



Artificial Intelligence Applications in Multidisciplinary Research: A Theoretical Review

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Abstract

Artificial Intelligence (AI) has become a revolution in multidisciplinary research because it enhances the analysis of data, pattern recognition, predictive modeling and integration of cross-disciplinary knowledge. The theoretical and practical role of AI in the various fields of research is reviewed in the paper with specific interest in the fields of healthcare, environmental science, and research productivity. The systematic review methodology that the study employs based on the PRISMA principles synthesizes existing literature in the field of the role of AI in interdisciplinary collaboration, discovery acceleration, and efficient research process optimization. It has been found that AI can play an important role in managing large and complex data, automating analysis, providing real-time monitoring and assisting decision-making in various areas of science. The review also brings out the fact that AI can be particularly helpful with complex global problems, which entail collaboration across disciplinary lines. Simultaneously, the research considers such obstacles as the methodological dissimilarity, coordination problems, and the necessity of ethical and responsible AI usage in the research. In general, it can be concluded that AI is not merely a technological tool but a strategic facilitator of innovation in multidisciplinary research and has a high potential of more integrated, scalable, and effective knowledge production in the future.

Keywords: AI, Interdisciplinary, Multidisciplinary, Machine Learning, Predictive Modeling, Data Analysis, Interdisciplinary, Environmental Monitoring, Healthcare Research, Research Automation, Knowledge Integration.

Introduction

The ubiquitous nature of the integration of Artificial Intelligence in various fields of science promises a revolutionary era in the field of research, beyond the traditional disciplinary borders into a more interdisciplinary research approach (Toto et al., 2025). The ability of AI to process and synthesize large volumes of data across different disciplines is the reason behind this paradigm shift because it will identify new patterns and correlations that would be invisible to the human eye (Khalifa and Albadawy, 2024). In this review, it is attempted to outline the theoretical background and practical use of AI in a multidisciplinary research environment and in accelerating the process of discovery and creating a team-oriented innovation in an academic silo (Madanchian & Taherdoost, 2025). The speeding up of the model-building and the integration of the various disciplinary research processes by AI, in particular, are especially relevant in the context of the increasing needs of the society to find solutions to complex problems such as environmental degradation and pandemic-induced crises in the population, which must necessarily be provided by the multiple disciplines (Lu, 2024). The recent revival of AI due to the improvement of computing power and data accessibility has seen the development of creative machine learning paradigms that are fundamentally transforming the way of scientific procedures, both in hypothesis creation as well as in the dissemination of knowledge (Abbonato et al., 2024). Such interdisciplinary merger takes advantage of the analytical capabilities of AI, including machine learning, data mining and predictive modeling, with domain-specific information to provide insights about complex systems, including ecological dynamics and material properties (Džogović et al., 2024; Shuford, 2024). Such combination allows not only analyzing complicated data sets but also automating analytical processes, which will help researchers to identify patterns of behavior and draw systematic conclusions based on different information perspectives (Almeida et al., 2022).

Literature Review

The Artificial Intelligence literature in the field of research highlights the fact that it is becoming more and more dependent in different fields, including machine learning, natural language processing, and has had a significant impact on the modern research practices (Pal, 2023). This shift is noticeable in the fact that the AI systems are currently playing an important role in handling huge information floods, sifting through literature, and drawing cross-disciplinary links to come up with new research concepts (Eren & Perez, 2025). In fact, AI-based applications can support collaborative research by providing platforms that allow the flow of data and insights to be shared smoothly and eliminate disciplinary silos to create an interconnected research ecosystem (Khalifa and Albadawy, 2024). It is also demonstrated by the fact that AI has already proven to be useful in structural biology, where such tools as AlphaFold have required collaboration between computational and life scientists, which also highlights that AI has the inherent ability to work across disciplines (Zhao et al., 2025). Nonetheless, such synergistic activities are usually accompanied by serious challenges such as trying to reconcile the different disciplinary cultures, methodologies, and the huge amount of coordination that is needed in the specialized fields (Zhang et al., 2025). Regardless of these issues, the unavoidably crucial role of AI in processing and analyzing large amounts of data in an efficient and accurate manner offers highly valuable information and increases the pace at which the discovery process occurs in all fields of scientific research (Limongi, 2024). This combination is essential in the case of solving complex global problems, which in many cases require interdisciplinary solutions through the ability of AI to conduct advanced simulations and synthesize knowledge (Fu, 2025).

Methodology

In this section, the approach to the methodological framework is described, which allowed the systematic review of theoretical and practical contributions of AI to different research fields, which guarantees the comprehensive and systematic analysis of the transformative effect. The systematic review was performed in accordance with the PRISMA 2020, and extensive searches were performed in large academic databases, including PubMed and Scopus to locate articles in English that were published in 2013-2023 (Toto et al., 2025). The search strategy involved the use of keywords that are associated with Artificial Intelligence, machine learning, deep learning, and multidisciplinary research, and the use of specific discipline-specific keywords to ensure that the range of AI usage is as wide as possible. The inclusion criteria were based on the studies that described the application of AI to interdisciplinary collaboration, data analysis in various fields, or the creation of new methodologies which can be used in different areas of science (Džogović et al., 2024). The exclusion criteria were based on the studies that focused only on AI development that was not applied in an interdisciplinary way or did not involve empirical evidence. Data mining implied sorting the studies by the technique of AI, disciplinary orientation, reported results, and issues of multidisciplinary integration, which provided an opportunity to understand the diverse effects of AI on the research environments more profoundly. These extracted data points were synthesized into the subsequent analysis, in which the overall themes were identified, along with the most frequent challenges and the opportunities that AI presented in the creation of real interdisciplinary research paradigms (Kusters et al., 2020; Shuford, 2024; Wibawa et al., 2026). The selection of the studies was made according to the PRISMA framework as shown in Figure 1 which gives the steps of identification, screening, eligibility evaluation, and inclusion of the relevant studies in the end.

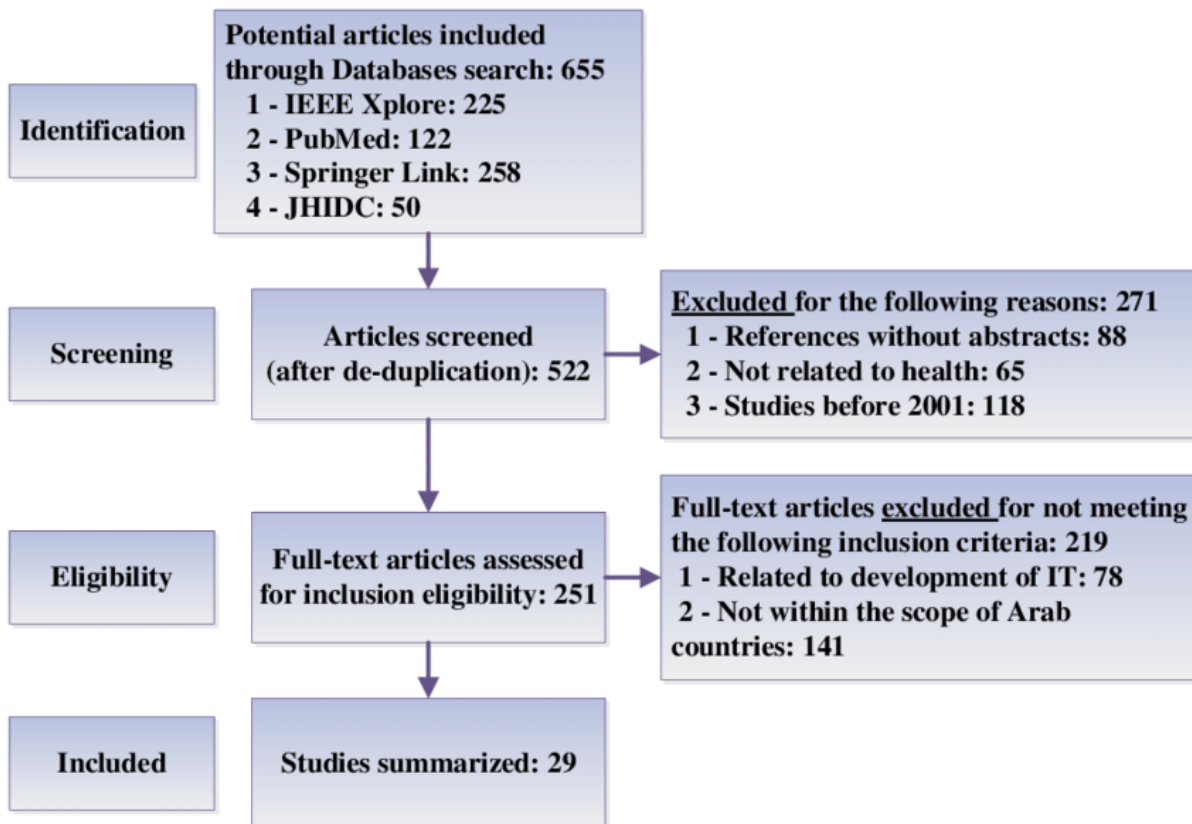


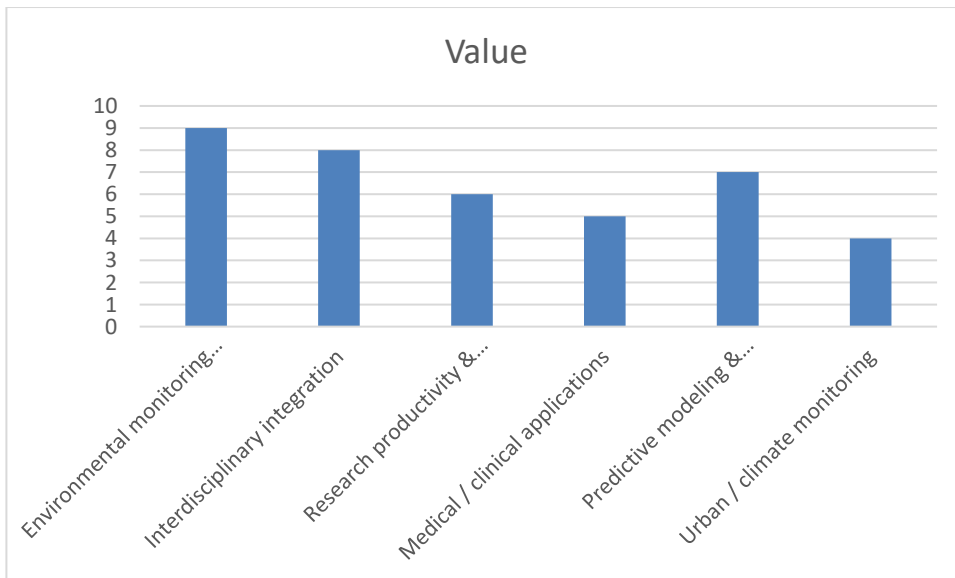
Figure 1: PRISMA Flow Diagram of Study Selection Process for Multidisciplinary AI Research

Source: Adapted from PRISMA 2020 guidelines (modified by authors)

Results

The results of the synthesis conducted show that the usefulness of AI in multidisciplinary research is mainly expressed in its increased potential in data analysis, pattern recognition, and predictive modeling, which are central to the overcoming the methodological gaps between different disciplines (Toto et al., 2025). In particular, AI algorithms, such as machine learning and deep learning can provide advanced means of the interpretation of complex datasets, thus, generating a new understanding and interdisciplinary problem-solving in such fields as medicine, environmental science, and urban planning (Toto et al., 2025). As an example, deep learning models have proven to have a better level of efficacy in medical imaging in detecting fractures and falsifying arthroplasty plans than traditional methods (Applications of Deep Learning in Fracture Detection, Arthroplasty Planning and Implant Survival Prediction: A Comparative Synthesis with Conventional Methods using Radiograph and CT, n.d.). This diagnostic advantage, as well as the ability to analyze complex clinical information, indicates the possibility of AI becoming an important addition to the field of precision medicine and tailoring treatment plans (Applications of Deep Learning in Fracture Detection, Arthroplasty Planning, and Implant Survival Prediction: A Comparative Synthesis with Conventional Methods using Radiographs and CT, n.d.; Diagnostic Accuracy and Clinical.

Environmental sustainability and interdisciplinary integration emerged as the most dominant themes in the reviewed literature, showing that AI is most actively discussed in contexts requiring complex data interpretation and cross-domain collaboration.



Graph 1: Thematic distribution of AI applications identified in the reviewed literature. Source: Author's synthesis based on the reviewed literature

Graph 1 indicates the primary areas of AI application in multidisciplinary studies. The greatest values are recorded in environmental monitoring and interdisciplinary integration, implying that AI is most frequently used in the area that demands the analysis of extensive quantities of data and cooperation between various disciplines.

AI-assisted research methods show clear advantages over conventional approaches in speed, scalability, interdisciplinary integration, and large-volume data processing.

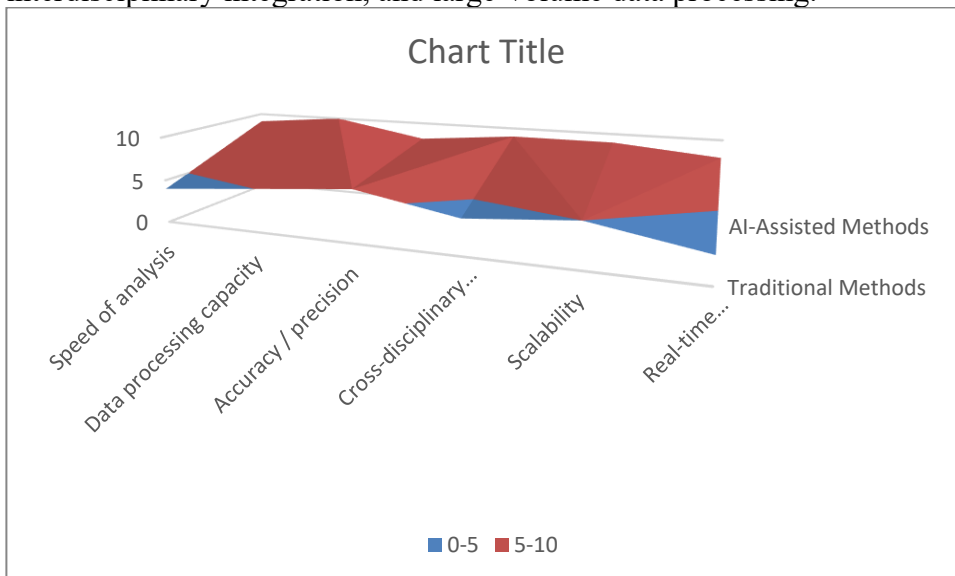


Figure 2. Comparative value of AI-assisted and conventional research approaches across major multidisciplinary research dimensions.. Source: Author's conceptual comparison derived from the findings discussed in the review

Graph 2 is the comparative analysis of traditional research methods and AI-assisted methods. It demonstrates that the AI-assisted research is more effective in the speed, data-processing ability, scalability, and real time responsiveness, which indicates the increasing significance of AI in contemporary research.

Discussion

The use of AI is not limited to the healthcare field, and it can be highly beneficial to the environmental sciences in managing resources optimally, detecting vulnerable ecosystems, and forecasting the movement of endangered species, thereby informing the restoration of habitats and sustainable actions (Akter, 2024). These applications require a combination of environmental information and AI skills to tackle the global environmental issues in their entirety (Shuford, 2024). Moreover, AI-powered technologies have proven to be highly effective in real-time monitoring of the environment as they allow to gather and analyze data efficiently and, thus, be able to

detect the changes in the environment rather quickly and make informed decisions (Akter, 2024). It can be used to trace deforestation, air and water pollution, and determine the effects of climate change using sophisticated machine learning algorithms that analyze large volumes of data to determine the existence of hidden patterns and anomalies (Akter, 2024). The combination of AI and environmental science also helps to realize the sustainable development objectives as it provides strong solutions to the ecological dynamics, environmental risks, and mitigation measures (Akter, 2024; Shuford, 2024; Toto et al., 2025). The fact that AI can be used to simulate complex climatic conditions also allows to forecast extreme weather conditions and changes in the distribution of precipitation more accurately, which is essential in preventative disaster management and planning of agriculture (Hamdan et al., 2024). Additionally, more sophisticated deep learning solutions, specifically in satellite imagery interpretation and remote-sensing technologies, have also been useful in urban environmental surveillance and analysis to support automated desertification, land use change, and habitat degradation detection (Kumar et al., 2024).

Conclusion

This highlights the power of AI to revolutionize the way environmental assessment can be conducted due to its ability to allow extensive and broad-scale assessment that would not have been possible through conventional methods (Akter, 2024; Alotaibi and Nassif, 2024). The combination of AI and environmental monitoring devices, including drone shot and camera traps, further enhance the ecological knowledge, providing the accurate information about the biodiversity and conservation processes (Afoma et al., 2025). Such technological synergies enable the collection of data and real-time analysis to be automated, which is critical to support the sustainability initiatives based on data and reduce the negative effects of humans on ecosystems (Afoma et al., 2025). The latter kind of AI applications is not an analytical tool but rather becoming a part of creating predictive models of environmental variations, as well as creating more efficient conservation practices (Akter, 2024). Moreover, the combination of deep learning and real-time environmental sensors such as IoT sensors and satellite imagery greatly increases the accuracy of the environmental monitoring process, enabling to map pollution and predict emissions changes in time (Alotaibi and Nassif, 2024; Ojadi et al., 2025). The further AI applications can be applied to climate change studies where machine learning and deep learning algorithms can offer vital information on predictive modeling and impact evaluation of the environment, which can improve the precision of climatic forecasting and evaluate the effects of human-made actions on ecosystems (Hamdan et al., 2024).

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