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Scientific Research Risks and Challenges in the Artificial Intelligence Era

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Abstract: ***This study examines the ethical, methodological, and socio-structural risks associated with the increasing use of artificial intelligence in scientific research. As AI tools increasingly support data analysis, content generation, and research workflows, concerns regarding academic integrity, transparency, overreliance, and governance have become more significant. A quantitative cross-sectional survey was conducted among 50 graduate students and researchers from diverse disciplines using an online questionnaire. Descriptive statistics, chi-square analysis, and regression-based interpretation were used to assess perceptions of AI-related research risks. Findings indicate widespread concern regarding academic integrity, trustworthiness of AI-generated outputs, reduced critical thinking, and inadequate researcher awareness of AI limitations. Participants strongly supported human oversight and clearer institutional ethical frameworks. Familiarity with AI was associated with greater adoption, but also with stronger awareness of governance concerns. The study highlights that the central challenge is not AI adoption itself, but the absence of robust accountability mechanisms and ethical guidance. These findings support the development of institutional AI governance policies that promote responsible and transparent research use.***

Keywords: Artificial intelligence; Scientific research; Research ethics; Academic integrity; Human oversight; Research governance; Generative AI.

1. Introduction

The advent of sophisticated Artificial Intelligence (AI), particularly generative models and Large Language Models (LLMs), is heralding a transformative period for global higher education and scientific research. This paradigm shift, often likened to a new industrial revolution [1,2], promises to democratize data analysis, accelerate discovery, and personalize the educational journey [2,3]. Powerful AI systems are poised to augment human intellect, offering tools that can synthesize vast corpora of literature, generate novel hypotheses, and even assist in drafting research manuscripts [4]. The potential for AI to contribute to global goals, such as Sustainable Development Goal 4 (SDG4) for quality education, is significant, suggesting a future of more inclusive and effective learning environments [5]. This rapid integration of AI into the academic fabric is not without profound risks and challenges.

The very tools designed to augment human capability are simultaneously introducing novel vulnerabilities that threaten the core principles of scholarly integrity, ethical conduct, and the production of valid, reliable knowledge. The "black-box" nature of many complex AI models, a central concern in the quest for Explainable AI (XAI), poses a fundamental challenge to research validation and reproducibility [1,2]. When the reasoning behind an AI-generated conclusion is opaque, the traditional peer-review process is compromised, creating a crisis of interpretability and trust [6].

A primary cluster of challenges revolves around research ethics and integrity. The ease with which AI can generate coherent text, and data raises acute concerns about plagiarism, authorship, and the authenticity of scholarly work [3,7]. Students and researchers may be tempted to use generative AI like ChatGPT to produce assignments or research components without adequate critical engagement or transparent disclosure, blurring the lines of original contribution [4,8]. This directly challenges long-standing scientific research ethics, forcing a re-evaluation of concepts like originality and intellectual labor [3,9]. Furthermore, AI systems trained on historical data can perpetuate and even amplify existing societal biases, leading to discriminatory outcomes and flawed research findings that reinforce social inequalities [1,10]. The challenges of adhering to strict ethical standards in AI application development are already evident among research communities, highlighting a gap between theoretical principles and practical implementation [3].

Methodological rigor is another area under threat. The uncritical adoption of AI-driven "big data" analytics can lead to a reliance on correlation over causation, potentially undermining the theoretical foundations of disciplines, particularly in the social sciences and humanities where qualitative depth is paramount [5,11]. The push towards data-intensive science must be balanced with efforts to transform data into meaningful, contextual knowledge, a challenge central to the vision of AI 2.0 [6]. Additionally, the immense computational resources required for state-of-the-art AI research create barriers to entry, potentially centralizing

innovation within a few well-funded institutions and exacerbating global digital divides [1, 2].

This paper argues that the academic community stands at a critical juncture. To harness the transformative potential of AI while safeguarding the foundational values of research, a proactive and multidisciplinary response is essential. This entails developing robust ethical frameworks, promoting algorithmic transparency through XAI, fostering AI literacy among students and researchers, and re-evaluating institutional policies on authorship and assessment [4,7,8].

By systematically examining the specific risks posed by AI, from data privacy and bias to the erosion of methodological rigor, this study aims to contribute to a roadmap for navigating the AI era responsibly. The goal is not to stifle innovation but to ensure that the future of research, as it is reshaped by AI, remains equitable, ethical, and epistemologically sound.

2. Research Gap and Contribution

Despite the growing body of literature addressing Artificial Intelligence in education and research, existing studies predominantly focus either on technological capabilities or ethical principles in isolation. There remains a lack of empirically grounded research that simultaneously integrates ethical, methodological, and socio-structural risks within a unified analytical framework, particularly in the context of active researcher behavior and perceptions. Moreover, few studies quantitatively examine how AI familiarity, publication pressure, and disciplinary context interact to shape ethical concerns. This study addresses these gaps by providing an integrated risk taxonomy supported by empirical survey data, thereby contributing both conceptual clarity and practical insights for policymakers, institutions, and researchers navigating AI-enabled scholarship.

Conceptual framework: AI risks across the research lifecycle
This study adopts a lifecycle-oriented conceptual framework that situates Artificial Intelligence risks across key stages of scientific research: problem formulation, data collection, analysis, interpretation, and dissemination. AI-related risks are classified into three interdependent domains: technical–methodological risks, integrity–ethical risks, and socio-structural risks. These domains interact dynamically, such that technical opacity may amplify ethical ambiguity, while institutional pressures may intensify uncritical AI adoption. By framing AI risks as systemic rather than isolated issues, this framework provides an integrative lens for analyzing how AI reshapes research practices, governance, and epistemic trust.

3. The Literature Review

AI is no longer an area of research but an engine of enterprise for mission-critical applications and systems. Supported by a perfect storm of large amounts of data, big computing, and open-source platforms, machine learning systems have become increasingly common. Yet increasingly sophisticated systems grapple with emerging requirements like secure, robust, and explainable AI and the ability to process data at scales larger than Moore's law suggests. This paper highlights opportunities for future research in task-specific hardware, modular AI, reliable AI systems, and edge-cloud architectures [1].

In [2], a literature review centered around human-centered smart societies powered by state-of-the-art technologies such as XAI, IoT, cyber-physical systems and digital twins. Relative to Industry 4.0 which was more focused on mass production and automation, Industry 5.0 is more connected to human-machine collaboration, mass personalization of products and services, and cross-domain advanced connectivity for health care, smart cities, autonomous driving and more. Research challenges in the field involve data interoperability, security and privacy in a networked environment and addressing the black-box nature of AI for transparency and trustworthy intelligent decision-making While prior studies highlight isolated ethical concerns or technical limitations, literature lacks a cohesive synthesis that frames AI risks as interconnected challenges affecting the entire research lifecycle.

Furthermore, existing research rarely operates these risks through measurable constructions linked to researcher behavior. By synthesizing insights from explainable AI, research ethics, and higher education governance, this study positions itself at the intersection of theory and practice, offering an empirically informed perspective that extends beyond normative discussions.

In [3], researchers operate under the assumption that AI applications exist that enhance reliability and effectiveness in research but also pose extreme ethical concerns for all researchers but especially those in Algeria. It demonstrates that artificial intelligence applications improve optimal speed data collection, translation access and creation, and knowledge acquisition and creation; however, the most significant ethical concerns in relative opposition to these findings are data privacy breaches, scientific plagiarism, bias and AI-generated responses, and lack of regulations and oversight. Ultimately, this literature review finds that overwhelming populations of researchers in Algeria are relatively uninformed about ethical concerns of AI applications relative to their research outcomes but simultaneously, laws and regulations established in the wake of such scientific AI applications are behind the times to better protect research in relative compliance with invention speed where the web and AI applications can outpace legislation.

In [4], C.K.Y. Chan and W. Hu and et al conducted within this document, university students possess an overall favorable perception of generative AI tools, understanding their advantages for personalized learning, writing support and research assistance but simultaneously, educators are cautioned by students' concerns for inaccuracy, opacity, privacy, plagiarism, reduced critical thinking abilities, and ambiguous administrative responses. Thus, the literature review supports a need for specific AI literacy instruction and comprehensive policies for responsible, ethical and efficient implementation of GenAI in the university setting.

According to [5], the study is relative to the ethical considerations of AI in education and how such technology should be ethically approached relative to UNESCO's SDG4

quality and inclusive education. Where AI offers personalized education, teaching support to teachers, and reduces a lot of the tedious administrative work that comes with education, the literature review shows how AI lacks humane empathy, creates additional bias, presents data privacy and protection concerns, and resources are not equitable unless socioeconomic equity is addressed - and likely, regulated against - in an AI-centered population. Ultimately, interdisciplinary guidelines, teacher preparation, and an appropriate ethical framework are needed to better support AI as a better solution for educational outcomes without sacrificing humanity.

Y. Zhuang and et al [6], contains the state of the art in AI, determining when rule-based reasoning is not enough and noting the transition to statistical machine learning to deep learning architectures. The authors note that a hybrid approach between data-driven and human-based approaches results in more explainable, robust, generalized AI solutions and better for NLP, multimedia, and knowledge engineering. Therefore, the gaps in the literature going forward are explainability of AI, optimal fusion of multi-modal data, creative AI, and human-machine partnerships for knowledge extraction from big data.

Adiguzel T and et al [7], reported that artificial intelligence, particularly chatbots like ChatGPT, is transforming education by fostering personalized learning experiences, automated assessment, and responsive, supportive learning environments. The advantages of implementation observed so far are enhanced student engagement, tailored support for varied learning and development needs, and teachers operating with increased efficiency through technology-assisted teaching. However, major ethical considerations and practical concerns emerge relating to bias, privacy, academic honesty, teacher training and equity and inclusion that require the implementation of supported frameworks for responsible use.

This study is guided by the following research questions:

- RQ1: To what extent do academic researchers adopt AI tools in their research activities?
- RQ2: How does familiarity with AI technologies influence perceptions of ethical and integrity-related risks?
- RQ3: What relationship exists between AI usage and demands for human oversight and ethical governance?
- RQ4: How do researchers who refrain from AI use conceptualized risks to research integrity and creativity?

4. Methodology

A quantitative approach was chosen to measure the prevalence of AI adoption and statistically correlate it with ethical concerns.

1) Design: A cross-sectional survey utilizing a Likert scale (1-Strongly Disagree to 5-Strongly Agree) with multiple-choice items. The methodology steps consist of the following:
2) Participants and data collection: The study included 50 participants consisting of graduate students and academic researchers from multiple disciplinary backgrounds. Inclusion criteria required participants to be actively engaged in scientific research activities and familiar with digital research tools. Participants were recruited using convenience sampling through academic WhatsApp groups. Data collection was conducted during November 2025 using an anonymous online questionnaire.
3) Survey Instrument Development and Validation: The questionnaire was developed based on constructs identified in prior literature concerning AI ethics, research integrity, trust in automation, and technology adoption in academic contexts [4,7,9]. Initial survey items were mapped to the study's conceptual framework covering technical-methodological risks, ethical-integrity concerns, and governance perceptions. To ensure content validity, the questionnaire items were reviewed for clarity, relevance, and alignment with the study objectives before distribution.
   - ***Hypotheses*** and analytical expectations: Based on prior literature, this study hypothesizes that researchers operating in high-publication-pressure environments demonstrate significantly higher adoption of AI tools alongside elevated concerns regarding authorship ambiguity and research integrity. Additionally, it is expected that increased AI familiarity positively correlates with demand for stricter ethical governance rather than blind trust in automation. These hypotheses guide the statistical analyses and enable empirical validation of the proposed risk framework.
   - ***Survey instrument validity***: The survey instrument was developed based on constructs identified in prior literature on AI ethics, research integrity, and technology adoption. Content validity was ensured through alignment with established ethical risk categories. Items were reviewed for clarity and relevance prior to distribution. While formal psychometric validation was beyond the scope of this exploratory study, internal consistency was examined to ensure coherence across thematic dimensions.
   - ***Reliability Assessment:*** As this study is exploratory in nature, the survey instrument primarily focused on conceptual coverage and internal thematic consistency. Formal large-scale psychometric validation was beyond the scope of the current study; however, item coherence was reviewed to ensure consistency across the measured constructs.
4) Analysis: Descriptive statistics (frequencies, percentages, and mean values) were used to summarize participant responses. Chi-square analysis was employed to explore associations between categorical variables across participant groups. Exploratory regression analysis was conducted to examine whether AI familiarity, prior AI usage, academic role, and perceived publication pressure were associated with concerns regarding research integrity and ethical risks.
5) Study Limitations: While this study provides useful exploratory insights, several limitations should be acknowledged. The relatively small sample size and convenience sampling approach limits external validity and broader generalizability. Additionally, reliance on self-reported perceptions may introduce response bias or social desirability effects. Nevertheless, as an exploratory investigation addressing an emerging research issue, the findings provide a useful foundation for future larger-scale and longitudinal studies.

6) Ethical considerations: Participation in the survey was voluntary, anonymous, and based on informed consent. No personally identifiable information was collected, and participants were informed of the academic purpose of the study. Because the research involved anonymous perception-based survey responses with minimal risk and no sensitive personal data, the study was considered exempt from formal ethical review under standard social science research guidelines (if applicable according to institutional policy). All procedures complied with accepted ethical principles for scientific research.

5. Results

1) Statistical tests indicated an association between familiarity with AI tools and their use in scientific research. The results showed that 80% of researchers with high confidence in their AI knowledge (who responded 'strongly agree') had already moved to the practical application stage and used AI in their research.
2) On the other hand, ethical awareness' emerged among those with neutral technical knowledge. All 100% of this group believed that stringent ethical rules and frameworks are necessary and that human monitoring is still very important. This shows that people will only embrace this technology if there are controls in place to make sure the results are correct.
3) To enhance analytical rigor, results are interpreted through comparative group analysis (AI users vs. non-users) and contextualized against existing empirical findings. Percentages are supplemented with interpretive explanations to clarify their implications for research governance and ethical decision-making 80% of those who answered the question "I am familiar with the concept of Artificial Intelligence" strongly agree with Figure 1.

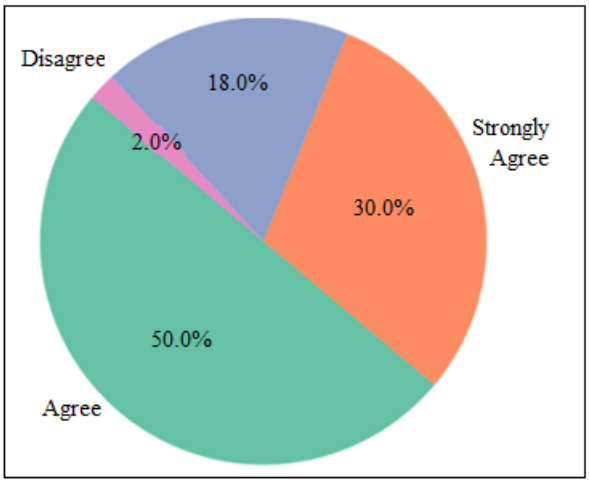

Figure 1: Familarity with the concept of AI

All neutral respondents who answered "I am familiar with the concept of Artificial Intelligence" agreed (100%) with either "a" or "strongly agree" on the following statements:

a) There should be stricter ethical guidelines for using AI in research.
b) Human oversight is essential when using AI in the research process.

4. All those who have never used artificial intelligence in scientific research answered with either:

a) 95% agree or strongly agree with the statement "AI poses significant risks to research integrity and accuracy", as illustrated in Figure 2.

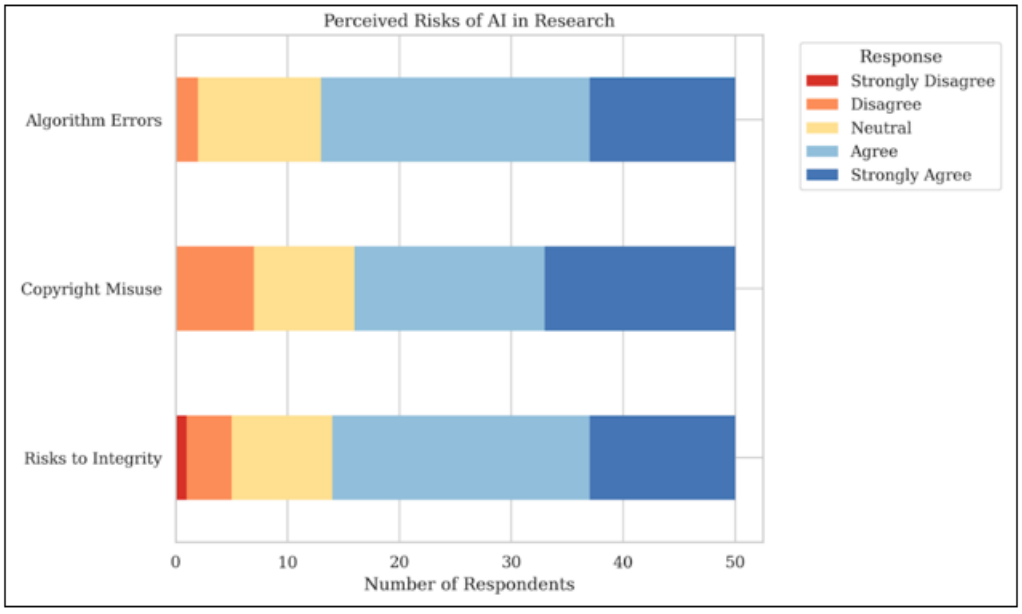

Figure 2: Preceded Risks of AI in Research

b) 100% agree or strongly agree with the statement "Researchers do not always understand the limitations of the AI tools they use".
c) 100% agree or strongly agree with the statement "Human oversight is essential when using AI in the research process".

5. About 73% of participants agreed that excessive reliance on AI in scientific research may weaken researchers' independent creative and critical thinking abilities, a concern also highlighted in prior higher education studies [4,7], see Figure 3.

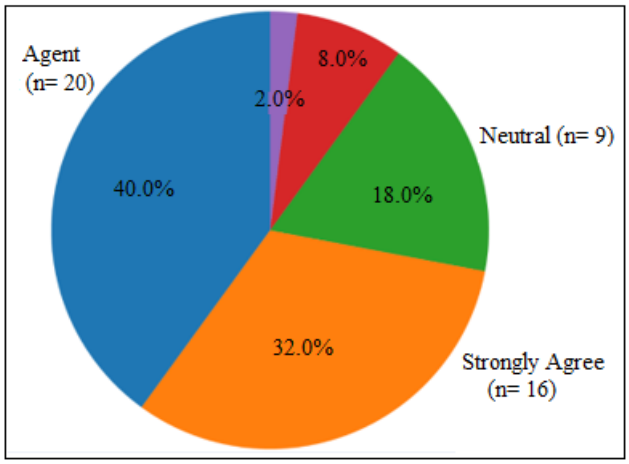

Figure 3: Counting AI by researchers on building on scientific research

6. A small percentage of participants responded that there are no benefits to using artificial intelligence compared to its risks, as shown in Figure 4.

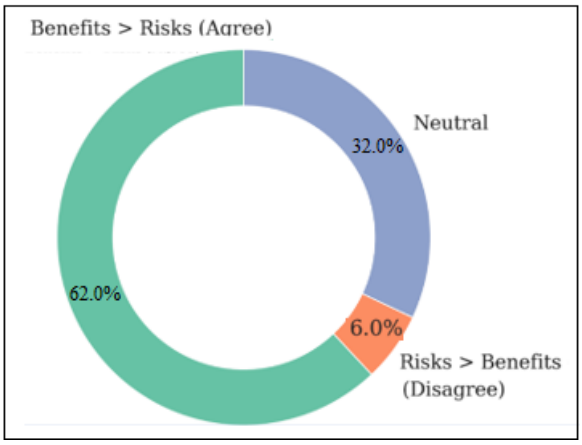

Figure 2: Assessment are benefits strongly than Risks

6. Discussion

The findings indicate that AI adoption in scientific research is increasing, but trust remains conditional rather than unconditional. Researchers with higher familiarity with AI demonstrated greater adoption rates, suggesting that technical awareness facilitates practical use. However, greater familiarity also corresponded with stronger support for ethical governance and human oversight, indicating that knowledge promotes critical caution rather than blind trust.

Non-users expressed significant concern regarding research integrity, authorship ambiguity, and overreliance on automated outputs. These findings align with prior research highlighting persistent skepticism regarding plagiarism, hallucinated outputs, and weakened scholarly accountability [4,7]. From an institutional perspective, the strong support for human oversight indicates a clear need for formal governance frameworks that define acceptable AI use, disclosure expectations, and accountability boundaries. Rather than rejecting AI, the findings support responsible governance-centered integration.

6.1 Implications for research governance

The findings suggest that resistance to AI adoption among researchers is driven less by technological skepticism and more by concerns over epistemic validity and ethical accountability. This highlights the urgent need for institutional governance mechanisms that emphasize transparency, explainability, and human-in-the-loop oversight. Without such measures, AI risks amplifying existing weaknesses in research evaluation, authorship norms, and scholarly trust.

6.2 Practical and policy implications

This study offers actionable insights for universities, research institutions, and publishers. Institutions should develop explicit AI usage policies that distinguish acceptable assistance from academic misconduct. Training programs aimed at enhancing AI literacy must integrate ethical reasoning alongside technical skills. Publishers and reviewers may also consider disclosure requirements for AI-assisted research processes to preserve transparency and trust.

7. Conclusion

This study demonstrates that while artificial intelligence offers meaningful support for scientific research, its adoption raises substantial concerns regarding academic integrity, transparency, trust, and researcher dependency. The findings indicate strong support for continued human oversight and formal governance frameworks to ensure responsible AI integration. Although limited by sample size and convenience sampling, the study provides useful exploratory evidence on researcher perceptions in the AI era. Future work should expand sampling scope, incorporate cross-institutional comparison, and examine discipline-specific AI governance needs.

8. Future Works

To harness the transformative potential of AI while mitigating its associated risks, future research and development should focus on the following key areas:

- **Institutional policy frameworks:** There is an urgent need to bridge the gap between theoretical ethical principles and practical application. Future work should focus on developing specific educational programs for universities and comprehensive policies that clarify the limits of AI use in the era of generative AI.
- **Implementation of restricted "Academic Search Modes":** There is a critical need for the development of specialized "Academic Search Modes" within generative AI tools. These modes should be "limited use" by design, technologically restricted to retrieving information solely from verified scholarly repositories (e.g., IEEE, PubMed, Scopus) and disabled from generating creative fiction. This would directly address the risks of hallucinations and non-existent citations, ensuring that students and researchers interact only with epistemologically sound data.

Future research should expand this study across diverse cultural and disciplinary contexts to enhance generalizability. Longitudinal designs are recommended to examine how ethical perceptions evolve with prolonged AI exposure.

Additionally, experimental studies evaluating the effectiveness of institutional AI governance frameworks and restricted academic AI modes could provide actionable guidance for universities and publishers.

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