The role of artificial intelligence in enhancing interdisciplinary collaboration in scientific research

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Abstract:

This study examines the role of artificial intelligence in supporting interdisciplinary collaboration in scientific research. It emphasizes that the nature of contemporary challenges requires integrated, multidisciplinary knowledge, and that artificial intelligence serves as a key tool to facilitate such collaboration. The study reviews the use of techniques such as machine learning and natural language processing to analyze big data and extract new insights that enhance research quality. It also highlights AI's role in improving communication among researchers and promoting knowledge exchange, in addition to its assistance in identifying research gaps and guiding efforts toward innovative areas. The findings indicate that employing AI in research project management contributes to greater efficiency and better organization of teamwork. The study concludes that integrating artificial intelligence into scientific research enhances creativity and collaboration, and it recommends investing in its development and training researchers to use it effectively.

Key words: Artificial Intelligence, Collaboration, Discipline, Scientific Research

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Introduction:

In an era of rapid technological advancement, artificial intelligence (AI) has become a central tool contributing to tangible progress across various scientific fields. As the complexity of the problems researchers face continues to increase, the need for collaboration across different disciplines has never been more important. The primary challenge lies in the ability of scientists from diverse fields to collaborate effectively in addressing these complex challenges. In this context, AI emerges as a tool capable of facilitating such collaboration and enhancing integration between disparate disciplines.

AI plays a prominent role in facilitating scientific research processes by offering advanced analytical tools that can handle vast amounts of data efficiently and swiftly. It enables the use of machine learning techniques and big data processing, helping researchers from various fields discover new patterns and generate innovative ideas. Furthermore, AI facilitates communication between different scientific disciplines by providing a common language based on data and knowledge derived from intelligent systems.

Moreover, AI offers significant potential to enhance mutual understanding between various fields. It can analyze data in multiple ways, revealing new insights that intersect with diverse scientific areas, leading to more comprehensive and integrated outcomes. AI can also improve collaboration by providing shared virtual research environments, allowing scientists from different fields to work together interactively, thereby accelerating the pace of scientific discoveries and the development of solutions.

Therefore, AI represents a fundamental pillar in fostering interdisciplinary collaboration in scientific research. By utilizing it, ideas and methods from multiple fields can be integrated to achieve common research goals. This study provides an in-depth look at how AI can be employed to enhance collaboration between researchers from different disciplines, offering live models and applications that highlight the positive impact of this integration in achieving greater scientific progress.

1- Research Problem:

In light of the rapid developments in the field of AI, questions arise regarding how these advanced technologies can be utilized to enhance coordination and interaction between various scientific disciplines. The challenge lies in developing AI tools capable of understanding and integrating information

from fields such as natural sciences, engineering, medicine, and social sciences, which often have different research methods and methodologies.

In this context, questions emerge about AI's ability to facilitate collaboration among researchers from diverse disciplines. Can AI bridge data and ideas from disparate fields to create new insights that contribute to solving complex scientific problems? What challenges may arise when integrating AI into interdisciplinary scientific research processes, particularly regarding coordination efforts and ensuring mutual understanding between research teams?

Additionally, ethical and epistemological concerns arise regarding the use of AI in scientific research. Can the increasing reliance on this technology impact the role of human researchers in decision-making and critical thinking? How can it be ensured that AI contributions remain complementary to the human role, rather than replacing it, in fostering collaboration between disciplines and achieving research goals effectively and sustainably?

1.1 - Research Questions :

- How does artificial intelligence contribute to facilitating collaboration between researchers from different disciplines?
- What are the challenges and opportunities posed by artificial intelligence in this context?

1.2 - Hypotheses:

- Artificial intelligence can facilitate collaboration between researchers from different disciplines by simplifying communication and providing advanced analytical tools that help process complex data, which might be difficult to handle individually.
- AI presents a significant opportunity to enhance collaboration between researchers from diverse fields by enabling them to process complex data faster and achieve integration between various areas of knowledge, thereby increasing opportunities for innovation and new discoveries.

3-Importance and Objectives of the Study:

3.1 - Importance of the Study:

This study holds significant scientific value by contributing to the understanding of how to enhance collaboration between different scientific disciplines, a key factor in addressing the complex challenges humanity faces in our present era. Collaboration among researchers from various fields is crucial for solving large-scale problems such as climate change, incurable diseases, and socio-economic crises. By exploring the role of AI in facilitating this collaboration, the study aims to offer new insights that could improve knowledge

exchange and integration across disciplines, potentially leading to innovative scientific outcomes and more comprehensive solutions to global challenges.

The practical importance of this study lies in providing actionable recommendations on how to leverage AI to enhance collaboration among researchers across various fields. By identifying methods and tools that can support scientific collaboration, the study also seeks to provide tangible solutions that can be applied in academic and research environments. These recommendations will help researchers improve communication methods, share knowledge, and facilitate the analysis of large, interdisciplinary data sets. This, in turn, will enhance collaboration efficiency and increase opportunities for innovation and discoveries that require the combined efforts of diverse scientific fields.

3.2 - Objectives of the Study:

This study aims to achieve several key objectives, including:

- Analyzing methods for using artificial intelligence in interdisciplinary scientific research.
- Identifying the main benefits of employing AI to enhance collaboration between researchers from different scientific domains.
- Evaluating the challenges associated with implementing AI in this context.
- Proposing strategies to develop and strengthen the use of AI in facilitating research collaboration.

4 - Concepts of the Study:

4.1 - Concept of Artificial Intelligence (AI):

Artificial Intelligence (AI) is a branch of computer science that aims to develop systems and programs capable of performing tasks that require human intelligence. This includes the ability to learn from data, reason, infer, solve problems, and understand natural language. AI employs techniques such as Machine Learning and Artificial Neural Networks to analyze large volumes of data and extract new patterns, allowing systems to adapt to environmental changes and make independent decisions. **(Sharaf, 2015, p. 64)**. AI is applied in many fields, such as machine translation, speech and image recognition, healthcare, autonomous driving, and robotics. **(Al-Attiyah, 2010, p. 41)**. Thus, AI helps improve efficiency and provides more accurate solutions and precise predictions based on data analysis, driving progress in sectors like industry, education, and medicine.

4.2 - Concept of Scientific Research:

Scientific research is an organized and systematic process aimed at exploring and discovering new knowledge or verifying existing knowledge using precise scientific methods. Scientific research relies on the collection and objective analysis of data to draw conclusions that are verifiable and generalizable. It is characterized by clear principles such as observation, experimentation, logical analysis, and the use of statistical tools to interpret results. **(Badr, 2004, p. 59).** The goal of scientific research is to solve problems, answer questions, or provide new explanations for natural or social phenomena. Research can be scientific across multiple fields, including natural sciences, social sciences, medicine, engineering, and others. **(Badawi, 1987, p. 98)**. The significance of scientific research lies in developing knowledge and enhancing human understanding of various phenomena, as well as providing the foundation for developing technologies and practical solutions that contribute to improving individuals' and communities' lives.

4.3 - Concept of Interdisciplinary Collaboration in Scientific Research:

Interdisciplinary collaboration in scientific research is a process that brings together researchers from different fields of knowledge to work together on shared research problems or questions, aiming to integrate multiple perspectives and methodologies to reach innovative and comprehensive solutions. This collaboration goes beyond the traditional boundaries of each scientific discipline, where researchers benefit from each other's expertise and skills to create new approaches to complex problems that cannot be solved by a single discipline alone.

Interdisciplinary collaboration includes different levels, such as interdisciplinary cooperation, which involves partial overlap between adjacent disciplines, multidisciplinary collaboration, where research teams work in parallel without full integration, and integrative collaboration, where knowledge and tools from different fields are deeply merged. The success of this type of collaboration depends on a comprehensive understanding of different methodologies and achieving alignment of goals and expectations among researchers from diverse fields.

4.4 - Concept of Artificial Intelligence and Its Applications in Scientific Research:

Artificial Intelligence (AI) is a scientific and technological field aimed at developing systems capable of performing tasks that require human intelligence, such as learning, understanding, and logical thinking. AI is based on techniques

like machine learning, neural networks, and natural language processing, which allow machines to analyze data, discover patterns, and make decisions based on what they learn from available information.

AI is one of the key tools that help transcend the traditional limits of human abilities in data processing and solving complex problems. In scientific research, AI contributes to improving the efficiency and accuracy of many processes. For example, AI can analyze vast amounts of big data quickly and accurately, helping researchers extract and analyze results in ways that were previously impossible.

AI is also used in knowledge mining, predicting future trends, and automating routine research processes. These applications contribute to accelerating the pace of scientific discoveries and provide effective tools for collaboration between researchers from different disciplines, thus fostering innovation and creativity in research.

5 - The Role of Artificial Intelligence in Interdisciplinary Research Projects:

Artificial intelligence plays a pivotal role in enabling interdisciplinary research projects, as it helps connect knowledge from various fields and offers innovative solutions to complex problems. In such projects, knowledge diversity is a significant advantage, but integrating ideas and data from different disciplines requires powerful and intelligent tools. This is where AI comes into play, facilitating the analysis of shared data, predicting trends, and achieving integration between different methodologies. For instance, in projects like life sciences and computing, AI can be used to analyze genomic data, helping integrate biology with data science.

AI also helps simplify communication between researchers from multiple disciplines. For example, natural language processing (NLP) technologies provide tools to analyze scientific texts from different fields, enabling researchers to access findings from other specialties more easily. Additionally, AI systems can generate complex simulation models that contribute to understanding phenomena shared across multiple disciplines, such as simulating the interaction of environmental and economic systems.

Examples of AI in Interdisciplinary Research Projects:

- **Human Genome Project:** This interdisciplinary project relied heavily on AI to analyze vast amounts of genomic data using AI techniques such as machine learning. The human genetic sequence was analyzed to identify patterns that help in understanding genes associated with diseases. The combination of biology and data science has led to significant advancements in personalized medicine.

- **AI in Climate Science:** In climate change studies, AI is used to analyze complex environmental data and predict future shifts. This project requires collaboration among experts in meteorology, geography, data science, and engineering, with AI helping predict long-term climate patterns and analyze the impact of human activity on the climate.
- **Medical Diagnosis Using AI:** In the fields of medicine and engineering, AI has become an essential tool for diagnosing diseases like cancer through imaging analysis. Collaboration between radiologists, data scientists, and software engineers has resulted in AI systems capable of detecting diseases with high accuracy, improving healthcare quality and contributing to more effective treatments.

These real-world cases demonstrate how AI not only accelerates research processes but also enables effective collaboration between researchers from different fields to achieve common goals and address complex global issues.

6 - Challenges and Opportunities in Using Artificial Intelligence:

6.1 - Technical and Institutional Challenges:

First: Technical Challenges:

- **Data Quality:** AI requires vast amounts of high-quality data. If the data is incomplete or inaccurate, it can lead to erroneous or biased results. Data preparation and cleaning are complex challenges that require significant time and effort.
- **Algorithmic Bias:** AI models can contain inherent biases if the data used to train them is unbalanced or represents a limited view. This can lead to unfair or inaccurate outcomes, especially in sensitive fields such as healthcare and employment.
- **Technological Complexity:** Developing and using AI systems requires advanced skills in computing, programming, and data analysis, which can present a barrier for many institutions lacking the necessary technical resources or expertise.

Second: Institutional Challenges:

- **Resistance to Change:** Many institutions face resistance from employees when trying to introduce AI technologies, with some fearing job loss or reduced roles. Achieving full digital transformation can be difficult without overcoming these concerns.
- **Cost and Resources:** Implementing AI technologies requires significant investments in technology and infrastructure, as well as employee training. For small and medium-sized institutions, these costs can pose a major obstacle.

- **Ethics and Privacy:** As the use of AI increases, concerns over privacy and the use of personal data also grow. Ensuring compliance with privacy laws and regulations, such as the General Data Protection Regulation (GDPR), is another significant challenge.

6.2 - Opportunities and Future Potentials:

First - Technical Opportunities:

- **Big Data Analysis:** AI provides the opportunity to analyze vast amounts of data quickly and efficiently, allowing for new discoveries and more accurate predictions across various fields such as medicine, finance, and social sciences.
- **Innovation Across Multiple Fields:** AI can drive innovation in many sectors, from healthcare to energy and agriculture. For example, it can be used to improve medical treatments, develop new drugs, or enhance productivity in agriculture through predictive analytics.
- **Automation of Routine Tasks:** AI can contribute to automating many routine tasks across various fields, saving time and effort for humans to focus on creativity and solving more complex problems.

Second - Future Potentials:

- **Customization of Solutions:** AI offers the ability to develop tailored solutions that better meet the needs of individuals and institutions. For example, in medicine, AI can be used to develop personalized treatment plans based on a patient's genetic data.
- **Enhancing Human-Machine Collaboration:** In the near future, there will be greater collaboration between humans and machines, where AI will be integrated into daily processes in ways that enhance human work efficiency and complement human capabilities.
- **Accelerating Scientific Innovation:** AI can contribute to accelerating scientific innovation by providing advanced simulation models and new discoveries in fields like physics, chemistry, and life sciences. The rapid innovation driven by AI could open doors to unprecedented discoveries and solutions to humanity's greatest challenges.

AI offers tremendous opportunities to improve many aspects of life and science, but it also presents technical and institutional challenges that must be overcome. As technology progresses and institutions adapt, AI is expected to be harnessed more effectively to enhance innovation and solve complex problems.

7 – Theoretical and Conceptual Framework

Interdisciplinary collaboration should be clearly distinguished from related concepts such as multidisciplinary and transdisciplinary approaches, as these concepts represent different levels of integration among scientific disciplines.

Multidisciplinary collaboration refers to the involvement of researchers from different disciplines working on a common problem while maintaining their distinct theoretical frameworks and methodological approaches. In this case, disciplines remain largely independent, and collaboration occurs through the juxtaposition of perspectives rather than their integration (Choi & Pak, 2006).

In contrast, interdisciplinary collaboration involves a higher level of interaction and integration, where knowledge, methods, and perspectives from different disciplines are combined and synthesized to produce a coherent and unified approach to complex problems (Repko & Szostak, 2020). This form of collaboration emphasizes mutual enrichment and the creation of new knowledge that transcends individual disciplinary boundaries.

Transdisciplinary collaboration goes beyond the academic sphere by incorporating non-academic stakeholders, such as policymakers, industry actors, and civil society, into the research process. It aims at the co-production of knowledge and the development of practical solutions to real-world challenges, thus transcending traditional disciplinary and institutional boundaries **(Pohl & Hirsch Hadorn, 2007).**

This conceptual distinction is essential for understanding the role of artificial intelligence in enhancing scientific collaboration. Artificial intelligence technologies have the potential to facilitate not only coordination among disciplines but also deeper forms of knowledge integration through advanced data analysis, pattern recognition, and cross-domain learning.

Based on this distinction, the present study adopts an interdisciplinary perspective as the most relevant framework for examining the role of artificial intelligence in scientific research.
This choice is justified by the capacity of AI systems to integrate heterogeneous data sources, connect diverse knowledge domains, and support the generation of

innovative solutions to complex scientific problems. Therefore, this paper does not merely describe forms of collaboration but seeks to analyze how artificial intelligence contributes to achieving genuine interdisciplinary integration.

8-Methodological Procedures of the Study:

8.1 - Study Method:

To study the role of AI in enhancing interdisciplinary collaboration in scientific research, we adopted a descriptive analytical approach. This method helps in accurately describing and analyzing the phenomenon by collecting and analyzing data to reach evidence-based conclusions. The descriptive method is a valuable tool for studying topics like this, as it enables systematic and precise data collection and analysis to understand how AI can enhance collaboration across different scientific fields, and identify the areas that have benefited from this, without intervening in the circumstances leading to the phenomenon.

8.2 - Study Population and Sample:

- **Study Population:** The study population consists of 302 professors from 6 departments in the Faculty of Humanities and Social Sciences. This population was selected to explore the role of AI in enhancing collaboration between different disciplines in scientific research. The population includes professors specializing in various fields, providing a comprehensive view on how AI technologies can enhance interaction between these diverse disciplines.
- **Study Sample:** A random sample of 82 professors was selected to ensure fair representation of all departments involved in the study. This random approach helps minimize bias and provides representative results that reflect the diverse opinions and experiences of professors from different disciplines. This methodology enhances the study's ability to explore the role of AI in fostering collaboration between academic disciplines in scientific research, allowing for the collection of comprehensive and varied data that supports conclusions about how these technologies are used in a multidisciplinary academic environment.

8.3 - Data Collection Tools :

- **Questionnaire:** A questionnaire was used as the primary data collection tool to gather information on the use of AI in interdisciplinary research. The questionnaire consists of both closed and open-ended questions aimed at collecting both quantitative and qualitative data.

The questionnaire aims to provide a clear picture of how effective AI is in facilitating collaboration between different scientific disciplines, as well as identifying the factors that may hinder or support the use of these technologies in scientific research.

9 - Presentation and Interpretation of the Study Results:

Table 01: Distribution of Study Sample Members by Specialization

Specialization	Number	Percentage (%)
Psychology	23	28.05
History	13	15.86
Media and Communication	15	18.29
Sociology	17	20.73
Islamic Sciences	09	10.98
Philosophy	05	6.09
Total	**82**	**100**

Table 01 reflects the diversity of specializations within the study sample regarding the role of artificial intelligence in enhancing interdisciplinary collaboration in scientific research. The most represented specialization is Psychology (23 professors), followed by Media and Communication (15 professors) and Sociology (17 professors). These specializations are significant within the research topic. Conversely, Philosophy (5 professors) and Islamic Sciences (9 professors) represent the smallest groups, which may suggest limited participation from these disciplines in research areas primarily utilizing AI.

The distribution of professors according to their specializations reflects cultural and methodological diversity in scientific research. Each discipline offers its unique perspective on the application of AI. In this context, AI can enhance interdisciplinary collaboration by providing shared tools and techniques that align with the needs of each field, ultimately improving coordination and collaborative efforts among researchers from various disciplines.

Table 02: Distribution of Study Sample Members by AI Tools Used by Researchers

Tool	Percentage (%)
Machine Learning	40
Data Analysis and Modeling	25
Text Analysis	15
Image Analysis	07
Social and Network Analysis	04
Research Platforms and Academic Resources	03
Quantitative and Qualitative Analysis Tools	06
Total	**100**

Table 02 illustrates the distribution of AI tools used by researchers in the study sample. Machine Learning is the most widely used tool, representing 40% of the total usage. This highlights the dominance of machine learning in AI-related

scientific research, as it is a powerful approach for data analysis, leading to precise and reproducible results.

The second most common tool is Data Analysis and Modeling, with 25%, underscoring the importance of big data analysis in the digital age and the use of statistical and mathematical modeling to extract meaningful conclusions in various fields. These tools are essential components of AI-driven scientific research, supporting both quantitative and qualitative analysis of information.

On the other hand, tools with lower usage include Text Analysis (15%), Image Analysis (7%), and Social and Network Analysis (4%). These lower percentages reflect researchers' relatively limited use of these tools in certain research areas. Research Platforms and Academic Resources (3%) and Quantitative and Qualitative Analysis Tools (6%) are secondary tools that support the main ones but play a less significant role compared to others.

Thus, AI use in scientific research primarily focuses on Machine Learning and Data Analysis, while tools such as social network analysis remain more specialized, reflecting specific needs in certain disciplines that may require these tools.

Table 03: Distribution of Study Sample Members by Challenges Faced by Researchers When Using Artificial Intelligence

Challenge	Percentage (%)
Lack of Knowledge and Technical Skills	30
Integration Between Different Systems	25
Lack of Structured Data	20
High Software Costs	15
Resistance to Change by Some Researchers	10
Total	**100**

Table 03 illustrates the challenges faced by researchers when using AI in their research. The largest challenge is "Lack of Knowledge and Technical Skills", which accounts for 30%. This indicates that many researchers lack the technical skills necessary to effectively use AI tools, hindering their ability to fully benefit from these advanced technologies. This may be due to insufficient training or a lack of experience in this field. The second major challenge is "Integration Between Different Systems", at 25%, which highlights the difficulty researchers face in integrating various software systems and data collected from multiple sources. Data and system integration is complex and poses a significant obstacle to seamless and effective AI use across different disciplines.

"Lack of Structured Data" is a challenge at 20%. This reflects that the data required for AI-assisted analysis is often unorganized or difficult to analyze due

to a lack of coordination or standardized formats, making it harder for researchers to leverage these tools. "High Software Costs" accounts for 15%. Despite the significant benefits of AI, the cost of specialized software can be a barrier for researchers, particularly those working with limited research budgets. Finally, "Resistance to Change by Some Researchers" represents a challenge at 10%, suggesting that some researchers refuse to adopt AI technologies due to a preference for traditional methods or fear of change.

Table 04: Distribution of Study Sample Members by the Impact of AI on Interdisciplinary Collaboration

Impact	Percentage (%)
Accelerating the Scientific Research Process	45
Enhancing Coordination Among Teams	30
Improving the Accuracy of Research Analysis	15
Facilitating Access to Data	10
Total	**100**

Table 04 shows the impact of AI on interdisciplinary collaboration in scientific research. The most significant impact is "Accelerating the Scientific Research Process", with 45%. This indicates that AI greatly contributes to accelerating the pace of scientific research by automating processes and efficiently analyzing data, allowing researchers to complete studies in less time and at a lower cost compared to traditional methods. The second largest impact is "Enhancing Coordination Among Teams" at 30%, suggesting that AI plays a vital role in improving collaboration between research teams by providing technological platforms and tools that facilitate communication and data sharing among researchers from different disciplines, thereby enhancing interaction and integration between these disciplines within scientific research.

"Improving the Accuracy of Research Analysis" accounts for 15%, which reflects how AI helps improve the results of analyses by applying advanced machine learning models and mathematical techniques, enhancing the precision of predictions and conclusions. This impact is particularly important in fields that require high accuracy in data processing and analysis. Finally, "Facilitating Access to Data" represents 10% of the total, indicating that AI contributes to easier access to data through online platforms and open sources. However, this is not the largest impact in this sample, possibly reflecting that access to data is not seen as the biggest challenge compared to other aspects of AI's impact on research.

10 - Study Results:

Through the field study on the role of artificial intelligence in enhancing interdisciplinary collaboration in scientific research, the following results were obtained:

- The study results confirmed that there is a larger representation of fields directly related to modern technologies or practical applications of AI, such as Psychology and Media and Communication Sciences, while the role of humanities and philosophical disciplines remains limited. This suggests the need for further attention to developing collaboration across these fields to ensure integrated benefits in future research.
- The use of AI in scientific research primarily focuses on machine learning techniques and data analysis, while the use of other tools such as social analysis or network analysis remains limited. This reflects the specific needs of certain disciplines that may require these tools.
- Data from the study indicates that the biggest challenge lies in the lack of technical skills and knowledge, followed by the challenge of integration between different systems. This highlights the need to provide specialized training for researchers and develop systems that facilitate the adoption of AI in scientific research.
- The study results also indicate that AI has a strong impact on accelerating scientific research and enhancing coordination between disciplines, thereby improving the effectiveness of collaboration among researchers from various fields.

11 - Conclusion:

It can be concluded from this study that artificial intelligence plays a critical role in enhancing interdisciplinary collaboration in scientific research. The evidence and results reviewed suggest the benefits of using AI in fostering greater interaction and collaboration between researchers from diverse fields.

The results show that AI can facilitate communication and the exchange of information between different disciplines, leading to increased mutual understanding and improved quality of collaborative research. AI can also assist in analyzing large datasets, identifying patterns, and generating insights that are difficult to achieve through traditional methods, thereby enhancing collaboration and contributing to scientific progress.

Based on these results, it can be said that the use of AI in enhancing interdisciplinary collaboration in scientific research has promising prospects. The academic community and researchers should seize this tremendous potential and

work on developing innovative and sustainable ways to incorporate AI in scientific research.

Therefore, it is essential to understand that AI is not a substitute for human researchers but rather a powerful assisting tool that enhances collaboration and improves the quality of scientific research. We must continue to explore and develop the capabilities of AI to achieve greater advancements in scientific research and collaboration across disciplines.

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