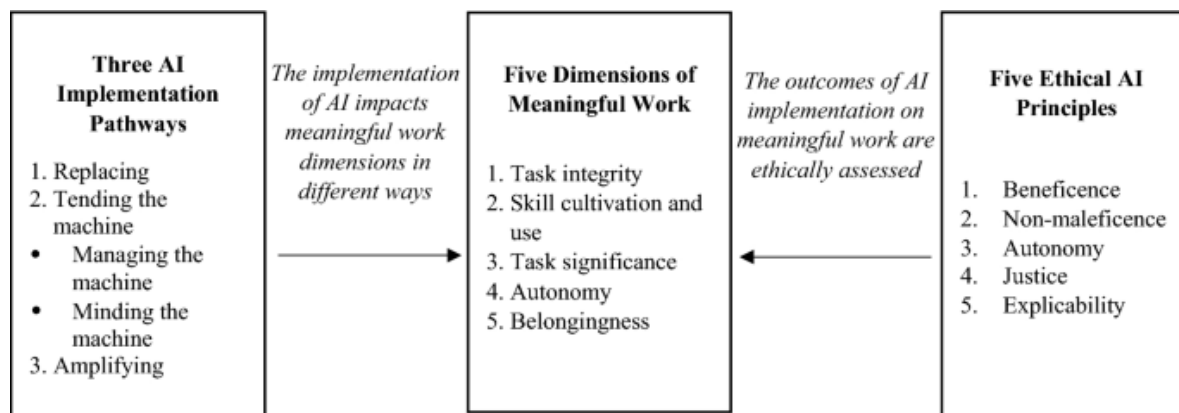


*Fig. 1. Example of an ethical framework [6]*

Artificial intelligence significantly increases the ability to analyze large volumes of data, which is important for scientific research. However, the use of personal data creates significant privacy risks [7]. AI can process information in a way that makes possible the reverse identification of participants even after the data

has been anonymized, which violates privacy rights. This necessitates the provision of adequate data protection measures, including cryptographic methods, access control and close supervision of who is authorized to use AI-processed data.

Today, various countries and international organizations are developing ethical standards and legal frameworks aimed at ensuring the responsible use of AI in science and innovation. For example, the European Union actively promotes its own ethical principles, enshrined in its AI White Paper and Ethical Guidelines for Artificial Intelligence, which focus on transparency, accountability and non-discrimination. Also, the UN and UNESCO published documents calling for the ethical use of technologies, including AI, to achieve the goals of sustainable development. In addition, various industry associations and academic institutions are developing their own codes of ethics for the use of AI in scientific research (fig. 2).



*Fig. 2. Overview of conceptual framework [8]*

However, regulations at the international level still remain fragmented, and there is no single, globally recognized standard for the ethical use of AI in science. There is a need to harmonize these approaches to avoid legal uncertainty and ensure global cooperation in research and development.

In addition, given the global nature of scientific research, new intergovernmental mechanisms of control and cooperation are needed, which would cover the ethical and legal aspects of the use of AI. Such mechanisms could include international commissions to assess the risks of new technologies, the development of common standards for scientific publications using AI, and the creation of ethical audits to monitor compliance with scientific research.

Ways to minimize ethical risks:

1. One of the effective ways to minimize ethical risks is to develop and implement clear ethical codes that would regulate the use of AI in scientific research and innovation. Such codes should outline ethical standards, regarding accountability, transparency, objectivity and data protection. They should also include recommendations for avoiding bias in algorithms and ensuring reproducibility of studies. The creation of such documents will promote compliance

with ethical principles in research activities and help regulate the use of AI at all stages of development.

2. In order to effectively control the ethical use of AI, it is important that regulation is collaborative and involves all key stakeholders: the scientific community, governments and technology companies. Interaction between these groups will contribute to the creation of harmonized standards and control mechanisms, which will avoid legal gaps and ensure accountability of developers and users of AI. Technology companies should actively participate in the development of ethical standards, by creating mechanisms to audit algorithms and ensure transparency of their models.

3. It is important that scientists and innovators are aware of the ethical challenges that arise when using AI. Conducting seminars, training and educational programs on the ethics of AI will contribute to increasing their awareness and understanding of the ethical implications of their research. This will allow scientists to be more deliberate in developing algorithms, avoid potential biases, and ensure responsible use of technology.

**Conclusions.** The use of artificial intelligence in scientific research and innovation is accompanied by several ethical dilemmas that require serious attention. The main ones include excessive automation, which can threaten the autonomy of researchers; issues of responsibility for results obtained using AI; algorithm transparency problems; risks of bias in models; as well as intellectual property issues. These dilemmas emphasize the difficulty of integrating AI into scientific and innovative activities, because they can significantly affect the quality and reliability of the results obtained.

The importance of finding a balance between technological progress and ethical standards cannot be underestimated. AI technologies can significantly improve research efficiency, but their implementation must be accompanied by clear ethical principles governing their use. Only in this way can it be ensured that achievements in the field of AI will be used for the benefit of society, without violating ethical norms.

For further research and development in the field of ethical regulation of AI, it is necessary to focus on the creation of universal ethical codes, the development of interdisciplinary research that combines technology and ethics, as well as on the improvement of control mechanisms for the use of AI. This will ensure the ethical use of technologies, minimizing risks and maximizing the positive impact of AI on scientific activity and innovation.

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