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The role of artificial intelligence in scientific research: productivity and ethics

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Abstract. *Introduction.* The widespread adoption of artificial intelligence (AI) models for automatic content creation highlights the need to develop appropriate approaches to address the ethical issues associated with this technology and to minimise the risks of its misuse. *Aim.* The *aim* of this study is to quantify and analyse the extent to which AI tools are implemented in research activities, as well as to assess their impact on research performance, with consideration of ethical aspects. *Methodology and research methods.* A descriptive correlational method was employed in this study. Empirical data were collected using a random sample of undergraduates from the University of Jordan (n = 511). *Results.* A statistically significant positive relationship was identified between the use of AI in research, the outcomes produced, and adherence to research ethics. It was found that artificial intelligence has a significant positive impact on enhancing the quality of scientific research. The key components of scientific ethics – fairness, confidentiality, and responsibility – are analysed, and their role in interactions with AI systems is examined. *Scientific novelty.* The study offers new insights into the direct and indirect effects of artificial intelligence on scientific research outcomes. *Practical significance.* The results of the study can be utilised in the development and formalisation of ethical standards for managing the application of AI in science, aiming to adapt to evolving academic practices and enhance the quality of research.

Keywords: artificial intelligence (AI), research ethics, fairness, AI integration, AI-driven decision-making

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Роль искусственного интеллекта в научных исследованиях: продуктивность и этика

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Аннотация. *Введение.* Широкое распространение моделей искусственного интеллекта (ИИ) для автоматического создания контента актуализирует необходимость разработки релевантных подходов к решению сопряженных с этим этических проблем и минимизации рисков злоупотребления технологиями. *Цель* исследования заключается в количественной оценке и анализе степени внедрения инструментов ИИ в научно-исследовательскую деятельность, а также определении их влияния на результативность исследований с учетом этического аспекта. *Методология, методы и методики.* В рамках исследования был применен описательно-корреляционный метод. Сбор эмпирических данных осуществлен методом анкетирования на основе случайной выборки магистрантов Университета Иордании (n = 511). *Результаты.* Выявлена статистически значимая

положительная связь между использованием ИИ в исследованиях, их результатами и соблюдением исследовательской этики: установлено, что искусственный интеллект оказывает значительное положительное влияние на повышение качества научных исследований. Проанализированы ключевые компоненты научной этики (справедливость, конфиденциальность, ответственность) и определена их роль во взаимодействии с системами ИИ. *Научная новизна.* Исследование предоставляет новые знания о прямом и косвенном влиянии искусственного интеллекта на результаты научных исследований. *Практическая значимость.* Результаты исследования могут быть использованы при разработке и формализации этических стандартов для управления применением ИИ в науке, с целью адаптации к изменяющимся академическим практикам и повышения качества исследований.

Ключевые слова: искусственный интеллект (ИИ), этика исследований, справедливость, интеграция ИИ, принятие решений на основе ИИ

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Introduction

People are constantly adapting to quickly changing technology and new technical instruments, such as different artificial intelligence (AI) models. AI has potential uses in a variety of industries, but little is known about academics' attitudes towards this new technology in higher education. Academics contribute to the advancement and development of knowledge by serving in a variety of jobs inside colleges [1–4]. They can share, create, and advance knowledge as educators, researchers, or both. AI's repercussions in higher education may have an impact on academic and student work. For example, it might help with study design and data collecting, increasing research productivity. Furthermore, AI might assist academic educators with administrative activities such as collecting student comments and creating a course outline [5–7].

Conversely, AI's capacity to produce natural-sounding language jeopardises academic credibility. Academics have raised ethical problems, including but not limited to prejudice within it. New technology tools may have an impact on educational and research processes; therefore, understanding attitudes is critical when discussing expectations and concerns about ChatGPT in academia [8–10].

AI in academia might give academics with new chances to strengthen academic procedures and increase research productivity, potentially influencing positive views towards the technology. For example, AI might help academics with study design, data collecting, analysis, and publishing. AI might do specific activities such as developing research topics, finding data sets, and coding data. Academic educators may employ AI to give student feedback, create course plans, and produce new methods of conveying concepts. AI help might save academics time, lowering the risk of burnout and other health problems. However, AI's ability to generate hu-

man-like outputs may jeopardise academic credibility. Specifically, AI has produced outputs that resembled authentic human language to the point where academics were unable to distinguish phoney scientific abstracts authored with it. Students may misuse AI to produce homework, inhibiting critical thinking and problem solving [11–14].

Academic plagiarism detection programs such as iThenticate, Turnitin, Grammarly, and other plagiarism detection tools are unreliable in detecting AI-generated material, which concerns academics. Academics are unable to effectively assess students' grasp of tested topic unless they can spot AI-generated work. To decrease students' usage of AI, professors are changing course structure and exams. Similarly, academic publishers are revising their authorship practices to ensure the integrity of scholarly work. AI's inherent bias may likewise threaten scientific integrity. Large Language Model (LLM) bias is defined as the systemic occurrence of misrepresentation, attribution mistakes, or factual distortions that benefit select groups, perpetuating stereotypes and making inaccurate assumptions as a result of its learning processes [15–18].

Academics are currently attempting to diversify study samples so that they better reflect the human population. Although academics seek for fairness and inclusivity in research, potential abuses of academic ethics and LLM prejudice may have a detrimental impact on academics' opinions towards artificial intelligence. With limited legislation governing the use of AI in Jordanian institutions, academic educators are battling to oversee its usage. Academic educators' discourse has increasingly evolved from being dealing with cheating to asking how to assist students' deep learning, as evidenced in emerging AI regulations [19–22].

Initial research on attitudes towards AI in higher education reveals varied results. Negative views were frequently stated regarding student misconduct, such as plagiarism and cheating, as well as pupils being sluggish in their studies. Concerns included ethical abuse, a decline in student assistance, and dangers to effective assessment processes. Positive views were stated regarding AI's capacity to reduce time, automate feedback, boost classroom participation, inspire critical thinking and creativity, and provide easily available course materials [23–26].

Scientific research is a hallmark of national advancement, providing solutions to many societal issues. Research is based on underlying concepts and ethical principles, as the philosophy of truth-seeking and the collection of information is grounded. These are the considerations of intellectual property, research procedures, citation, and general knowledge [27, 28]. The key ethics in the work of researchers and graduate students include credibility, expertise, safety, trust, consent, digital record-keeping, feedback, and confidentiality in managing samples [29, 30].

The electronic software and recent innovations, such as artificial intelligence (AI), that have transformed the internal and external structures of the university are causing a swiftly changing environment in university education [31–33]. The aspect of quality in higher education is highly connected with the area of technological advancement that adopts the use of personal computers and information

networks instead of traditional lectures. Smart technologies developed with AI have excelled in accommodating education and facilitating its growth and development. The new AI-driven educational systems and expert systems have created a holistic architecture that improves the learning process and assists in scientific studies via e-learning systems [34, 35].

University-related AI ethics are the standards of responsible use, human rights preservation, harm reduction, benefit maximisation, bias minimisation, and fairness, transparency, and privacy of the involved data [36, 37]. Ethical standards of AI within higher education are offered by global standards, including the Association of the Advancement of Artificial Intelligence (AAAI) and the International Association of Computing and Philosophy (IACAP). Other projects, such as the global initiative on ethical autonomous systems by IEEE, are also concerned with ethical principles in AI research, education, and industry generation [38].

Study Problem

AI has significantly transformed the learning and research process undertaken by students and professors in institutions of higher learning. The increased significance of AI in the process of academic environment changes has been evidenced by the fact that many universities have integrated the tools. ChatGPT, a language model developed by the OpenAI Company, is one of the most popular instruments that has demonstrated an outstanding ability to produce coherent and high-quality written data. Nonetheless, the widespread use of ChatGPT has shown that there are severe gaps in the academic field, including the lack of official ethical regulations to control the use of ChatGPT in academic institutions. Nevertheless, there are no specific rules that regulate the application of AI technologies in educational institutions and threaten academic honesty and transparency in knowledge creation. The excessive utilisation of technologies such as ChatGPT to enhance critical and analytical skills has become an issue among professionals and educators. The use of ChatGPT in academic projects by students has significantly decreased critical thinking processes [39].

The other major gap that is identified is related to the biases that AI models contain. An IEEE survey shows that 42 per cent of AI-generated texts, even those that ChatGPT generated, had some form of prejudice. Such prejudices compromise objectivity and diversity in a process of knowledge building and extend injustices and strengthen stereotypes instead of enhancing inclusive and egalitarian education [40].

To deal with the ethical dilemma of AI misuse, various programmes have been developed, and institutions, governments, non-governmental organisations, and industries have developed AI ethics. Such examples are the Montreal Declaration, the IEEE, and conferences on Fact at ACM, which note that rigorous AI ethics are necessary. Advanced AI models can generate texts, images, and even videos based on textual prompts. OpenAI launched DALL-E 2, a generative AI model for image creation based on text, followed by Google and Meta, who developed AI systems that produce videos from text prompts [26–30]. This study seeks to measure the relation-

ship between the degree of AI research tool usage and research outcomes in light of research ethics compliance.

Study Questions

The study aims to answer the following questions:

- To what extent do graduate students at the University of Jordan use AI technologies in research?
- To what extent do graduate students at the University of Jordan adhere to research ethics when using AI systems?
- To what extent do graduate students at the University of Jordan use AI applications in research?

Significance of the Study

The study aims to assist educational policy makers in universities in emphasising ethical principles and intellectual rights to achieve research goals. It also encourages universities to motivate educators and specialists to prioritise scientific research using AI technologies and to provide graduate students with research ethics standards. This study represents a scientific addition to a crucial and under-researched field due to the increasing prevalence of AI applications. It is hoped that this study will open new avenues for researchers, contributing to positive changes and expanding knowledge in educational thought and scientific research.

Literature Review

The possibilities of AI to generate academic knowledge are enormous, yet there are concerns about the biases of an algorithm and even ethical concerns. Analysing, understanding, and generating text based on huge datasets are the abilities of language models, like ChatGPT, that use artificial intelligence to work with enormous amounts of data. Nevertheless, it is possible that these models are biased in the training material, resulting in writings that are either inaccurate or unethical as academic assignments. The impartiality and neutrality that should be ensured in academic work are under threat by the possibility of algorithmic biases, referring to the distortions or prejudices that arise due to the nature of the data on which the AI systems train their outputs.

The issue of algorithmic biases is critical in academic research since they damage the objectivity and neutrality that academic work should possess. The importance of reducing these biases is essential in terms of proper and ethical use of AI in academics [25–30]. Acceptability of the use of ChatGPT in the future is positively correlated with the desire to use it. The ethical principles, which are maximised in academic research, especially transparency, integrity, and respect for copyright, are of particular significance to AI-assisted research.

Among the most topical ethical issues, there is the possibility of students or researchers giving cognitive tasks to ChatGPT too many times, risking their ability to formulate their own information and their active participation in the research process. The use of technologies like ChatGPT in academic life needs clear stan-

dards that regulate the usage of technologies and make the academic process real, and adhere to academic ethical values.

Authorship, which can be described as the official acknowledgement of the input of a person in the creation of an academic publication, is vital in academic work. In AI-supported studies, there is no clarity on who the true author of the information is [18–21]. The perceived objectivity of ChatGPT is also a significant point in the efficiency of the tool, as students value its objectivity and think that it is needed to maintain neutrality in their research. This perception gives confidence and loyalty to instructional technology that promotes its use on an ongoing basis. The perceived usefulness of ChatGPT is making scholars use this tool, as students admire the tools that can assist them in achieving better results and streamline their academic activities with minimal time consumption. Educational technology studies have indicated that the perception of usefulness in a tool facilitates the impact of deciding to use it on a permanent basis in academic practice, especially when it contributes to the increment of productivity and quality of work. Plagiarism is a big violation of academic ethics whereby an individual offers the work, ideas, or words of another individual without giving the necessary credit to the original writer. In order to prevent plagiarism, it is important to reference all the sources and give citations to the external material.

M. Gerlich [41] examined the correlation between cognitive offloading and the critical thinking skills of the use of AI tools. In the research, it was found that there is a negative correlation between the regular use of AI tools and the skills of critical thinking, mediated by increased cognitive offloading. Participants of younger ages showed more dependence on AI technologies and worse scores in critical thinking. An increased education level was linked to better critical thinking skills, with or without the use of AI. The results highlight the potential cognitive costs of using AI tools and require educational interventions that promote critical thinking in relation to AI technology. The research is essential for the educators, politicians, and technologists to deal with the cognitive implications of AI.

In their research made in the field of social science, J. Jeon, L. Kim, and J. Park [42] explored the use of generative AI in research practice by focusing on three narratives: equaliser, meritocracy, and community. It argues that AI-assisted social-scientific investigations cannot be diminished to universalised checklists and that institutionally based research ethical standards must be used. The authors claim that AI-based research ethics must include community involvement, educational needs, institutional regulations, and the social impact of AI technology. Democratic discourse is needed to cope with the complexity of the interaction between AI systems and societal processes.

J. Ayling and A. Chapman [43] studied the ethical frameworks of AI systems, with the focus on the practical tools to be applied during the system development and implementation. The study appraises these frameworks on best practices, impact assessment, and auditing and also compares present AI ethical tools to previous methods in technology, the environment, privacy, finance, and engineering. It

discusses the use of AI ethics tools by different stakeholders and different parts of the AI development and deployment cycle and identifies a lack of auditing and risk assessment that needs to be closed.

The article by M. O. Rodriguez-Saavedra, A. R. Barrientos-Alfaro, C. P. Malaga-Davila et al. [44] assesses the ethical concerns related to the utilisation of ChatGPT in academic research. The authors emphasised its acceptability, perceived usefulness, and impact on future usage intentions of the university students. Structural equation modelling with SmartPLS was used to test the associations between the essential variables. The researchers discovered that the ease of use and content reliability influenced the future use of ChatGPT in a positive and significant way. However, ethical issues and perceived neutrality did not play a major role. In addition, the use of ChatGPT has a significant effect on scholarly research. It is mentioned that ChatGPT can offer significant advantages to other scholarly studies, including effectiveness and efficiency; the application, however, is advised to be supported by ethical principles in order to minimise the risks concerning authorship and originality. Regarding their practical implications, colleges and universities ought to establish clear regulations and educational courses that will help to foster the correct and moral application of computer-assisted intelligence systems such as ChatGPT. These can be applied to ensure that these tools can be effectively utilised by students without compromising their academics.

M. Hosseini, D. B. Resnik, and K. Holmes [45] delved into the question of how ethical the use of AI technologies (like ChatGPT or large language models (LLMs)) is in scientific papers. Other journals, such as Science, have banned LLMs due to ethical considerations regarding accountable authorship. But the authors argue that these kinds of prohibitions cannot be enforced and encourage clandestine use. YLLMs are able to assist in text editing and scientific equality. They also allege that it is incorrect to acknowledge LLMs as writers and to give them credit because they do not have free agency. They suggest that the APA style should be improved to include the author, version, model, and time of use when citing ChatGPT. Researchers are expected to provide their usage in the introduction or methods section, reference and cite it in the text, and report their contacts with the LLMAs to be in additional material or in appendices.

S. Balakrishnan and B. Vidya [46] addressed the topic of the use of ChatGPT by teaching faculty in Chennai, India, and its beneficial effects. Semi-structured interviews were used to gather information by interviewing twenty faculty members. The results indicate that educators often utilise ChatGPT to provide assistance in assignments and lecture preparation, which results in better and increased student engagement and efficiency in education. Nevertheless, data privacy issues, security issues, technical constraints, and the low level of interaction between students and lecturers were found. The research contributes to the gap in the current literature as it offers local information on the implementation of ChatGPT in the higher education system of Chennai. It highlights the importance of having a balanced approach that accommodates both moral and practical issues. The findings provide insight

to teachers, governments, and scholars to enhance the results of learning through artificial intelligence systems.

Based on a systematic literature review with the PRISMA model, S. Dube, S. Dube, B. M. Ndlovu et al. [47] investigated how university students view the use of ChatGPT in their study and research. The study is expected to give a thorough insight into how students view ChatGPT, how education is positively affected by the tool, and how people are worried about the possible introduction of the tool to the academic process. The paper examined 32 articles on the perceptions of students towards ChatGPT, and it found that there are five constructs that mediate its use in academic tasks. Students have mixed views, but all of them affirm that ChatGPT impacts positively on their learning. They, however, also raised some concerns regarding its application, which could be enhanced so that it could be effective in terms of education.

C. Wilkinson, M. Oppert, and M. Owen [48] conducted a study to better understand the viewpoints of university instructors on ChatGPT. The data analysis revealed three significant themes: ethics, changes in academic practices, and accessibility and inclusivity. Academics have positive perceptions of ChatGPT in general, but unfavourable attitudes towards unethical use of the technology. The findings demonstrated disparities in academics' attitudes about their own ethical use of ChatGPT vs unethical use by others. Additionally, academics regarded ChatGPT as a beneficial tool for saving time while increasing research processes and student learning. Lastly, ChatGPT may increase equality among different groups, but it ought to be used with prudence.

M. J. Drolet, E. Rose-Derouin, J. C. Leblanc et al. [49] investigated cross-cutting ethical concerns in academic research, focusing on the viewpoints of researchers, research ethics board members, and ethics specialists. The study took a descriptive phenomenological method, gathering data using questionnaires and interviews. The ethical difficulties noted were study integrity, conflicts of interest, and respect for participants, a lack of supervision, individualism, insufficient direction, social inequities, distributive injustices, epistemic injustices, and ethical suffering. The findings can assist identify future solutions to these problems, addressing the various responsibilities of academic members in the academic community.

Methods

The study utilised a descriptive, survey-based correlational method suitable for the research objectives and questions.

Study Population and Sample

The study population comprised all postgraduate students at the University of Jordan during the 2023–2024 academic year, totalling 6,765 students, according to the Annual Statistical Report of the Ministry of Higher Education and Scientific Research (2023–2024) [41]. Table 1 presents the study population distribution.

Table 1

Distribution of the study population by university

University	Master's	Doctorate	Total	Sample size
University of Jordan	4,904	1,861	6,765	400

The study instrument was distributed to a suitable random sample. According to U. Sekaran and R. Bougie [50], a representative and appropriate sample size for the study population is 400 students.

Study Instrument

The study instrument was developed based on previous research [e.g. 33–37] Responses were classified according to a five-point Likert scale, with numerical weights assigned as follows:

- Strongly Agree – 5 points
- Agree – 4 points
- Neutral – 3 points
- Disagree – 2 points
- Strongly Disagree – 1 point

Validity of the Study Instrument

To ensure the validity of the study instrument, the initial version was reviewed by expert judges from Jordanian universities to verify the clarity and linguistic accuracy of the items, as well as their suitability for measuring the intended constructs. The judges were asked to assess the content quality of the items and their relevance to the dimension under which they were classified. Modifications were made based on the judges' feedback regarding the scientific wording of certain items, and some items were removed.

Internal Validity

The internal consistency validity of the study variables was examined by calculating the correlation coefficients of each dimension with the overall score of the respective variable. For the dependent variable, the correlation coefficients of individual items with the total score of the variable were computed.

Internal Consistency

Pearson correlation was used to verify the internal consistency for each dimension. Table 2 presents the results.

Table 2

Pearson correlation of the internal consistency for each dimension

Variable	Dimension	Correlation with total
Ethical use of AI in research	Vision & Transparency	0.94*
	Fairness	0.90*
	Privacy	0.95*
	Responsibility	0.95*
AI techniques in research	Smart Search Engines	0.87*
	Automated Summarisation	0.94*
	Statistical Analysis	0.95*

Note. * Significant at 0.01 level

Table 3 further illustrates the correlation of specific items with the total variable scores, confirming statistical relevance and high internal consistency for the tool.

Tool Reliability

The reliability of the study was assessed using Cronbach's alpha to measure internal consistency, with values ranging from 0 to 1. A Cronbach's alpha of 0.6 or higher indicates acceptable consistency. Current results show high reliability across variables, with alpha values between 0.89 and 0.95.

Table 3

Cronbach's alpha reliability for study variables and dimensions

Variable	Number of items	Alpha (⊠) value
Ethics in AI Research	11	0.955
Use of AI Techniques in Research	8	0.916
Outcomes of AI Application Usage	8	0.895
Total	27	0.973

Statistical Analysis Methods

To answer research questions and test hypotheses, the study employed SPSS and AMOS software, with the following methods:

- Descriptive Statistics: Frequencies, percentages, means, and standard deviations to describe the sample's characteristics and responses.
- Reliability Analysis: Cronbach's alpha for internal consistency.
- Multicollinearity Testing: Variance Inflation Factor (VIF) and Tolerance tests, along with the Durbin-Watson test.
- Normality Check: Skewness analysis.
- Multiple Regression Analysis: to assess the impact of independent variables on a single dependent variable.
- Path Analysis: to examine the direct and indirect effects of the mediator variable.

Data Analysis and Hypothesis Testing

The descriptive results showcase averages, standard deviations, rankings, and agreement levels for each variable and dimension.

Results and Discussion

Responses on the ethics of AI use in research are shown in Table 4, with dimensions ranked by mean scores and agreement levels.

Table 4

Mean scores, standard deviations, rankings, and agreement levels for ethics in AI research

No.	Dimension	Mean	Std. Dev.	Rank	Agreement level
1	Responsibility	4.03	0.78	1	High
2	Vision & Transparency	4.02	0.87	2	High
3	Privacy	3.92	0.80	3	High
4	Fairness	3.89	0.98	4	High

It is shown in Table 4 that the attitude of students towards following research ethics in AI is high-positive and the mean is 3.97. The greatest rating was on responsibility, then on openness, privacy, and fairness. It shows that students are aware of ethical research principles when applying AI to academic projects, which may be explained by their understanding of the research process and research ethics in the context of AI application. According to the findings, the students are also more concerned about responsibility and openness issues, which prove that they need trust and accountability in the utilisation of AI technology in research. Such results align with previous studies, which reveal the applicability of the ethical questions when AI is used in research. Indicatively, A. Jobin, M. Ienca, and E. Vayena [52] also identified the recurring themes in their study of AI ethical principles as responsibility, fairness, and privacy, which can also be found in the present results, with the average rating of privacy and fairness being rather high.

On the same note, L. Floridi, J. Cowls, M. Beltrametti et al. [53] have indicated that accountability and openness are ethical pillars in artificial intelligence governance, which aligns with our research findings, which indicate that the two were the highest ranked by students. This shows that students are becoming more aware of the ethical concerns of AI, which is consistent with the findings of J. Morley, L. Floridi, L. Kinsey et al. [54], who noticed an increase in academic understanding of AI's societal repercussions. Additionally, the emphasis on responsibility suggests that students prefer explicit accountability frameworks, which is consistent with R. Binns' [55] study, which suggested that the creation of ethical AI necessitates a clear distribution of responsibility throughout all stages of research. The findings for these factors are shown in Table 5.

Table 5

Means, standard deviations, rankings, and agreement levels for ethics in AI research items

No.	Item	Mean	Std. Dev.	Rank	Agreement level
1	AI systems in research are transparent.	4.20	0.81	1	High
2	AI systems in research are accountable.	4.16	0.86	2	High
3	You can understand how AI arrives at conclusions.	3.70	1.24	10	High
4	AI systems in research are fair.	3.77	1.24	9	High
5	AI enhances your access to information.	4.02	0.86	6	High
6	AI systems in research protect research privacy.	4.05	0.82	4	High
7	AI is utilised to complete research.	4.02	0.85	5	High
8	Data storage and usage are secure.	3.67	1.10	11	Medium
9	AI systems are used objectively in research.	3.97	0.91	8	High
10	AI considers the societal impact of research.	4.10	0.85	3	High
11	Ethical concerns are addressed, and faculties are consulted.	4.01	0.89	7	High

Table 5 reveals that all topics linked to ethics in AI research obtained high agreement, with the exception of one at a medium level. Means varied from 3.67 to 4.20, with the highest-ranked item, "AI systems in research are transparent", having a mean of 4.20 (*SD* = 0.81), most likely due to the progress and broad acceptance of AI research tools. The lowest-ranked item, "data storage and usage are secure", had a mean of 3.67 (*SD* = 1.10), which might be explained by university students' recent adoption of AI systems, which has resulted in data storage issues. The findings generally indicate an increasing awareness among students about the relevance of ethical considerations when using AI technology in scientific research, notably in terms of openness, accountability, and privacy protection.

The present findings are congruent with those of S. Schicktanz, J. M. Welsch, M. Schweda et al. [56], who discovered that consumers are more likely to trust and accept AI systems when they believe they are simple to grasp and transparent. Likewise, responsibility and attention to societal consequences were also very important, which agrees with the report of H. Machado, S. Silva, and L. Neiva [57], who stated that AI systems should be answerable to societal impact and the rest of the general interests. The fact that the mean of the respondents in relation to comprehending how AI arrives at its decisions is rather low (*M* = 3.70) aligns with the results of S. Kruschel, N. Hambauer, S. Weinzierl et al. [58], who tackled the topic of explainability as one of the challenges in the sphere of applying AI.

Furthermore, the item "data is stored and used securely" (*M* = 3.67) was the only one rated at an average level, which aligns with the study conducted by L. Floridi, J. Cowls, M. Beltrametti et al. [53], who warned that data privacy and secure data governance remain underdeveloped areas in many institutional AI frameworks. The

means, standard deviations, rankings, and agreement levels for the use of AI techniques in research are presented in Table 6.

Table 6

Means, standard deviations, rankings, and agreement levels for AI techniques usage in research

No.	Dimension	Mean	Std. Dev.	Rank	Agreement Level
1	Intelligent search engines	4.18	0.73	1	High
2	Statistical analysis and prediction	4.14	0.69	2	High
3	Automated summarisation and content generation	3.99	0.80	3	High

Table 6 shows that there is a great deal of student concurrence regarding the use of AI in research, with a total mean of 4.09. The high level of agreement was found in all dimensions, and means were between 3.99 and 4.18. The intelligent search engines domain was ranked highest (M = 4.18), then the statistical analysis and prediction, and automated summarisation and content generation (M = 3.99). This demonstrates that students and teachers admire the ability of AI to learn content fast and in an accurate manner, as well as to create academic writing. These results show that students and professors increasingly value the role of AI technologies in accelerating the right access to material and helping to generate scientific content, which is a significant change in the usage of AI as a powerful research instrument.

Our results can be correlated with the findings of J. Haider and O. Sundin [59], who mentioned the increasing reliance of students on the search technology supported by AI to quickly and effectively find the appropriate information. They are also consistent with the study carried out by M. I. Jordan and T. M. Mitchell [60], who highlighted that machine learning models are used in scientific studies to enhance data interpretation and forecasting ideas. The aspect of automated summarisation and content generation (M = 3.99) can be attributed to the results of R. Binns [55] concerning efficiency and the possibility of a lack of critical depth in the content produced by AI. The results for certain items related to the variable of AI methods used in research are presented in Table 7.

Table 7

Means, standard deviations, rankings, and agreement levels for AI techniques usage in research items

No.	Item	Mean	Std. Dev.	Rank	Agreement level
1	I use AI to access relevant academic articles.	4.20	0.79	2	High
2	I use AI to analyse large volumes of literature.	4.16	0.85	4	High
3	I use AI to summarise academic articles.	4.12	0.91	6	High
4	I use AI for automatic academic content generation.	4.13	0.78	5	High

5	I use AI to generate new content from existing sources.	3.72	1.11	8	High
6	I use AI for data and statistical analysis.	3.96	0.91	7	High
7	I use AI to draw expected research conclusions.	4.19	0.85	3	High
8	I use prediction techniques to forecast future research trends in the field.	4.28	0.73	1	High

Table 7 indicates that all the issues surrounding the application of AI methods in research had a high level of agreement, with a mean score of 3.72 to 4.28. The answer ranked with the highest score of 4.28 (*SD* = 0.73) is the highest-ranked answer, which is "I use prediction techniques to predict future research trends in the field", as the answer that indicates that graduate students are aware of the ability of AI to identify new research trends and have significant potential in making predictions. The least rated answer, which is the generation of new material using the already available sources, had a mean of 3.72 (*SD* = 1.11); so, this shows that students are familiar with the role of AI in drawing conclusions and tendencies in scholarly studies. This can be a sign of a relative reluctance of students to use AI to create original content, or of their familiarity with the necessity to combine the application of modern technologies with preserving the originality of the content in the research. The outcomes are mostly a positive tendency to use AI in different steps of the scientific research, including data analysis, source summarisation, and forecasting future outcomes.

The findings are not new in the study conducted by M. Shah, M. Wever, and M. A. Espig [61], who accentuated the predictive abilities of AI in shaping the direction and priorities of research. We also find the previous results by F. Bolanos, A. Salatino, F. Osborne et al. [62], who reported the growing use of AI devices as the source of literature retrieval and generation of inferences. The least rated item, namely, "I use AI to produce new content out of existing sources", shows that the students are very cautious when it comes to using AI in creative synthesis. These results are correlated with those of the research by R. Binns [55], who pointed at the issue of excessive dependence on generative AI in the production of content originality and the preservation of academic integrity. Table 8 displays the means, standard deviations, ranks, and the level of agreement of the results of the impact of AI application usage.

Table 8

Means, standard deviations, ranks, and agreement levels for AI techniques in scientific research

No.	**Item** (AI techniques are used in research to)	**Mean**	**Stnd. Dev.**	**Rank**	**Agreement level**
1	Access most works on topics related to my research.	3.69	1.22	8	High
2	Acquire new technical skills through these applications in social research.	4.22	0.72	2	High

3	Stay updated on these applications for research use.	4.26	0.72	1	High
4	Save effort in gathering scientific material.	4.19	0.80	3	High
5	Facilitate the practical aspect of scientific research.	3.99	0.87	5	High
6	Facilitate access to the latest research in my field.	3.99	0.91	6	High
7	Improve the quality of research outputs.	4.03	0.93	4	High
8	Access various references related to my studies.	3.91	1.14	7	High
Overall mean	4.03	0.70	-	High	

According to Table 8, the overall level of agreement concerning the effect of AI applications in research is large, with the overall mean of 4.03. The agreement rates on all items were high, with a score of between 3.69 and 4.26. The most rated item was "Keep abreast of these applications to use in research", and its mean was 4.26 (*SD* = 0.72), probably because AI would provide access to new information. The lowest position is the access to most works on topics related to my research, which had a mean of 3.69 (*SD* = 1.22), which is possibly because of language barriers or limitations of accessing some publications. This could be an indicator of some obstacles to researchers, like language problems or problems accessing some references and sources. In general, the findings indicate the growing dependency on the use of artificial intelligence to streamline access to information, enhance the quality of research products, conserve resources in gathering scientific data, and learn new technical competencies, thereby increasing the efficiency of the scientific research process and speeding it up.

The findings presented correlate with the conclusions of Z. Kavashev [63], who accentuated the importance of artificial intelligence in gaining knowledge and lifelong learning. On the same note, the outcomes of our study do not contradict the findings of the research by D. Zou, H. Xie, and L. Kohnke [64], where the authors reported that AI applications contribute to skill development and procedural competence in academia.

Data Suitability for Regression Analysis

Linear regression and parametric tests have two requirements: no multicollinearity among independent variables and normal distribution. In order to make the data appropriate to regression assumptions, the following tests were carried out:

- Multicollinearity Check: The Variance Inflation Factor (VIF) and Tolerance were utilised. VIF should be less than 10 for each variable. Tolerance should be greater than 0.05.
- Normal Distribution Check: Skewness was computed; a value of less than 1 means that it is normally distributed.
- Autocorrelation Check: The Durbin-Watson test was applied.

- Multicollinearity Testing: VIF was determined to test multicollinearity with the independent variable.

Table 9

VIF and tolerance values

Variable	Dimension	VIF	Tolerance
AI Usage in Research	Intelligent Search Engines	2.867	0.349
	Automated Summarisation and Content Generation	3.916	0.255
	Statistical Analysis and Prediction	8.258	0.121
Ethics in AI	Transparency	4.616	0.217
	Fairness	4.197	0.238
	Privacy	6.689	0.149
	Responsibility	8.648	0.116

The VIF values ranged from 2.867 to 8.648, and "tolerance values" ranged from 0.116 to 0.349, all above 0.05, indicating no high multicollinearity. This confirms the absence of severe overlap between the variables, and enhances the reliability of the model in explaining the relationship between the dimensions of the use of artificial intelligence and its ethics in scientific research.

Autocorrelation Testing

The Durbin-Watson Test indicated values between 1.54 and 1.51, close to 2, confirming the absence of autocorrelation.

Table 10

Autocorrelation test

Variable	D-W	Upper Limit (DU)
AI Usage in Research	1.54	1.77
AI Ethics	1.51	1.77

Normal Distribution Testing

To verify the assumption of normal distribution for the data, the skewness value was calculated for the variables. The skewness of all dimensions of both the independent and mediator variables was less than 1, indicating that the data follow a normal distribution.

The results of the autocorrelation test using the Durbin-Watson (*D-W*) statistic indicate the following:

- D-W value for the use of artificial intelligence in scientific research = 1.54
- D-W value for the ethics of artificial intelligence = 1.51
- Upper bound- Dobson- Unit (*DU*) = 1.77 in both cases

Since the calculated values of the Durbin-Watson statistic are less than the upper bound (*DU* = 1.77) but greater than 1.5, this indicates that there is no strong evi-

dence of autocorrelation in the model residuals, but complete independence cannot be confirmed.

Table 11

Skewness test

Variable	Dimensions	Skewness
Independent Variable: AI Techniques in Scientific Research	Smart Search Engines	-0.44
	Automated Summarisation & Content Generation	-0.20
	Statistical Analysis & Prediction	-0.36
Mediator Variable: Research Ethics in Light of AI Systems	Vision & Transparency	-0.54
	Fairness	-0.45
	Privacy	-0.09
	Responsibility	-0.53

Study Hypothesis Testing

Main Hypothesis 1: Ho1: There is no statistically significant relationship exists at ($\alpha = 0.05$) level between the use of AI techniques in scientific research and the application of AI under research ethics.

Table 12

Model fit summary

Model	C.R	CFI	RMSEA
X-M-Y		1.000	0.036
X-M	29.504		
X-Y	18.390		
M-Y	8.075		

Where:

- X: Independent Variable (Use of AI Techniques)
- M: Mediator Variable (Research Ethics)
- Y: Dependent Variable (Outcomes from AI Applications)
- CFI: Comparative Fit Index
- C.R: Composite Reliability
- RMSEA: Root Mean Square Error of Approximation

The data in Table 13 show that the model is suitable for path analysis, with a CFI of 1.000 and an RMSEA of 0.036 (below 0.05). All composite reliability values exceed 1.964.

Path Analysis for Direct and Indirect Effects

The path analysis results for direct and indirect effects are presented in Table 13. Table 13 shows a direct effect of 0.69 for AI use in research on AI application outcomes, with an indirect effect of 0.26 through research ethics, making a total

effect of 0.95. This highlights the role of research ethics in linking AI use in research to outcomes.

Table 13

Path analysis results

Model	Direct Effect	Indirect Effect	Total Effect
X-Y	0.69	0.26	0.95
X-M	0.98		
M-Y	0.26		

To determine the effect of the indirect effect with the mediator, one can compute the variance accounted for, which is the indirect effect divided by the total effect (VAF = 0.26/0.95 = 0.27), which is considered a moderate relationship. The main hypothesis was therefore rejected, and the alternative hypothesis adopted and confirmed that there was a statistically significant relationship between the use of AI in scientific research and AI application in light of research ethics. This finding indicates that research ethics greatly contribute to the quality of scientific research in the use of AI applications.

The use of sophisticated AI methods enhances the accuracy and efficiency of the research because it allows a researcher to process large data more quickly, which means that he or she can make more accurate conclusions using a larger amount of data and enable experiments and simulations with complex models and algorithms, which creates the best environment to test research hypotheses and minimise human bias in analysis, as algorithms are more objective.

The results of our study correspond to the works by D. Peters, K. Vold, D. Robinson et al. [65], who have reported that ethical considerations play a crucial role in the effectiveness of AI applications in research because ethical considerations promote responsible data management and open methodology, which helps to improve the results of research. The findings of the research are also consistent with those of L. Floridi, J. Cowls, M. Beltrametti et al. [53], who stated that ethical principles play the role of a key mediator in the implementation of AI in academic research and that transparency and fairness can create trust and enhance the credibility of the research. They, similarly, are aligned with the conclusions of X. Wang, M. Yu, and S. Fong [66], who discovered that AI tools benefit research productivity most when combined with ethical oversight, eliminating the likelihood of misusing data and encouraging responsibility, and that is why you can say that they have an indirect impact on the matter of research ethics.

1: Path analysis results for the direct and indirect effects of the relationship between the use of AI techniques in scientific research and the outcomes of using AI applications in the presence of research ethics.

Sub-hypothesis 1: Ho1-1: There is no statistically significant relationship at (0.05 = α) level between the use of AI techniques in scientific research and the use of AI applications in light of research ethics (the presence of vision and mission).

Table 14

Path analysis results

Statement/Model	Direct Effect	Indirect Effect	Total Effect
X-Y	0.82	0.12	0.95
X-M1	0.95		
M1-Y*	0.13		

Note. * M1: Vision and Transparency

Table 14 reveals that the direct effect of using AI in scientific research on the outcomes of using AI applications is 0.82, and the indirect effect through the presence of vision and mission as a mediating variable is 0.13, resulting in a total effect of 0.95. This confirms the relationship between the use of AI in scientific research and the outcomes of using AI applications. To calculate the variance caused by the indirect effect with the mediating variable, (VAF) (Variance Accounted) is computed, which is the ratio of the indirect effect to the total effect, yielding 0.14, indicating a weak relationship. Therefore, the first sub-hypothesis was rejected, and the alternative hypothesis was accepted: There is a statistically significant relationship at (0.05 = α) level between the use of AI techniques in scientific research and the use of AI applications in light of research ethics (the presence of vision and mission), suggesting that AI systems used in scientific research are fair and unbiased. This implies that the data to be used to train the AI system must be heterogeneous and representative of the population, and the AI system must be tested to be objective and remedied in case of need.

The researchers J. Wanner, L. V. Herm, K. Heinrich et al. [67] revealed that transparency and clear vision in the application of artificial intelligence positively affect acceptance and trust, yet their mediating effect on the outcomes of performance is weaker in comparison with that of direct technological capabilities. This follows the conclusions of A. Singhal, N. Neveditsin, H. Tanveer et al. [68], who added that fairness and unbiased training data are crucial factors in achieving ethical results in AI, but they cannot account for ethical results unless transparency is actively controlled and refined. This helps us to conclude that transparency and vision need to be supplemented by strict checking of AI impartiality.

Sub-hypothesis 2: Ho1-2: The relationship between the use of AI techniques in scientific research and the use of AI applications in light research ethics (the presence of fairness) is not statistically significant at the 0.05 = a level.

Table 15

Path analysis results

Statement/Model	Direct Effect	Indirect Effect	Total Effect
X-Y	0.74	0.16	0.90
X-M2	0.89		
M2-Y*	0.18		

Note. * M2: Fairness

From Table 15, it is evident that the direct effect of using AI in scientific research on the outcomes of using AI applications is 0.74, and the indirect effect through the presence of fairness as a mediating variable is 0.16, resulting in a total effect of 0.90. This confirms the mediating role of fairness in the relationship between the use of AI in scientific research and the outcomes of using AI applications. To calculate the variance caused by the indirect effect with the mediating variable, (VAF) (Variance Accounted) is computed, which is the ratio of the indirect effect to the total effect, yielding 0.18, indicating a weak relationship. Therefore, the second sub-hypothesis was rejected, and the alternative hypothesis was accepted: There is a statistically significant relationship at (0.05 = α) level between the use of AI techniques in scientific research and the use of AI applications in light of research ethics (the presence of fairness). This can be attributed to the fact that AI systems used in scientific research protect individuals' privacy. This means that researchers should only collect the necessary data for their research, obtain informed consent from participants, and store and use the data securely.

It is in line with the results of the research conducted by P. Chen, L. Wu, and L. Wang [69], who highlighted fairness as an essential aspect that is insufficiently discussed in the context of AI research, and identical biased training data may compromise the validity of research. It is also compatible with the results of P. Panarese, M. M. Grasso, and C. Solinas [70], who identified the obstacles to fairness in the AI industry and found that fairness interventions do not affect AI ethics, but their impact on the performance outcomes is usually slow. Likewise, the results are consistent with the work of A. Jobin, M. Ienca, and E. Vayena [52], who noted that fairness in AI governance leads to ethical compliance, albeit with a rare effect on the overall impact of AI technologies on the research outcomes or its societal impact, which substantiates the findings according to our study.

Sub-hypothesis 3: Ho3-3: The use of AI techniques in scientific research and the use of AI applications in view of research ethics (presence of privacy) do not have a statistically significant correlation at the (0.05 = a) level.

Table 16

Path analysis results

Statement/Model	Direct Effect	Indirect Effect	Total Effect
X-Y	0.78	0.17	0.95
X-M3	0.92		
M3-Y*	0.18		

Note. * M3: Privacy

From Table 16, it is clear that the direct effect of using AI in scientific research on the outcomes of using AI applications is 0.78, and the indirect effect through the presence of privacy as a mediating variable is 0.17, resulting in a total effect of 0.95. This confirms the mediating role of privacy in the relationship between the use of AI in scientific research and the outcomes of using AI applications. To calculate the variance caused by the indirect effect with the mediating variable, (VAF) (Variance

Accounted) is computed, which is the ratio of the indirect effect to the total effect, yielding 0.18, indicating a weak relationship. Therefore, the third sub-hypothesis was rejected, and the alternative hypothesis was accepted: There is a statistically significant relationship at (0.05 = α) level between the use of AI techniques in scientific research and the use of AI applications in light of research ethics (the presence of privacy). This can be attributed to the fact that AI systems used in scientific research are transparent, interpretable, and accountable. This means that researchers must be able to understand how the AI system reaches its conclusions or recommendations.

Sub-hypothesis 4: Ho1-4: There is no statistically significant relationship at (0.05 = α) level between the use of AI techniques in scientific research and the use of AI applications in light of research ethics (the presence of accountability).

Table 17

Path analysis results

Statement/Model	Direct Effect	Indirect Effect	Total Effect
X-Y	0.69	0.25	0.94
X-M4	0.96		
M4-Y*	0.26		

Note. * M4: Accountability

From Table 17, it is clear that the direct effect of using AI techniques in scientific research on the outcomes of using AI applications is 0.69, and the indirect effect through the presence of accountability as a mediating variable is 0.25, resulting in a total effect of 0.94. This confirms the mediating role of accountability in the relationship between the use of AI in scientific research and the outcomes of using AI applications. To calculate the variance caused by the indirect effect with the mediating variable, (VAF) (Variance Accounted) is computed, which is the ratio of the indirect effect to the total effect, yielding 0.27, indicating a strong relationship. As such, the fourth sub-hypothesis was rejected, and the alternative hypothesis was accepted: There is a statistically significant relationship at the (0.05 = a) level between the application of AI techniques in scientific research and the application of AI applications in view of research ethics (the presence of accountability). It may be explained by the fact that AI systems are used responsibly in scientific research. This implies that the researchers ought to anticipate the effects that their studies may have on society and any ethical issues and discuss them with the stakeholders during the process of undertaking the research.

The current results of our study are consistent with I. Rahwan [71], who pointed out that responsibility is a core pillar of ethical use of artificial intelligence and that systems with clear responsibility structures foster a greater level of trust and provide more effective results. Also echoing the points made by L. Floridi, J. Cowls, M. Beltrametti et al. [53], who emphasised that accountability should be implemented across all stages of the AI lifecycle, minimise risks, and facilitate social acceptance,

which in turn validates your conclusion that accountability is a key factor to consider in the configuration and implementation of the AI. Conversely, I. Rahwan, M. Cebrian, N. Obradovich et al. [72] also indicated that, despite the significance of accountability, in many situations, it is challenging to fully apply accountability to AI systems, which can also be a limitation to the mediating power of accountability.

Main Hypothesis 2: Ho2: There is no statistically significant relationship at (0.05 = α) level between the use of AI techniques in scientific research and the outcomes of using AI applications.

Table 18

Results of multiple regression analysis to test the relationship between dimensions of AI technology use in scientific research and the outcomes of using AI applications

Dependent variable	Co. Co. (R)*	Deter. Co. (R^2)**	Calculated F	DF	F Sign. level	AI***	B	Calculated T Value	T Sign. level
Outcomes of Using AI Applications	0.925	0.856	663.588	3,334,337	0.000*	Smart Search Engines	0.291	8.829	0.000*
						Automatic Summarisation & Content Generation	0.228	6.526	0.000*
						Statistical Analysis & Prediction	0.442	9.922	0.000*

Note. * Correlation Coefficient (R); ** Determination Coefficient (R^2); *** AI Technology Use Dimensions

The results of the multiple regression analysis indicate a positive and strong relationship between the use of AI technologies in scientific research and the outcomes of using AI applications, with a correlation coefficient of 0.925. The impact of AI technology use on the outcomes of AI applications is statistically significant, with a calculated F value of 663.588 and a significance level of 0.000. The determination coefficient (R^2) indicates that 85.6% of the variance in the outcomes of AI application use is due to strategies for using AI technologies in scientific research. The analysis also reveals that all dimensions of use (smart search engines, automatic summarisation & content generation, and statistical analysis & prediction) have an effect on the outcomes, with calculated T values of 8.829, 6.526, and 9.922 respectively, and significance levels of 0.000, 0.000, and 0.000.

Therefore, the null hypothesis for the second main hypothesis was rejected, and the alternative hypothesis was accepted, stating that there is a statistically significant relationship at the level (α = 0.05) between AI technology use in scientific research and the outcomes of using AI applications. This could be attributed to the fact that while AI plays an important role in many fields, its role in modern educational and pedagogical processes is even more critical. Studies have highlighted the importance of its applications in education, leading to improved decision-making,

better quality of education, development of life skills, and enhancement of cognitive achievement and research skills among faculty and researchers [51]. There are ethical issues with AI that require a more insightful and thorough cooperation with the humanities and social sciences to make sure that its technologies do not make more issues than they are intended to resolve. These courses are important in critical thinking and creativity, as they equip individuals and societies to meet the changing world and give a better insight into the issues posed by technology. As the importance of AI in education grows, conferences on AI ethics in education are becoming more common, so that stakeholders can share their ideas, knowledge, and experiences, which may eventually see the creation of more responsible and ethical AI tools.

Our findings align with the research by R. Luckin, J. Rudolph, M. Grunert et al. [73], who found that artificial intelligence allows producing more personalised and accurate research results, as it allows digging deeper into the data and helps to generate new content. The focus on automatic summarisation and content generation in this paper is the reflection of the tendencies stated by J. Zhao, E. Chapman, and P. G. Sabet [74], who mentioned that there is an increasing reliance on generative AI in drafting summaries and synthesising findings. It is also in line with reports of R. Binns [55] and A. Jobin, M. Ienca, and E. Vayena [52], who suggested that more robust ethical principles are needed to ensure that AI applications in education and research prevent bias reinforcement and damage academic integrity unintentionally.

Table 19

Multiple regression analysis and the relationship between AI technology use dimensions and research ethics in scientific research

Dependent variable	Co. Co. (R)*	Deter. Co. (R^2)**	Calculated F	DF	F Sign. level	AI***	B	Calculated T Value	T Sign. level
Research Ethics in Scientific Research	0.884	0.781	396.150	3,334,337	0.000*	Smart Search Engines	0.047	1.024	0.306
						Automatic Summarisation & Content Generation	0.116	2.383	0.018*
						Statistical Analysis & Prediction	0.938	15.075	0.000*

Note. * Correlation Coefficient (R); ** Determination Coefficient (R^2); *** AI Technology Use Dimensions

The results of the multiple regression analysis indicate a positive and strong relationship between the use of AI technologies in scientific research and research ethics in scientific research, with a correlation coefficient of 0.884. The impact of AI technology use on research ethics is statistically significant, with a calculated F value of 396.150 and a significance level of 0.000. The determination coefficient (R^2)

indicates that 78.1% of the variance in research ethics is due to strategies for using AI technologies in scientific research. The analysis reveals an effect of two usage dimensions (automatic summarisation & content generation, and statistical analysis & prediction) on research ethics, with calculated T values of 2.383 and 15.075 respectively, and significance levels of 0.018 and 0.000. However, the analysis did not show a statistically significant effect of the smart search engines dimension on research ethics, with a T value of 1.024 and a significance level of 0.306. Therefore, the null hypothesis for the third main hypothesis was rejected, and the alternative hypothesis was accepted, stating that there is a statistically significant relationship at the level ($\alpha = 0.05$) between the use of AI technologies and research ethics in scientific research. This could be attributed to the fact that these tools can be used to access data and scientific references, explore research ideas, and provide access to various relevant scientific references across global databases, saving time and effort while being more accurate. These tools can be utilised while respecting the integrity guidelines set at both the local and international levels.

These findings are in line with those of J. Zhao, E. Chapman, and P. G. Sabet [74], who discovered that AI tools have greatly improved transparency, particularly those utilised in data analysis and prediction. According to T. Eloundou, S. Manning, P. Mishkin et al. [75], when used properly, automatic summarisation and content creation technologies, including large language models (LLMs), can enhance ethical research writing.

In contrast to the findings of D. Chalmers, N. G. MacKenzie, and S. Carter [76], who proposed that AI-powered search tools improve ethical research behaviour by improving access to diverse sources, thereby reducing publication bias, there is no statistically significant correlation between intelligent search engines and research ethics. This disparity might be explained by user awareness, changes in the application and comprehension of these technologies, or other contextual factors.

Main Hypothesis 4: Ho4: There is no statistically significant relationship at ($\alpha = 0.05$) level between research ethics and the results of using AI applications.

Table 20

Results of multiple regression analysis testing the relationship between research ethics and the results of using AI applications

Dependent variable	**Co. Co. (R)***	**Deter. Co. (R^2)****	**Calculated F**	**DF**	**F Sign. Level**	**AI*****	**B**	**Calculated T Value**	**T Sign. level**
Results of Using AI Applications	0.889	0.790	313.321	3, 334, 337	0.000*	Vision and Transparency	0.052	1.196	0.233
						Fairness	0.285	8.265	0.000*
						Privacy	0.018	0.324	0.746
						Responsibility	0.515	9.043	0.000*

Note. * Correlation Coefficient (R); ** Determination Coefficient (R^2); *** AI Technology Use Dimensions

The results of the multiple regression analysis indicate a positive and strong relationship between research ethics and the results of using AI applications, with a correlation coefficient of (0.889). The effect of research ethics on the results of using AI applications is statistically significant, with a calculated F value of (313.321) and a significance level of (0.000). The coefficient of determination (R^2) indicates that (79.0%) of the variance in the results of using AI applications is attributed to research ethics. The analysis also reveals that the dimensions of fairness and responsibility have a significant effect on the results, with calculated T values of (8.265 and 9.043) and significance levels of (0.000 and 0.000), respectively. However, the analysis did not show a statistically significant effect for the dimensions of vision and transparency, and privacy, with T values of (1.196 and 0.324) and significance levels of (0.233 and 0.746), respectively.

Therefore, the null hypothesis of the fourth main hypothesis was rejected, and the alternative hypothesis was accepted, which states: There is a statistically significant relationship at ($\alpha = 0.05$) level between research ethics and the results of using AI applications. This can be attributed to the fact that AI tools can help researchers in drafting their research papers by providing the necessary data and relevant information, thereby improving the quality of the research paper. AI tools can also reduce typographical, linguistic, and grammatical errors, and contribute to detecting academic plagiarism and scientific theft. As a result, researchers can benefit from various available research literatures across different global databases, quickly and accurately. However, when using these tools, researchers must adhere to the ethical standards of research and academic integrity.

S. Schicktanz, J. M. Welsch, M. Schweda et al. [56] also pointed out that the responsible use of artificial intelligence leads to high-quality research outcomes by preventing bias, ensuring fair access to data, and maintaining integrity, all of which contribute to improving research results. The insignificant effects of vision and transparency contrast with the emphasis on the importance of transparency in building trust [77] and privacy in protecting sensitive data [78].

Conclusions and Recommendations

Our findings indicate that artificial intelligence has a significant positive impact on improving scientific research outcomes. However, the indirect effect of factors like vision and mission is weak. Fairness plays a weak mediating role in the relationship between AI and applications, highlighting the need to strengthen principles of justice. Privacy is considered an important variable to ensure research fairness, while responsibility is seen as a strong mediating factor that enhances transparency and analysis of societal impacts. Additionally, AI significantly promotes research ethics, especially in summarisation and statistical analysis, with a strong relationship between research ethics and the outcomes of AI applications.

In light of our findings, we recommend establishing ethical standards to keep pace with the future of AI applications in scientific research and improve research outcomes; expanding the digital infrastructure of universities related to the devel-

opment of scientific research and continuously train researchers on AI applications and research services, under the guidance of skilled AI professionals; developing a national strategy for the dissemination and general use of AI and big data technologies within Jordan's higher education and research systems; allocating investments for developing the technological infrastructure necessary for integrating AI and big data analysis into research programs; and encouraging the establishment of research partnerships with leading global AI and big data centers and universities to incorporate these technologies into scientific research in Jordanian universities.

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