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How do Iranian and Turkish Researchers Collaborate? Business Intelligence based Decision Support Tool for Monitoring the Scientific Collaborations

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Abstract

Progress in information and communication technologies necessitates the use of cutting-edge technology tools in the field of higher education, as in every sector. Business intelligence technology is one of these tools. Business intelligence applications fed from many different systems are a digital tool that can be used at different decision levels at the operational, tactical and strategic level. It can be used for the management and monitoring of scientific research, monitoring the effectiveness over the years. In the study, the scientific productivity of Iran and Turkey between the years 2010-2020 is questioned by bibliometric methods through the bibliometric data obtained from the Web of Science. There are many studies in the literature that analyze the scientific productivity of countries with different methods. However, no study has been found that both develops an application and shares these findings with the researchers, taking into account the needs of policy makers and administrators. With this aim in mind, a decision support system is developed by focusing on scientific cooperation between countries and taking into account the needs of decision makers and rule makers. Afterwards, the scientific productivity of the two countries is analyzed at the macro level through the relevant bibliometric data source, and at the micro level, the publications jointly produced by the researchers in the two countries are detailed in the research areas, researchers, institutions, works produced and citations received, journals published together, funds, etc. evaluated in terms of Scientific productivity is evaluated in terms of universities, regional location, and other countries with joint cooperation. In the relevant period, the number of joint publications in the two countries was 6.723 (5.915 articles). Although both countries are neighbors to each other, they are in the eighth rank in the list of collaborating countries in terms of research intensity. Among the countries with the most intense cooperation for both countries are the United States and the United Kingdom. The top three institutions working together most intensively in both countries are Islamic Azad University, Middle East Technical University and Istanbul Technical University. Physics, engineering, chemistry, mathematics and materials science are the most intensely collaborative research areas. The developed model is seen as a valuable tool for university library or scientific productivity monitoring services, which are different from packaged software for the evaluation of scientific productivity at the level of countries, and provide the opportunity to go into details. Such tools are seen as valuable for monitoring and improving scientific productivity.

Keywords: Iran, Turkey, collaboration, scientific productivity, business intelligence, bibliometrics, data management.

İranlı ve Türk Araştırmacılar Nasıl İşbirliği Yapıyor? Bilimsel İşbirliklerinin İzlenmesi için İş Zekası Tabanlı Karar Destek Aracı

Öz

Bilgi ve iletişim teknolojilerindeki ilerleme, her sektörde olduğu gibi yükseköğretim alanında da son teknoloji araçlarının kullanılmasını zorunlu kılmaktadır. İş zekası teknolojisi de bu araçlardan birisidir. Pek çok farklı sistemden beslenen iş zekası uygulamaları, günümüzde operasyonel, taktik ve stratejik düzeyde farklı karar seviyelerinde kullanılabilecek bir dijital araçtır. Bilimsel araştırmaların yönetimi, izlenmesi, yıllar içindeki etkinliğin gözlenmesi için kullanılabilir. Çalışmada Web of Science üzerinden elde edilen bibliyometrik veriler aracılığı ile, 2010-2020 yılları arasındaki İran ve Türkiye'nin bilimsel üretkenliği bibliometric yöntemler ile sorgulanmaktadır. Literatürde ülkelerin bilimsel üretkenliğini farklı yöntemler ile analiz eden pek çok çalışma mevcuttur. Fakat bunu kural koyucu ve yöneticilerin ihtiyaçlarını gözeterek hem bir uygulama geliştiren hem de bu bulguları alan araştırmacıları ile paylaşan çalışmaya rastlanılmamıştır. Bu amaç gözetilerek, ülkeler arası bilimsel işbirliğine odaklanılarak karar verici ve kural koyucuları ihtiyaçları dikkate alınarak karar destek sistemi geliştirilmektedir. Sonrasında, iki ülkenin bilimsel üretkenliği ilgili bibliyometrik veri kaynağı üzerinden makro düzeyde analiz edilmekte, mikro düzeyde ise iki ülkedeki araştırmacıların ortak ürettikleri yayınlar detaylı olarak araştırma alanları, araştırmacılar, kurumlar, üretilen eserler ve alınan atıflar, birlikte yayın yapılan dergiler, fonlar vb. açısından değerlendirilmektedir. Bilimsel üretkenlik, üniversiteler, bölgesel konum, ortak işbirliği yapılan diğer ülkeler başlıkları ile değerlendirilmektedir. İlgili dönemde iki ülkede ortak yayın sayısı 6.723 (5.915 makale)'dır. Her İki ülke de birbiriyle komşu olmasına rağmen araştırma yoğunluğunda işbirliği yapılan ülkeler listesinde sekizinci sırada yer almaktadır. Her iki ülke için en yoğun iş birliği yapılan ülkeler arasında Amerika Birleşik Devletleri ve İngiltere vardır. Her iki ülkede en yoğun birlikte çalışan ilk üç kurum İslami Azad Üniversitesi, Orta Doğu Teknik Üniversitesi, İstanbul Teknik Üniversitesi'dir. Fizik, mühendislik, kimya, matematik ve malzeme bilimi en yoğun iş birliği yapılan araştırma alanlarıdır. Geliştirilen model, bilimsel üretkenliğin ülkeler düzeyinde değerlendirilmesi için paket yazılımlardan farklı, kullanışlı, detaylara inmeyi imkan sunan üniversite kütüphane veya bilimsel üretkenlik izleme servisleri için değerli bir araç olarak görülmektedir. Bu tür araçlar, bilimsel üretkenliğin izlenmesi ve iyileştirilmesi için değerli görülmektedir.

Anahtar Kelimeler: İran, Türkiye, işbirliği, bilimsel üretkenlik, iş zekası, bibliyometri, veri yönetimi.

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Introduction

Higher education policy makers and rule makers want to strengthen their institutions or countries in the research areas they focus on, and encourage innovative, interdisciplinary and international activities with both regional and international collaborations. Information and communication technologies are critical management tools at this point. It is a common and desirable goal for higher education institutions to collaborate with other institutions on research, to establish regional or international cooperation, and to maintain these collaborations in a healthy manner, both among universities and among higher education institutions' policymakers.

Scientific cooperation arise on a global scale as countries reach the boundaries of their scientific capacity, and knowledge diffusion increases in the same direction (Leydesdorff & Wagner, 2008). Academic cooperation at the national and international levels promote inter-institutional ties and provide conducive circumstances for the formation of values that benefit science and industry. Chen et al. (2019) stated this situation as a mandatory requirement that policy makers should take effective measures to reveal collaborative ties between countries.

Knowledge has emerged as the most crucial resource for late-modern cultures' future. What sorts of knowledge are required for the development of civilizations, which are unnecessary, and which should be fostered and developed? Since Francis Bacon, science (research) and technology (development) policies have been questioned and exist (Stehr, 2005). The most sophisticated economies of today are largely knowledge-based (Dunning, 2000). Higher education institutions are the most critical resources and transformative instruments that produce the raw material for this economy. Schmidt (2007) asserted that knowledge politics and knowledge evaluation appear to be significantly more basic than conventional science and technology politics, and that the importance of knowledge control in defining the future of societies is obvious.

Higher education institutions work in an increasingly complicated and competitive environment as they attempt to adapt to national and global economic, political, and social developments (Daniel, 2015). It is particularly beneficial for universities to develop relationships with the regions in which they are located and even to initiate international collaboration. Realizing scientific cooperation is regarded as beneficial for both the relevant country and the countries with whom it establishes links. This scenario is much more critical for neighboring countries. Within this framework, regional growth on a country-by-country basis can become sustainable through the

improvement of international ties, increased representation in important organizations, and the construction of an appropriate research ecosystem with experts.

There is a fast rising body of literature on the growth in international scientific collaboration (Wagner & Leydesdorff, 2005). As examples of these studies, consider the following: Chinese scientific collaboration between China and the US (Tang & Shapira, 2011), assess the scientific standing of nations at field (Abramo & D'Angelo, 2020), research collaboration and productivity (Abramo et al., 2009), scientific collaboration in the tourism field between Australia and New Zealand (Benckendorff, 2010), analyzing the research trends and collaboration patterns in Iran (Nikzad et al., 2011), Spain (Ardanuy, 2012), Hungary (Inzelt et al., 2009), comparing collaborations in different field of science (Lariviere et al., 2006), analyzing business stakeholder networks (Chung et al., 2009), analyzing the inter-university and international collaboration networks (Olmeda- Gómez et al., 2009), and investigating collaboration patterns in national and international scientific databases (Zeng et al., 2011).

In his study, Chen et al. (2019) investigated the phenomenon of international research collaboration in terms of its historical context, emphasizing the importance of such studies in better understanding the dynamics of a research area. Chen et al. (2019) highlighted the relevance of such studies in order to better understand the dynamics of a research field in his paper, which analyzed the phenomena of international research collaboration in terms of its historical background. Additionally, it may be desirable to quantify the investment in science and the policies established, the monitoring of those policies, the economic benefits associated with the aspects they contribute, and the international partnerships achieved (Leydesdorff & Wagner, 2008).

Iran and Turkey are two big countries with long-standing historical ties. The subject of whether these two adjacent nations' historical connections are represented in the literature has arisen as an important one that piques people's curiosity. As a result, it is believed that this issue may be answered by examining the scientific production of the two countries via Web of Science (WoS), one of the most significant venues for publishing activities on a worldwide scale.

In summary, the study aims to evaluate in depth the articles generated by the two nations combined in the relevant time while offering a macro-level review on the publications indexed by the WoS bibliometric data source between 2010 and 2020 in Iran and Turkey. With the cooperation of the two nations, a business intelligence tool based on BI-based bibliometric data was developed to allow policymakers to do more extensive analyses on the publications published to the scientific world. The materials ad methods used in the study, the business intelligence application model

carried out, the findings obtained from the developed application, together with the other findings obtained thanks to the tools expressed in the materials methods section, are discussed and presented below, respectively.

1. Materials and Methods

The data gathered from the WoS bibliometric databases were used as a reference in the study. "The Web of Science is the world's most trusted publisher-independent global citation database. Over 9,000 leading academic, corporate and government institutions and millions of researchers trust the Web of Science to produce high-quality research, gain insights and make more-informed decisions that guide the future of their institution and research strategy." (Clarivate, 2022). The Web of Science bibliometric database was used to get data for our study. As is well known, *Science Citation Index Expanded (SCI-Expanded: Search across over 9,200 of the world's most impactful journals across 178 scientific disciplines.), Social Sciences Citation Index (SSCI: Search across over 3,400 of the world's most impactful journals across 58 social sciences disciplines), Arts & Humanities Citation Index (AHCI: Search across over 1,800 of the world's most impactful journals across 28 arts & humanities disciplines), Emerging Sources Citation Index (ESCI: Search across over 7,800 of the world's highest-quality journals across 254 disciplines), Book Citation Index (BKCI: Discover over 104,500 editorially selected books with 10,000 new books added each year), Conference Proceedings Citation Index (CPCI: This multidisciplinary index is the fastest way to gain access to cutting edge, impactful research derived from over 205,000 conference proceedings)* (Clarivate, 2022), indexes are located in the WoS system. In Turkey's associate professorship system, these indexes hold a special and important role. In addition, the relevant bibliometric database has been favored due to the presence of these indexes in premier journals in a variety of disciplines (ÜAK, 2022).

By analyzing and modeling the gathered data with Microsoft Power BI business intelligence technology, a decision support system application for policymakers is created. The reader is shown some of the findings from the parametric reports generated by this built decision support system (Figure 1). As seen in Figure 1, the tools used were Microsoft Excel, Microsoft Power BI, Biliometrix R package, Web of Science Report tools. Data were analyzed with bibliometric tools. The reporting tools developed in the study were created to answer the question "What Rulemakers want".

Figure 1: Research Methodology

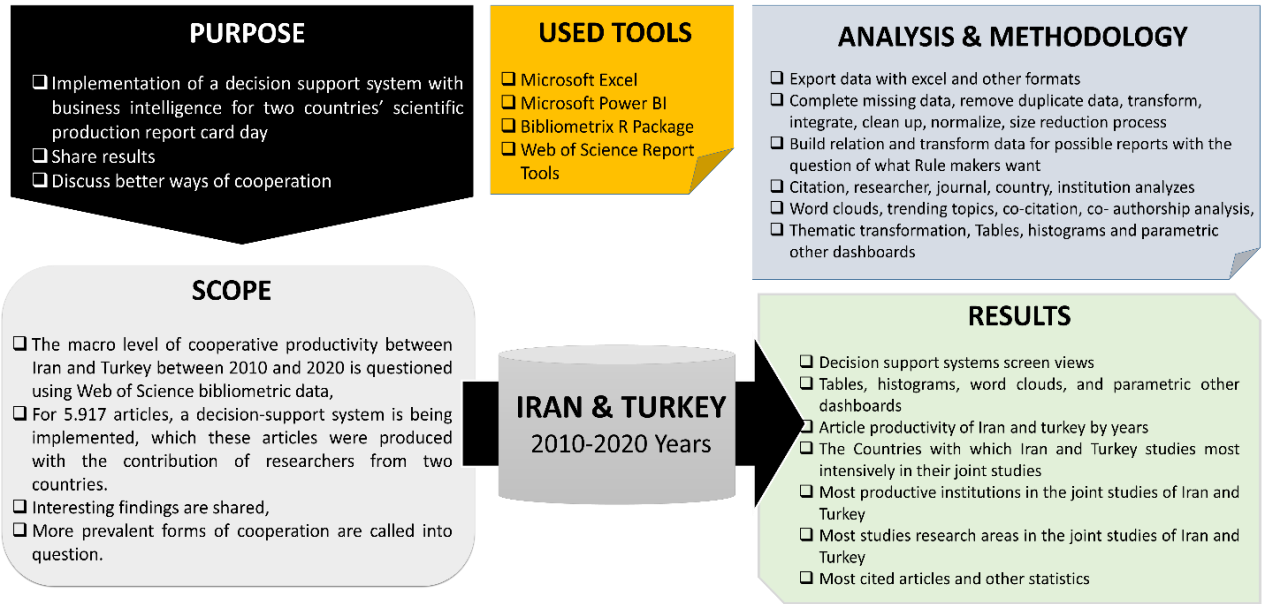


Figure 1 depicts the study's research approach in detail. Between 2010 and 2020, the scientific production of the two nations is studied at the macro level using appropriate bibliometric data sources. At the micro level, the publications created collaboratively by researchers in the two nations are thoroughly analyzed in terms of study topics, researchers, institutions, works produced and citations received, journals published together, and funding.

Through the analyzes carried out, the publications carried out jointly by Turkish and Iranian researchers within the body of WoS between the years 2010-2020 were examined. In this context, it seeks answers to the following questions:

- What are the implementation steps of the business intelligence application?
- What were our final implementation outputs?
- What is the number of documents Which is produced by the two countries in all years?
- How many documents were produced between 2010-2020 and how many of these documents were produced with the cooperation of the two countries?
- What is the distribution of document types and the number of documents produced?
- Distribution of the produced publications by years, and the number of citations?
- Which are the countries with which the two countries cooperate most intensively?
- Which are the higher education institutions that contributed the most to these publications and who are the prominent researchers?
- Have funding opportunities been used for research undertaken?

- In which areas did the two countries cooperate more intensively?
- In which journals were the publications of the two countries the most intensive?
- What are the titles, number of citations and other citation information of the studies that received the most citations from the studies produced by the cooperation of the two countries?

Scientific production is measured in terms of institutions, regional location, and collaboration with other nations. An assessment will be performed of the areas in which the two countries collaborate closely. The Bibliometrix library, which is written in the R programming language, was used to do content analysis on the years and grouping of the participating researchers, institutions, and countries.

2. Implementation of Decision Support Systems, Results and Discussion

The flow of information between nations and researchers within countries is increasing as scientific capability grows globally and more links are formed between countries. In 2021, Turkey has over 200 universities involved in teaching and training operations. Also, these schools educate 3.114.623 associate degree, 4.676.657 undergraduate, 343.569 graduate, and 106,148 doctorate students (Damar, 2021). In Iran, on the other hand, there are around 3,4 million higher education students and researchers, with 142 state institutions and the many private universities spread over the country. While the student population was 175.675 in 1980, it has more than doubled to 3.375.000 in 2019 (MSRT, 2022). According to Webometrics (2022) statistics, Iran seems to have 704 universities. According to the Webometrics ranking, while Iran has no universities in the top 200, there are 2 between 201-500, 10 between 501-1000, 141 between 1001-5000 and 60 between 5001-10000. Universities in Turkey, on the other hand, are not in the top 200, there are 1 between 201-500, 9 between 501-1000, 123 between 1001-5000 and 47 between 5001-1000. In total, there are 213 universities in Turkey. The number of higher education in Iran is quite good compared to the population ratio. Iran's 2020 population is 83.992.953 while Turkey's is 84.339.067 (DataWorldBank, 2022).

The research's broad findings are given with the outputs of the decision support system built for the evaluation of joint publications for the two nations. The created application is regarded to be a useful tool for university library services as well as policymakers. The decision support system displays and development process are shown here, with screen chunks shared with the reader. The findings of two nations at the macro and micro levels are then analyzed.

2.1. Implementation of Decision Support System with Business Intelligence

The advancement of information and communication technologies demanded the employment of cutting-edge technological tools in the education sector, as well as in all other sectors. This condition may be attributed to both sector competitiveness and the desire of managers who have become stakeholders in the industry to do their work effectively and continue their operations by making good judgments based on facts. Developing technology is more than just a means of gaining a competitive edge in the educational system. Managers who have authority over various aspects of education, such as students, instructors, finances, activities, resources, and control systems, can guarantee that their operations are efficient and sustainable. Today, business intelligence technology is fed by several systems and may be used at various decision levels at the operational, tactical, and strategic levels. It is a crucial and essential digital tool (Damar, 2021).

Miller (2011) stated that, in the face of constantly expanding data quantity, displaying and understanding data on a specific network might become difficult, but information technology experts have created various tools and methodologies (Miller, 2011). According to Zeng et al. (2012, p.297), business intelligence is the process of gathering the correct information in the right format at the right time. When the research are examined, numerous studies show the necessity of business intelligence for a successful and long-term information system in higher education institutions (Guster & Brown, 2012; Scholtz et al., 2018). Furthermore, several research on the application of business information in academic library procedures have been found (Hamad et al., 2021; Cox et al., 2012; Teendi, & Krstiev, 2019). These investigations, which analyze various processes, are not regarded sufficient, despite the fact that they are carried out.

The created decision support system's major focus is on how policymakers may make the most use of bibliometric data to enhance collaborative collaboration between the two nations. Sections of the decision support system application are depicted in Figures 2, 3, 4, and 5. Each screen has a distinct purpose. For example, Figure 2 shows the general statistical data of the articles produced jointly by the two countries. Figure 3 shows the full name based publication productivity of the researchers, and in which journals the publications are made. Figure 4 lists our articles by funding organizations and filters the journals in which they were published. Figure 5 requested responses to queries such as which study field, what type of research was conducted, and which journals they were published in. Of course, it is not feasible to disclose all of the screens created here, but they may be found under the results area of the two nations' collaboration. The results of all of the tools mentioned in the methodology section are shown here in the order they were

acquired. Furthermore, only our final application screens are presented; the process of preparing the data for the reporting process and the modeling process of the data are not shown on the screens.

Figure 2: General Statistics

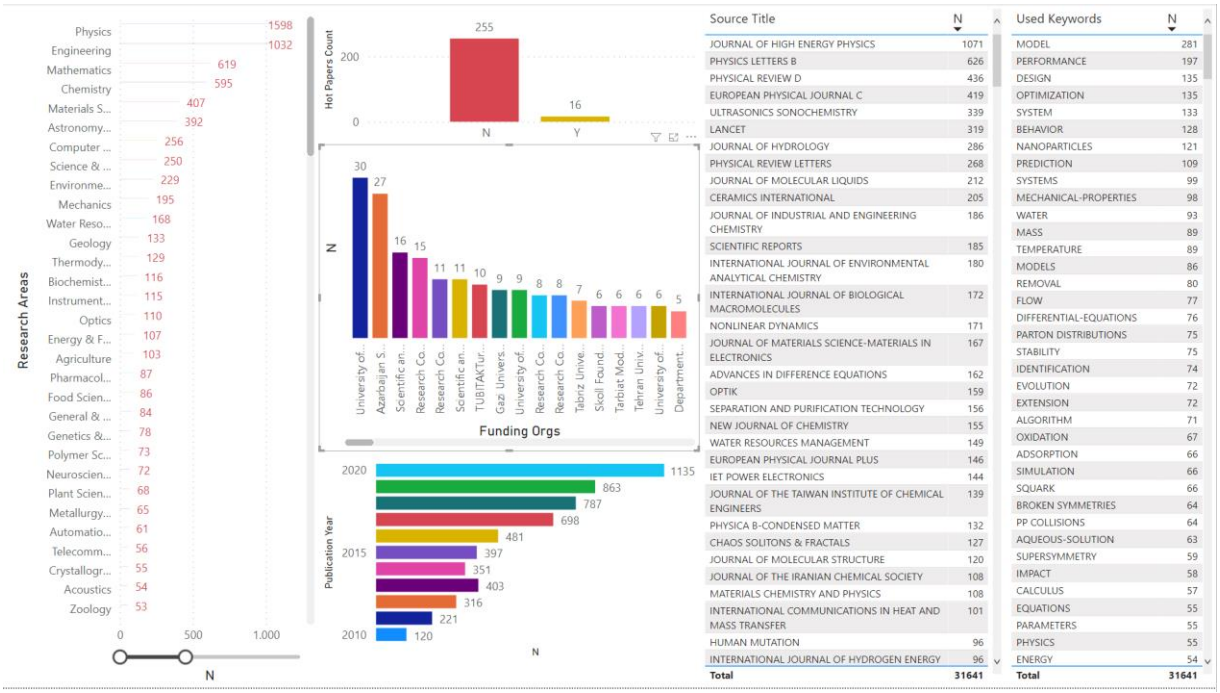


Figure 3: Search for Articles Using the Full Name of the Researcher

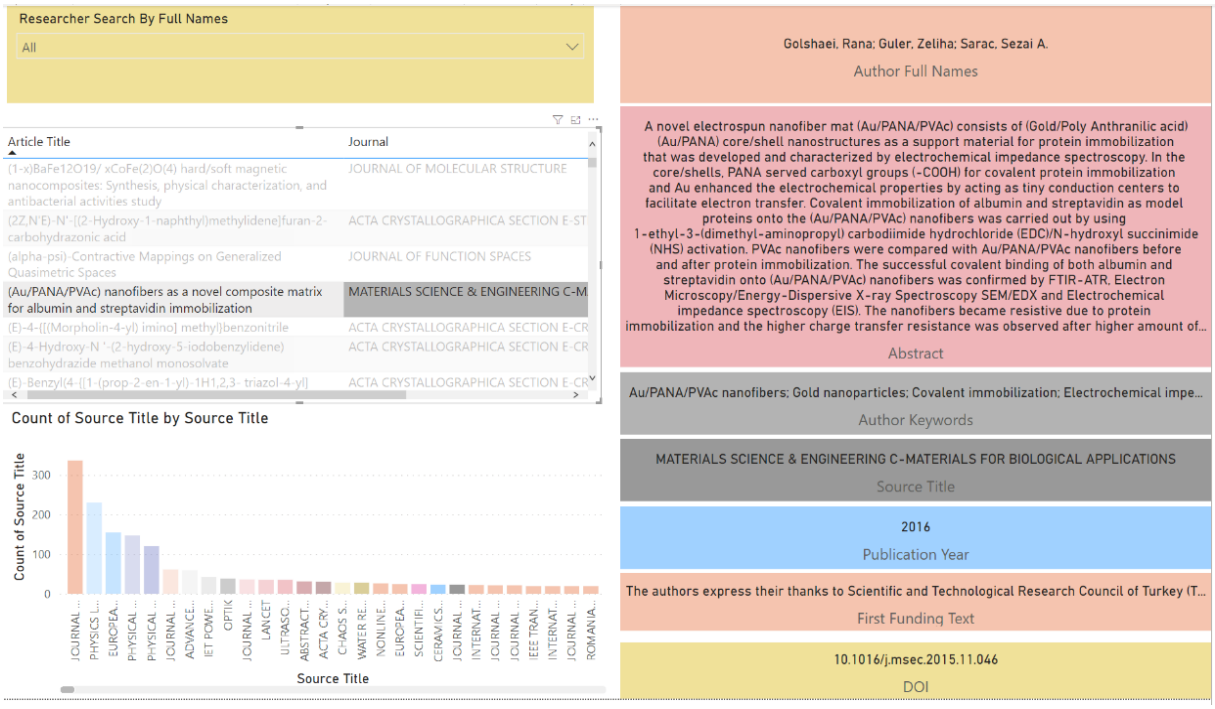


Figure 4: Search for Articles by Funding Organizations

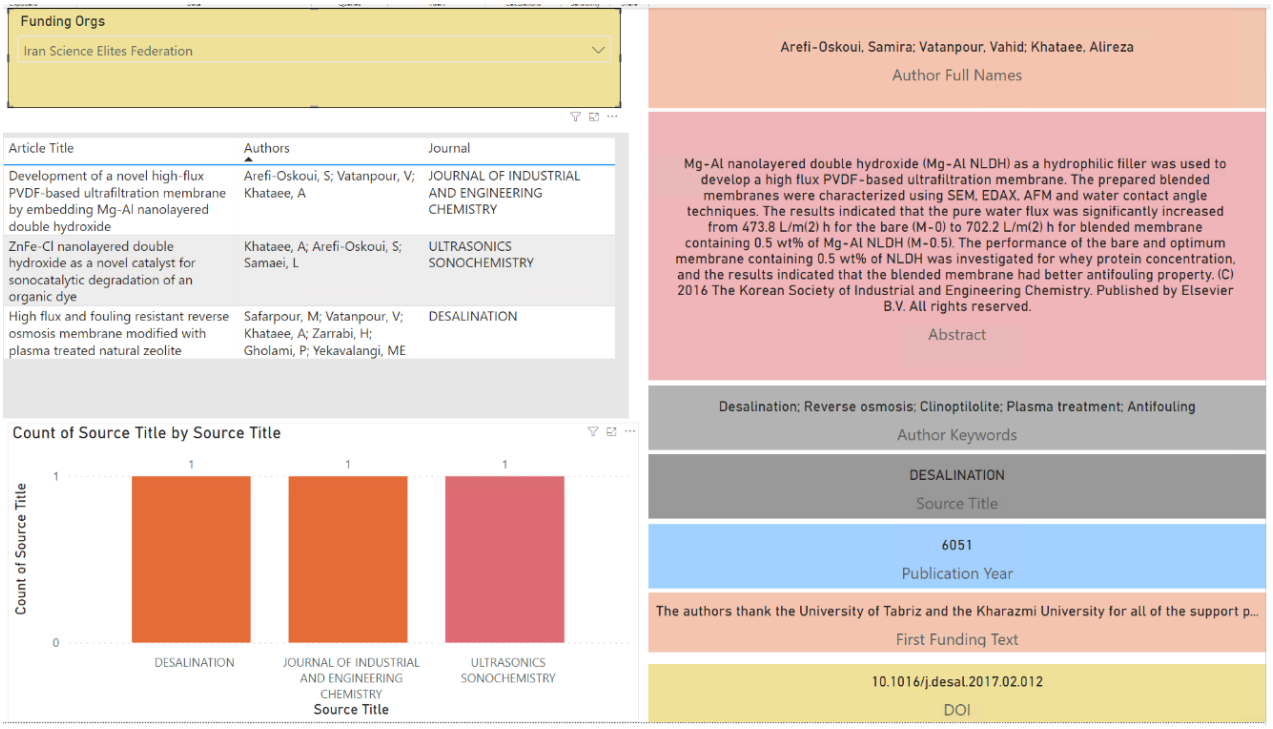
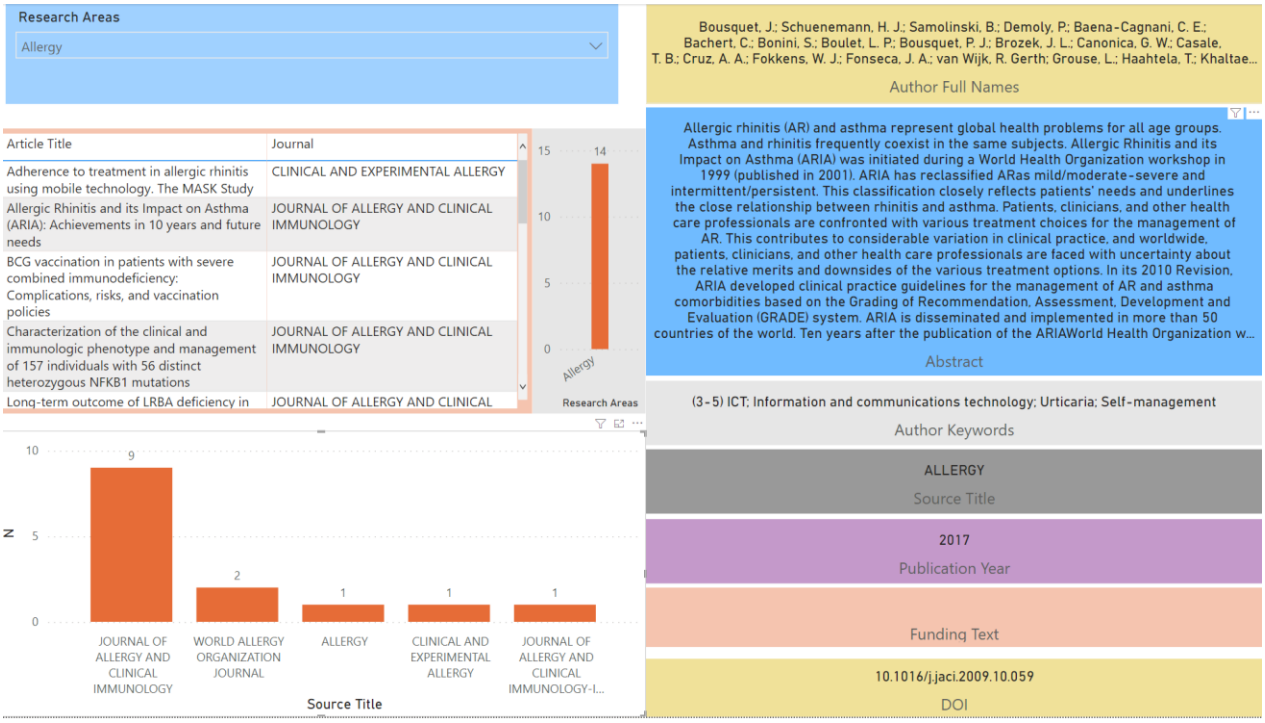


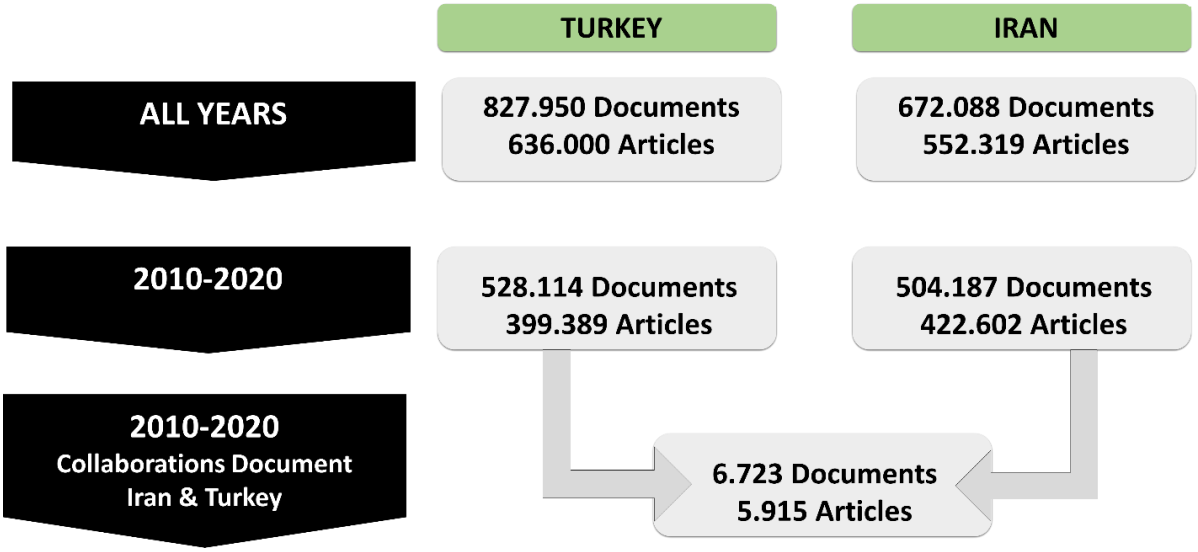
Figure 5: Search for Articles Based on Research Interests



2.2. Results and Discussion

Turkey and Iran are two important and valuable neighbors of the Middle East and its regions with two deep-rooted histories. Considering the two nations' scientific production between 2010 and 2020, the number of publications directed to Iran is 504.187 and the number of publications addressed to Turkey is 528.114 throughout the relevant timeframe (Figure 6).

Figure 6: Document the Productivity Outlook in Two Countries from 2010 to 2020



The top ten documents in which Turkey-addressed publications are produced most intensively are respectively; articles (*f:*399.508), proceedings papers (*f:*48.411), meeting abstracts (*f:*42.353), letters (*f:*15.573), review articles (*f:*14.408), editorial materials (*f:*10.738), book chapters (*f:*8.346), book reviews (*f:*2.458), early access (*f:*1.414), corrections (*f:*1.403), etc. According to the top ten document types, in which Iranian-addressed publications are most frequently produced; articles (*f:*422.732), proceedings papers (*f:*36.116), review articles (*f:*20.055), meeting abstracts (*f:*13.985), letters (*f:*6.385), editorial materials (*f:*4.153), book chapters (*f:*3.706), corrections (*f:*2.260), early access (*f:*1.868), book reviews (*f:*534).

In their study, Laverde-Rojas & Correa (2019) found that the scientific output of basic sciences and engineering had a considerable beneficial effect on the economic complexity of countries between 2003 and 2014. They also argued that metrics such as the number of academic papers published, the number of academic articles per capita, and the involvement of articles published by a country in international publications are sufficient to represent scientific production and predict national economies. Some of these markers are listed in Table 1.

Table 1: Article Productivity of Iran and Turkey by Years

Country/Year	Iran (N)	Turkey (N)	Collaboration (N)	Collaboration (C)
2020	60.076	53.540	1.222	45.128
2019	55.554	46.287	908	33.044
2018	48.899	39.348	795	25.986
2017	46.811	37.687	701	19.506
2016	42.455	38.483	481	15.403
2015	35.268	35.380	397	10.604
2014	32.818	33.153	351	7.949
2013	30.147	31.850	405	6.076
2012	27.921	29.878	316	3.787
2011	24.173	27.659	221	1.574
2010	18.860	26.243	120	217
Total	422.732	399.383	5.917	169.274

The value of citing articles (without self-citations: 150.201) is 153.254 and the total number of citations is 225.393. (without self-citations:210.962 and until 2022) for 5.917 articles. The average item value is 38,09, and the h-index is 168. When the data from Table 1 is analyzed, it is clear that the number of publications in Iran has declined while the number of articles in Turkey has grown in recent years. Between 2010 and 2020, Iran seems to be more productive in terms of article production.

The relationship of scientific productivity between countries has attracted the attention of many researchers with different topics and research questions (Merigó et al., 2016; Coronado et al., 2021; López-Rubio et al., 2021; Ibrahim, 2018; Robert et al., 2010). For example, Coronado et al. (2021) examined business and management research in Latin America in their study. Merigo et al. (2016) evaluated academic studies on innovation by focusing on countries, and stated that America and England are the two countries that stand out in scientific productivity in innovation. López-Rubio et al. (2021), on the other hand, evaluated the regions that produce the most productive innovation policy in their studies. Ibrahim (2018) assessed the effects of the Arab Spring on scientific output and research performance in Arab nations in his study.

Table 2 lists the countries that have contributed to Iran and Turkey's cooperative work. It was performed on jointly published publications by Turkey (*f:*399.508) and Iran (*f:*422.732) for the evaluation of institution, author, nation, and research topics. The top ten countries in which Iran has done the most intensive scientific work are respectively; USA (*f:*22.036), Canada (*f:*10.751), Germany (*f:*8.603), Australia (*f:*8.458), England (*f:*8.343), China (*f:*7.391), Malaysia (*f:*7.375), Italy (*f:*7.302), Turkey (*f:*5.957), France (*f:*5.312). Turkey is as follows; USA (*f:*28.087), England (*f:*11.867), Germany (*f:*11.759), Italy (*f:*9.811), France (*f:*8.340), Spain (*f:*7.520), China (*f:*7.274),

Netherlands (*f:*6.012), Iran (*f:*5.917), Switzerland (*f:*5.508). Both countries ranked eighth among the countries with which they cooperate most intensively in scientific work productivity. Scientific progress and the wealth of nations are closely linked **(Sachs, 2005**). It can be seen that countries like the United States and England, which have a say in many different fields of global literature (**Merigo et al., 2016;**), are at the forefront of scientific cooperation between the two neighboring countries.

Table 2: The Countries with which Iran and Turkey Work Most Intensively in their Joint Studies

Rank	Country	Country (N)	Country (%)	Country (C)	API	X
1	USA	1.652	27,92	142.987	86,55	154
2	China	1.467	24,79	141.054	96,15	155
3	Germany	1.378	23,28	131.488	95,42	144
4	Italy	1.375	23,23	131.229	95,44	143
5	India	1.374	23,22	137.060	99,75	152
6	England	1.373	23,20	134.085	97,66	146
7	Spain	1.333	22,52	130.336	97,78	144
8	France	1.301	21,98	127.723	98,17	142
9	Poland	1.273	21,51	118.505	93,09	143
10	Brazil	1.253	21,17	132.023	105,37	148
11	Pakistan	1.250	21,12	125.159	100,13	142
12	South Korea	1.219	20,60	122.005	100,09	138
13	Russia	1.211	20,46	121.362	100,22	138
14	Belgium	1.204	20,34	106.390	88,36	131
15	Greece	1.193	20,16	117.024	98,09	132
16	Switzerland	1.193	20,16	119.402	100,09	138
17	Egypt	1.188	20,07	120.658	101,56	138
18	Portugal	1.186	20,04	120.099	101,26	136
19	Taiwan	1.185	20,02	118.959	100,39	132
20	Austria	1.174	19,84	117.248	99,87	136

**N: Document Count; C:Citation; API: Average Per Item, X: H-index*

Table 3 displays the institutions with which Iran and Turkey have the most active collaboration. Only two institutions from Iran and one from Turkey are among the first fifteen institutions, while both nations' cooperation is largely carried out in collaboration with foreign organizations. These are among the top fifteen institutions; Islamic Azad University (*f:*1.762) is first, Middle East Technical University (*f:*1.170) is third, and Istanbul Technical University (*f:*1.111) is fourth.

Table 3: Iran and Turkey's Most Productive Institutions in Joint Studies

Rank	Affiliations	A (N)	A (%)	MS3RA
1	Islamic Azad University	1.762	29,77	Physics (f:939), Astronomy Astrophysics (f:286), Engineering (f:223)
2	Egyptian Knowledge Bank	1.173	19,82	Physics (f:967), Astronomy Astrophysics (f:341), General Internal Medicine (f:40)
3	Middle East Technical University	1.170	19,77	Physics (f:974), Astronomy Astrophysics (f:343), Engineering (f:63)
4	University of California System	1.138	19,23	Physics (f:958), Astronomy Astrophysics (f:344), Instruments Instrumentation (f:61)
5	Istanbul Technical University	1.111	18,77	Physics (f:884), Astronomy Astrophysics (f:316), Engineering (f:71)
6	Imperial College London	1.105	18,67	Physics (f:956), Astronomy Astrophysics (f:342), Instruments Instrumentation (f:58)
7	State University System of Florida	1.104	18,65	Physics (f:965), Astronomy Astrophysics (f:344), Instruments Instrumentation (f:60)
8	Helmholtz Association	1.091	18,43	Physics (f:957), Astronomy Astrophysics (f:339), Instruments Instrumentation (f:56)
9	Centre National De La Recherche Scientifique	1.088	18,38	Physics (f:960), Astronomy Astrophysics (f:345), Instruments Instrumentation (f:58)
10	University of Belgrade	1.087	18,37	Physics (f:955), Astronomy Astrophysics (f:340), Instruments Instrumentation (f:54)
11	Russian Academy of Sciences	1.086	18,35	Physics (f:959), Astronomy Astrophysics (f:342), Instruments Instrumentation (f:60)
12	Ghent University	1.084	18,32	Physics (f:950), Astronomy Astrophysics (f:339), Instruments Instrumentation (f:54)
13	University of Bologna	1.082	18,28	Physics (f:954), Astronomy Astrophysics (f:342), Instruments Instrumentation (f:58)
14	Johns Hopkins University	1.081	18,26	Physics (f:950), Astronomy Astrophysics (f:340), Instruments Instrumentation (f:54)
15	University of Helsinki	1.078	18,21	Physics (f:952), Astronomy Astrophysics (f:341), General Internal Medicine (f:33)

**A:Affliations; N: Document Count; MSRA: Most Studied Three Research Area*

Bogazici University (*rank:* 29; *f:*1.058), which does not appear in Table 3 but is among the top 100. Other universities in the top 300 are listed as follows; Isfahan University of Technology (*rank*:157; *f:*1.006), Kafkas University (*rank*:182; *f:*985), Mersin University (*rank*:192; *f:*959), Adiyaman University (*rank*:193; *f:*958), Izmir Institute of Technology (*rank*:200; *f:*927), University of Tabriz (*rank*:201; *f:*904), Gaziosmanpasa University (*rank*:203; *f:*856), Mimar Sinan Guzel Sanatlar University (*rank*:211; *f:*775), Erzincan Binali Yildirim University (*rank*:212; *f:*768), Ozyegin University (*rank*:219; *f:*724), Marmara University (*rank*:224; *f:*79), Hacettepe University (*rank*:225; *f:*690), Piri Reis University (*rank*:239; *f:*587), Istanbul Bilgi University (*rank*:245; *f:*510), Ege University (*rank*:255; *f:*473), Yildiz Technical University (*rank*:257; *f:*473), University Of Tehran (*rank*:259; *f:*465), Cag University Turkey (*rank*:263; *f:*452), Istanbul Aydin University (*rank*:266; *f:*447), Sharif University of Technology (*rank*:270; *f:*406), Istanbul

University (*rank*:272; *f:*395), Beykent University (*rank*:275; *f:*389), Sinop University(*rank*:276; *f:*389), Bingol University (*rank*:278; *f:*378), Cankaya University (*rank*:285; *f:*325), Suleyman Demirel University (*rank*:286; *f:*325), Tabriz University of Medical Science (*rank*:296; *f:*261), University of Yazd (*rank*:297; *f:*261), Tehran University of Medical Sciences (*rank*:298; *f:*256).

Many studies have been published that look at the impact of scientific output on national economic productivity and how to comprehend macroeconomics utilizing multidisciplinary techniques (Jaffe et al., 2013). The relationship between them is also valuable for creating new products and services (Laverde-Rojas & Correa, 2019). Scientific productivity has the potential to boost a country's economic productivity. This situation can also affect regional development through joint work at the country level and well-managed funds. As a matter of fact, when both the distribution of funds (Table 4) and the institutions are evaluated (Table 3), there is no common fund that Iran and Turkey built together as two neighboring countries and that prioritizes regional development. In addition, in terms of regional proximity, joint scientific cooperation of neighboring universities is also open to improvement.

Table 4: Top Ten Institutions that Provide the Most Intensive Support for Iran-Turkey Joint Studies

Rank	Funding Agencies	FA (N)	FA (%)	Rank	Funding Agencies	FA (N)	FA (%)
1	Turkiye Bilimsel ve Teknolojik Arastirma Kurumu	1.200	20,28	6	National Natural Science Foundation Of China	1.000	16,90
2	European Commission	1.151	19,45	7	Fonds De La Recherche Scientifique	973	16,45
3	UK Research Innovation	1.130	19,10	8	Conselho Nacional De Desenvolvimento Cientifico E Tecnologico	967	16,34
4	Science Technology Facilities Council	1.025	17,32	9	Greek Ministry of Development	964	16,29
5	National Science Foundation	1.012	17,10	10	German Research Foundation	963	16,28

**FA: Funding Agencies; N: Document Count*

Table 4 shows the funding organizations supporting the joint research of Turkey and Iran. While Turkey's scientific research funding organizations ranked first in this list, Europa Commission and UK Research Innovation institution came next. The institutions that support Iran's scientific research most intensively are Iran National Science Foundation (*f:*10.458), Tehran University of Medical Sciences (*f:*6.631), Islamic Azad University (*f:*4.913), University of Tehran (*f:*4.592), European Institutions such as the Commission (*f:*3.501), National Natural Science

Foundation of China (*f:*2.466), UK Research Innovation (*f:*2.088) stand out. For Turkey, this is the case; Scientific and Technological Research Council of Turkey (*f:*35.968), European Commission (*f:*7.001), National Science Foundation (*f:*4.785), Istanbul University (*f:*4.223), UK Research Innovation (*f:*4.203), National Natural Science Foundation of China (*f:*3.770).

Table 5 shows the journals in which the studies of the two countries are published most intensively. Considering the scientific areas in which the journals publish, it has been observed that physics, astronomy and astrophysics, engineering, and mathematics journals publish the most articles.

Table 5. Journals In Which The Two Countries Publish Their Joint Articles Intensively

Rank	PT	JRD	5YIF	CQ	PT (N)	PT (%)
1	Journal of High Energy Physics	Physics	4.977	Q4	337	5.69
2	Physics Letters B	Astronomy & Astrophysics; Physics	3.779	Q2; Q1	230	3.88
3	European Physical Journal C	Mathematics	2.018	Q1	155	2.61
4	Physical Review D	Astronomy & Astrophysics; Physics	3.865	Q1; Q1	147	2.48
5	Physical Review Letters	Physics	9.044	Q1	120	2.02
6	Journal of Instrumentation	Instruments & Instrumentation	1.328	Q4	60	1.01
7	Advances in Difference Equations	Mathematics	2.285	Q1	59	0.99
8	Lancet	General & Internal Medicine	77.237	Q1	46	0.77
9	Iet Power Electronics	Engineering	3.055	Q2	42	0.70
10	Optik	Optics	1.955	Q2	38	0.64
11	Journal of Hydrology	Engineering; Geology; Water Resources	6.033	Q1	36	0.60
12	Ultrasonics Sonochemistry	Acoustics; Chemistry	7.537	Q1	35	0.59
13	Abstract and Applied Analysis	Mathematics	1.288	Q1	31	0.52
14	Chaos Solitons Fractals	Mathematics; Physics	4.415	Q1; Q1	28	0.47
15	Water Resources Management	Engineering; Water Resources	3.868	Q2; Q2	28	0.47
16	Nonlinear Dynamics	Engineering; Mechanics	4.799	Q1; Q1	26	0.43
17	European Physical Journal Plus	Physics	3.304	Q1	24	0.40
18	Scientific Reports	Science & Technology - Other Topics	5.134	Q1	24	0.40
19	Acta Crystallographica Section E Crystallographic Communications	Crystallography	-	-	23	0.38
20	Ceramics International	Materials Science	4.049	Q1	23	0.38

* Publication Titles*: PT; N: Document Count; 5YIF: Five Years Impact Factor; JRD: Journal Research Domain; CQ: Category Quartile*

It is essential from an academic standpoint to classify published materials in a research field in order to address the discipline's leading trends (**Merigó et al., 2016**). The top ten research areas in which Iran produces the most produced articles are as follows; engineering (*f:*86.982), chemistry (*f:*57.842), materials science (*f:*36.701), physics (*f:*33.839), mathematics (*f:*25.540), science technology other topics (*f:*19.962), computer science (*f:*19.756), environmental sciences ecology

(*f:*15.195), pharmacology pharmacy (*f:*15.015), mechanics (*f:*14.378). As for Turkey, engineering (*f:*44.566), chemistry (*f:*26.178), general internal medicine (*f:*25.190), engineering materials science (*f:*23.404), physics (*f:*22.043), mathematics (*f:*18.225), environmental sciences ecology (*f:*16.220), surgery (*f:*15.985), computer science (*f:*12.832), education educational research (*f:*11.717). The subjects of physics, engineering, mathematics, chemistry, materials science, astronomy, and astrophysics are focused in the papers produced together (Table 6).

Table 6: The Most Worked Research Areas in Iran-Turkey Joint Studies

Rank	Research Area	RA (N)	A (%)	Rank	Research Area	RA (N)	A (%)
1	Physics	1.598	27,00	16	Optics	110	1,85
2	Engineering	1.032	17,44	17	Energy Fuels	107	1,80
3	Mathematics	619	10,46	18	Agriculture	103	1,74
4	Chemistry	595	10,05	19	General Internal Medicine	95	1,60
5	Materials Science	407	6,87	20	Pharmacology Pharmacy	87	1,47
6	Astronomy Astrophysics	392	6,62	21	Food Science Technology	86	1,45
7	Computer Science	256	4,24	22	Genetics Heredity	78	1,31
8	Science Technology Other Topics	251	4,32	23	Polymer Science	73	1,23
9	Environmental Sciences Ecology	230	3,88	24	Neurosciences Neurology	72	1,21
10	Mechanics	195	3,29	25	Plant Sciences	68	1.14
11	Water Resources	168	2,83	26	Metallurgy Metallurgical Engineering	65	1,09
12	Geology	133	2,24	27	Automation Control Systems	61	1,03
13	Thermodynamics	129	2,18	28	Telecommunications	56	0,94
14	Biochemistry Molecular Biology	116	1,96	29	Crystallography	55	0,93
15	Instruments Instrumentation	115	1,94	30	Acoustics	54	0,91

** RA: Research Area; A: Affliations; N: Document Count; MSRA: Most Studied Three Research Area*

Furthermore, the Lancet stands out among the publications that publish the most frequently referenced papers (Table 7). Other journals in which the most cited studies are published are Journal of Extracellular Vesicles, International Journal of Surgery, Lancet Gastroenterology & Hepatology.

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Table 7: Most Cited Articles in Joint Studies

Rank	Title	Authors	Journal	C
1	Observation of a new boson at a mass of 125 GeV with the CMS experiment at the LHC	Chatrchyan, S; Khachatryan, V; (...); Wenman, D	Physics Letters B	6.266
2	Global, regional, and national age-sex specific all-cause and cause-specific mortality for 240 causes of death, 1990-2013: a systematic analysis for the Global Burden of Disease Study 2013	Naghavi, M; Wang, HD; (...); Murray, CJL	Lancet	4.528
3	Global, regional, and national incidence, prevalence, and years lived with disability for 310 diseases and injuries, 1990-2015: a systematic analysis for the Global Burden of Disease Study 2015	Vos, T; Allen, C; (...); Murray, CJL	Lancet	3.711
4	Global, regional, and national incidence, prevalence, and years lived with disability for 301 acute and chronic diseases and injuries in 188 countries, 1990-2013: a systematic analysis for the Global Burden of Disease Study 2013	Vos, T; Barber, RM; (...); Murray, CJL	Lancet	3.414
5	Global, regional, and national incidence, prevalence, and years lived with disability for 354 diseases and injuries for 195 countries and territories, 1990-2017: a systematic analysis for the Global Burden of Disease Study 2017	James, SL; Abate, D; (...); Murray, CJL	Lancet	3.408
6	Global, regional, and national life expectancy, all-cause mortality, and cause-specific mortality for 249 causes of death, 1980-2015: a systematic analysis for the Global Burden of Disease Study 2015	Wang, HD; Naghavi, M; (...); Murray, CJL	Lancet	3.048
7	Global, regional, and national incidence, prevalence, and years lived with disability for 328 diseases and injuries for 195 countries, 1990-2016: a systematic analysis for the Global Burden of Disease Study 2016	Vos, T; Abajobir, AA; (...); Murray, CJL	Lancet	2.782
8	Worldwide trends in body-mass index, underweight, overweight, and obesity from 1975 to 2016: a pooled analysis of 2416 population-based measurement studies in 128.9 million children, adolescents, and adults	Ezzati, M; Bentham, J; (...); Cisneros, JZ	Lancet	2.705
9	Minimal information for studies of extracellular vesicles 2018 (MISEV2018): a position statement of the International Society for Extracellular Vesicles and update of the MISEV2014 guidelines	Thery, C; Witwer, KW; (...); Zuba-Surma, EK	Journal of Extracellular Vesicles	2.455
10	Trends in adult body-mass index in 200 countries from 1975 to 2014: a pooled analysis of 1698 population-based measurement studies with 19.2 million participants	Di Cesare, M; Bentham, J; (...); Cisneros, JZ	Lancet	2.420

Table 7: Continue…

Rank	Title	Authors	Journal	C
11	Global, regional, and national age-sex-specific mortality for 282 causes of death in 195 countries and territories, 1980-2017: a systematic analysis for the Global Burden of Disease Study 2017	Roth, GA; Abate, D; (...); Murray, CJL	Lancet	2.121
12	Global, regional, and national comparative risk assessment of 79 behavioural, environmental and occupational, and metabolic risks or clusters of risks, 1990-2015: a systematic analysis for the Global Burden of Disease Study 2015	Forouzanfar, MH; Afshin, A; (...); Murray, CJL	Lancet	2.042
13	Worldwide trends in diabetes since 1980: a pooled analysis of 751 population-based studies with 4.4 million participants	Zhou, B; Lu, Y; (...); Cisneros, JZ	Lancet	1.754
14	Global, regional, and national comparative risk assessment of 79 behavioural, environmental and occupational, and metabolic risks or clusters of risks in 188 countries, 1990-2013: a systematic analysis for the Global Burden of Disease Study 2013	Forouzanfar, MH; Alexander, L; (...); Murray, CJ	Lancet	1.645
15	Global, regional, and national comparative risk assessment of 84 behavioural, environmental and occupational, and metabolic risks or clusters of risks for 195 countries and territories, 1990-2017: a systematic analysis for the Global Burden of Disease Study 2017	Stanaway, JD; Afshin, A; (...); Murray, CJL	Lancet	1.462
16	Global, regional, and national comparative risk assessment of 84 behavioural, environmental and occupational, and metabolic risks or clusters of risks, 1990-2016: a systematic analysis for the Global Burden of Disease Study 2016	Gakidou, E; Afshin, A; (...); Murray, CJL	Lancet	1.315
17	The SCARE Statement: Consensus-based surgical case report guidelines	Agha, RA; Fowler, AJ; (...); Rosin, D	International Journal of Surgery	1.274
18	Global, regional, and national disability-adjusted life-years (DALYs) for 315 diseases and injuries and healthy life expectancy (HALE), 1990-2015: a systematic analysis for the Global Burden of Disease Study 2015	Kassebaum, NJ; Arora, M; (...); Murray, CJL	Lancet	1.142
19	Global prevalence and genotype distribution of hepatitis C virus infection in 2015: a modelling study	Blach, S; Zeuzem, S; (...); Razavi, H	Lancet Gastroenterology & Hepatology	1.133
20	Global, regional, and national disability-adjusted life years (DALYs) for 306 diseases and injuries and healthy life expectancy (HALE) for 188 countries, 1990-2013: quantifying the epidemiological transition	Murray, CJL; Barber, RM; (...); Vos, T	Lancet	1.099

There is no doubt that scientific and technological research influences economic development (Teitel, 1994; Wang, 2007). Therefore, there is no doubt that scientific cooperation between the two neighbors will contribute to regional development and regional peace. As can be seen in Table 2, Table 3 and Table 6, in the scientific collaborations between Iran and Turkey, a publication productivity has been seen in indirect, more global projects rather than direct collaborations. However, unfortunately, the areas in which the two countries cooperate intensively are not the areas where both countries are very strong in the global literature. Also, considering the institutions on Table 3, one from Iran and only two from Turkey took part in these collaborations. This is a very thought-provoking finding that supports the thesis of coming together with global collaborations.

3. Strengths and Limitations

In this study, only data received from the Web of Science bibliometric data source were analyzed. Some of the publications that Scopus or PubMed scanned were not included in this study. Naturally, research included in Scopus or PubMed is scanned and accessible on Wos. Different researchers can analyze this circumstance as a prospective research topic in the future. However, it should be noted that the types of data drawn from many different bibliometric data sources are different file types and formats. This was a challenge to make the study more comprehensive, and the WoS bibliometric data source was preferred under the circumstances.

4.Conclusion and Suggestion

Cooperation between the two countries is an area open to improvement. The fact that the two countries' scientific production and domains of contribution to the global literature are distinct also shows the presence of significant potential for collaboration, scientific productivity, and information exchange. Iran and Turkey are two important and valuable countries with a deep-rooted and historical background. However, the joint cooperation of the two countries is seen as quite insufficient. Due to the fact that the two nations are neighbors, bilateral cooperation is a natural outcome. With the support of public institutions and policymakers, researchers in the two nations may expand their bilateral collaboration in commercial and regional areas. With the help of public institutions and policymakers, researchers in the two nations should expand their collaboration on commercial and regional cooperation.

Skolnikoff (1993) stated that worldwide intellectual advances should be perpetuated locally, and that governments should adopt science and technology policies to accomplish this. Political methods and the resulting special funding can have a considerable effect on the linkages in the studied network. Political approaches and the special funds created by these

programs can have a significant impact on the connections in the observed network. Additionally, it is thought that the two countries' ministries of commerce and industry, as well as officials working in this field, should benefit more from university dynamics. The existence and nature of these policies might be as a good research question for different studies.

The number of students enrolled in higher education institutions in Iran and Turkey, the youthful population, and the number of universities are similar (MSRT, 2022; Webometrics, 2022; DataWorldBank, 2022). It is self-evident that the two nations are geographically adjacent, have comparable temperatures and vegetation, and can collaborate in a variety of sectors ranging from agriculture to animal husbandry, and that this collaboration will also benefit regional growth.

Naturally, not all of the screens generated here could be shared. However, as can be seen in the findings section in the collaborations between the two countries, there has been a publication productivity in indirect, more global projects rather than direct collaborations. It has been observed that the articles generated in collaboration are mostly in the subjects of physics, engineering, mathematics, chemistry, materials science, and astronomy and astrophysics.

Another critical evaluation is the preservation of our data in the data warehouse using business intelligence technology, as well as the expansion and growth of this data collected from various systems of the higher education system, which is becoming more complex by the day, and in accordance with the demands of administrators and policymakers. Not only will reports and images obtained from the analysis of bibliometric data on the data held with Business Intelligence technology be integrated into the existing smart system by matching the manager's requirements, but also heterogeneous corporate data will be integrated into the existing smart system.

According to our research, our provinces bordering Iran are not at the top of the list for collaboration, and regional cooperation is underdeveloped. The majority of the collaboration between the universities of the two countries was between the top-ranked institutions in the globe. The majority of these cooperation were supported by international grants. Nonetheless, the two nations are the two largest countries in the region and are neighbors. It might be advised that they intensify their collaboration by putting regional growth and regional cooperation first. Applications such as the scientific productivity decision support system developed in this work have the capacity to serve as a crucial instrument in international calls for scientific bilateral collaboration.

It is an outstanding resource management tool for business intelligence and is well-suited for library activities. In addition, in Turkey, the personnel working in university libraries within the higher education structure should not only be responsible for the management of books, journals and various subscriptions. This is not considered sufficient. University libraries are also seen as strategic units for monitoring and improving the scientific productivity of the university. It is seen as the most ideal unit within the university for the management of this and similar applications developed. Considering the institutional organizational frameworks of Turkish universities, the library and documentation departments can play a leadership role in monitoring, regulating, and implementing university-wide policies on scientific output and joint research.

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