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Identifying and Analyzing Interdisciplinary and Inter-Organizational Collaborations in Research Outputs

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Abstract

Purpose: This study aims to identify and analyze interdisciplinary and inter-institutional collaborations evident in research outputs.

Methodology: In terms of purpose, this research is classified as applied, and in terms of methodology, it is a scientometric study. The research population comprised articles published in 2022 and 2023 from fifty-seven journals across six fields: basic sciences, engineering, agriculture, humanities, veterinary medicine, and art and architecture. Data analysis was conducted using Excel, Ravar Matrix, UciNet, and VOSViewer software.

Findings: The predominant collaboration pattern was intradisciplinary, with interdisciplinary collaborations constituting a smaller proportion. The highest frequencies of interdisciplinary collaboration were observed in veterinary medicine between pathobiology and clinical sciences (30 instances), in art and architecture between visual and Islamic arts (44 instances), and in engineering between chemical and petroleum engineering (8 instances). The University of Tehran emerged as the central hub for collaboration across all fields.

Conclusion: The results indicate that while Iran possesses the capacity to develop interdisciplinary research, the absence of a supportive policy framework, a weak culture of cooperation, and the concentration of resources in a limited number of universities have impeded large-scale interdisciplinary interactions. This current institutional pattern hinders broader impact and the sustainability of collaborative research.

Value: The findings can inform higher education policymakers in designing support programs, formulating incentive policies, and establishing platforms to foster increased interdisciplinary and inter-institutional collaboration.

Keywords: ***Co-authorship, Knowledge Fields, interdisciplinary studies, research output, Scientific Collaboration***

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Extended Abstract

Introduction: In today's complex world, scientific advancement necessitates effective knowledge management. Interdisciplinary collaboration enables researchers to integrate diverse expertise, exchange ideas, and enhance the quality of research. By synthesizing distinct perspectives, it facilitates comprehensive solutions to multifaceted problems. This approach not only fosters innovation but is also acknowledged and emphasized in academic promotion regulations as a key indicator of scholarly engagement and research impact.

Purpose: This study investigates and analyzes the current status of interdisciplinary scientific collaboration across various subject fields. It addresses the following primary research questions: 1. What patterns characterize current interdisciplinary collaborations among researchers, students, and faculty within these fields? 2. How have interdisciplinary collaboration patterns been shaped at the inter-organizational level, particularly between universities and research institutes?

Methodology: This scientometric study analyzed articles published in 57 leading journals across six major fields: basic sciences, engineering, agriculture, humanities, veterinary medicine, and art and architecture during 2022 and 2023. The final sample comprised 4,014 documents. Interdisciplinary collaborations were examined using Microsoft Excel. To assess inter-organizational collaboration, a co-occurrence matrix was constructed with RavarMatrix software. Scientific mapping and metrics of organizational collaboration were then performed using VOSviewer.

Findings: An analysis of interdisciplinary collaborations in the sampled articles reveals that the dominant pattern across most fields is intradisciplinary. **In agriculture (Table 2)**, the highest frequency of collaborations was observed in *Animal Science* (121 instances), *Horticulture* (58 instances), and *Biosystem Engineering* (31 instances). Interdisciplinary collaborations were also present, notably between *Horticulture and Soil Science* (7 instances), *Biology and Animal Science* (5 instances), and *Plant Production and Livestock & Poultry Nutrition* (5 instances). **In veterinary medicine (Table 3)**, the primary collaborative fields were *Clinical Sciences* (17 instances), *Pathobiology* (14 instances), and *Food Sciences and Industries* (14 instances). The most frequent interdisciplinary collaborations occurred between *Pathobiology and Clinical Sciences* (30 instances) and *Clinical Sciences and Food Hygiene* (17 instances). **In the humanities (Table 4)**, collaborations were most common in *Accounting* (49 instances), *Information Science and Epistemology* (48 instances), and *Economics* (42 instances). Limited interdisciplinary collaboration was observed, with 4 instances each for *Information Science and Epistemology with Law* and *Information Science with Psychology*. **In basic sciences (Table 5)**, the leading fields for collaboration were *Mathematics* (101 instances), *Geology* (45 instances), *Biology* (31 instances), and *Chemistry* (28 instances). Key interdisciplinary links were found between *Applied Mathematics and Mathematics* (9 instances) and *Mathematics and Computer Science* (8 instances). **In technology and engineering (Table 6)**, the highest collaboration counts belonged to *Chemical Engineering* (53 instances), *Agricultural/Mechanical Engineering* (43 instances), and *Petroleum Engineering* (29 instances). Interdisciplinary collaborations emerged between *Chemical Engineering and Petroleum Engineering* (8 instances)

and *Chemical Engineering and Pharmacy* (4 instances), indicating links to the health and energy sectors.

The collaboration network map for veterinary medicine reveals that the University of Tehran and Ferdowsi University of Mashhad are the most central nodes, with a combined total of 16 collaborative instances. The prevailing pattern is inter-organizational, where geographical proximity and institutional scientific reputation play crucial roles in fostering research interactions.

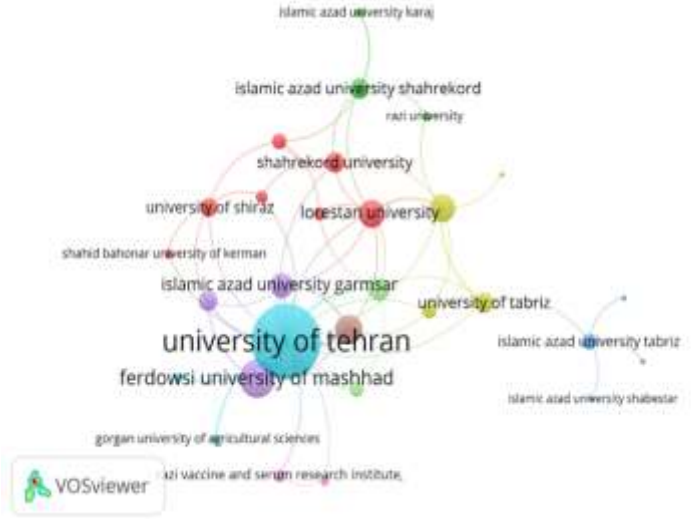

Figure 1. Inter-organizational collaboration network in veterinary medicine research publications

The collaboration network map for the technical and engineering fields indicates that the University of Tabriz and the Islamic Azad University, Research Sciences Branch, exhibit the strongest collaborative link, with 10 co-authored publications. The network is extensive and decentralized, with the University of Tehran, University of Tabriz, Islamic Azad University (Research Sciences Branch), and University of Kermanshah serving as pivotal hubs. Furthermore, specialized national industrial universities actively function as key nodes within this network.

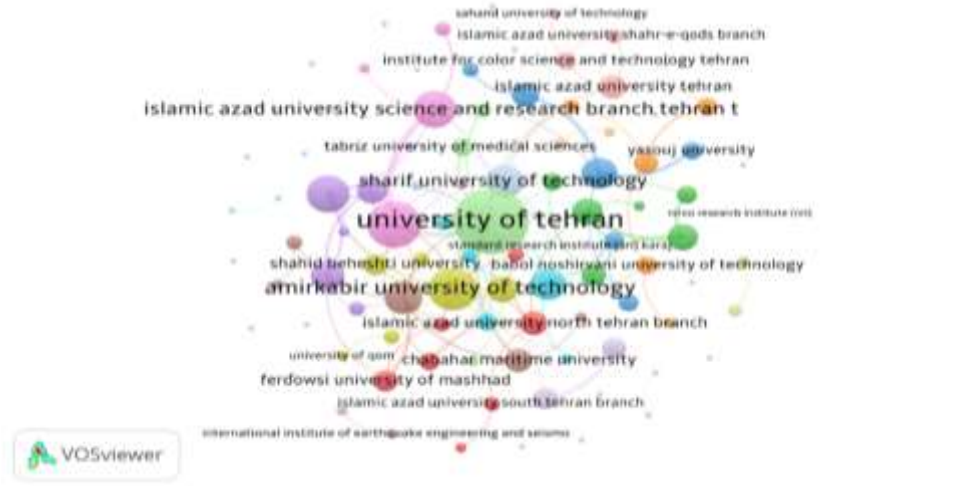

Figure 2. Inter-organizational collaboration network in technical and engineering research publications

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The collaboration network map for agriculture indicates that the University of Tehran and the University of Gorgan share the strongest collaborative link, with 16 co-authored publications. The geographic concentration of collaborations in Tehran, combined with the proximity and similar agro-climatic conditions of Gorgan and Sari, significantly fosters the expansion of research interactions in this field.

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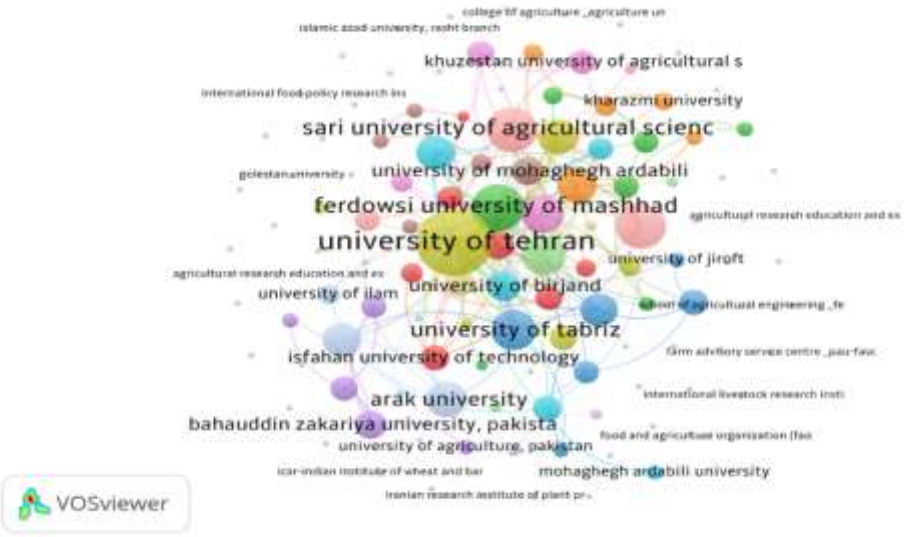

Figure 3. Inter-organizational collaboration network in agriculture research publications.

The inter-organizational collaboration network for basic sciences reveals that Razi University and the University of Kurdistan serve as central hubs. International collaborations are also prominent, involving partners from several African and Asian countries, including Ethiopia, Nigeria, and Pakistan. This pattern underscores the need to further develop scientific partnerships with research institutions in developed nations.

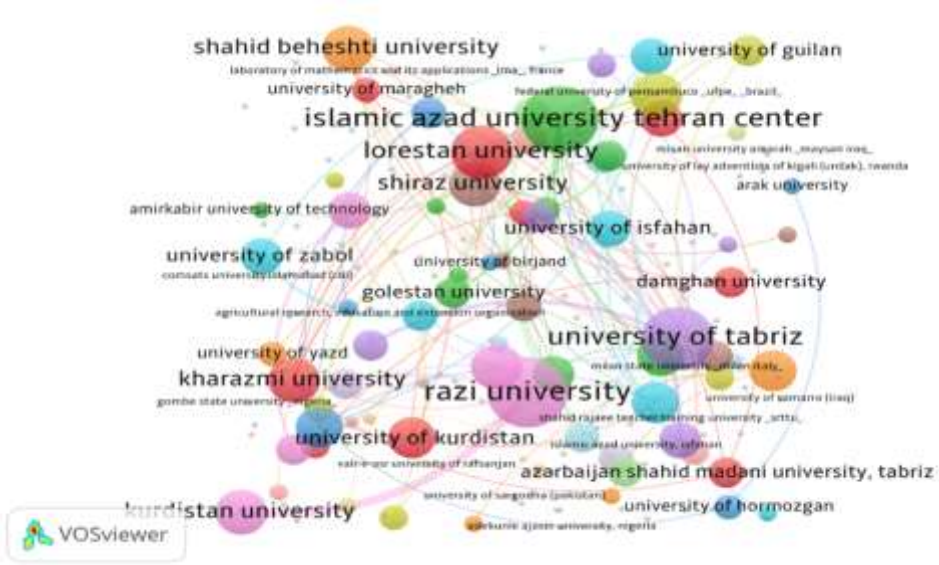

Figure 4. Inter-organizational collaboration network in basic sciences research publications.

The inter-organizational collaboration network for the humanities shows that the University of Tehran and the University of Tehran, Farabi Campus (Qom) share

the strongest collaborative link. The network is predominantly composed of intra-organizational ties, with limited inter-organizational connections. Its central cores comprise the University of Tehran, Kharazmi University, and Shahid Beheshti University, which act as key hubs connecting other institutions within the network.

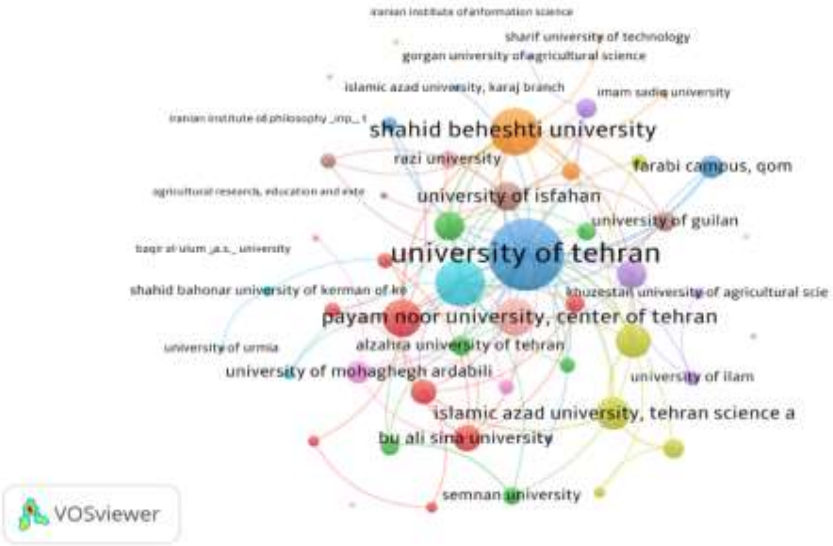

Figure 5. Inter-organizational collaboration network in humanities research publications.

In the field of art and architecture, the collaboration network is dominated by the University of Tehran and Tehran University of Art, with 74 co-authored publications. Other institutions, such as Tarbiat Modares University, Alzahra University, and the Research Institute of Cultural Heritage and Tourism, contribute to a lesser extent. This uneven distribution underscores a pronounced concentration of scientific collaboration around these two primary hubs.

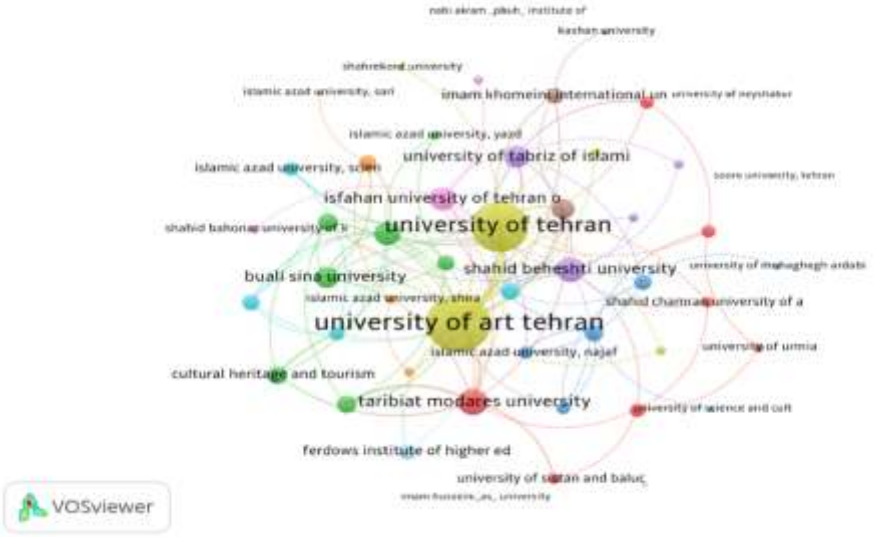

Figure 7. Inter-organizational collaboration network in art and architecture research publications.

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Conclusion: Based on the findings, the dominant collaboration pattern remains intradisciplinary, indicating that researchers still tend to collaborate primarily within their own specialized fields. This points to a persistent limitation in establishing broader interdisciplinary research networks. Nevertheless, notable instances of successful convergence were observed, particularly between pathobiology and clinical sciences in veterinary medicine, between visual and Islamic arts, and between chemical and petroleum engineering, demonstrating the existing potential for substantive interdisciplinary collaboration.

At the inter-organizational level, the results reveal a strong concentration of collaborative activity within a limited number of universities, with the University of Tehran serving as the central hub. In the field of arts, Tehran University of Art also plays a prominent role. The study concludes that while interdisciplinary collaboration in Iran is growing, it continues to face significant structural barriers, including underdeveloped policy frameworks, institutional bureaucracy, and inefficient evaluation systems, all of which require targeted attention and systematic reform.

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Value: The findings provide actionable insights for higher education policymakers and administrators. They can inform the design of targeted support programs, the formulation of effective incentive policies, and the development of dedicated platforms to foster both interdisciplinary and inter-organizational collaboration.

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