INTERNATIONAL SCIENTIFIC COLLABORATION: BENEFITS AND CHALLENGES

Received: October 7, 2023
Accepted: December 10, 2023

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Abstract
A broad range of teamwork styles and practices characterizes the present state of science. Working together across organizational and cultural boundaries widens the horizons of scientific discovery. Collaborative research initiatives that span international borders frequently yield results that surpass the accomplishments of individual teams working alone. Collaboration among scientists is an essential aspect of the advancement of all scientific disciplines, particularly in the field of clinical medicine. Cultural and international diversity involvement in projects can be advantageous for scientific progress. However, it also brings specific difficulties, potential hazards, and drawbacks. Some of the significant difficulties identified are related to the physical distance between people and the variations in culture, language, and career level. This review analyzes the benefits and challenges associated with international scientific collaboration and strategies for effective collaboration.

Keywords: International, Collaboration, Science, Society, Research, Interdisciplinarity

INTRODUCTION
International cooperation in research has different motives. Researchers may have different goals, such as organizing their studies, building a good reputation, gaining visibility, or pursuing collaborative research. Collaborating with other researchers can provide access to research funds and mentoring opportunities for younger researchers. The sharing of knowledge, tools, laboratories, and vast scientific infrastructures, which include data, can be an excellent catalyst for creating more extensive networks and encouraging collaboration. Moreover, it can potentially foster the creation of novel techniques and facilitate the sharing of crucial knowledge [1].

The extent of international collaboration can vary from individual co-authorship to more extensive collaborations that involve multiple countries. The internationality of journals can also be considered when analyzing this topic [2,3,4].

Collaboration among scientists is an essential aspect of the advancement of all scientific disciplines, particularly in the field of clinical medicine. Collaborating across disciplines and international borders can yield numerous benefits. Extensive collaborative efforts have been crucial in advancing our knowledge of COVID-19 and developing vaccines. Without such efforts, we could not have achieved our current understanding of the virus and the progress made in vaccine
development [5]. The academic community has recently emphasized the importance of working together in research and development [6,7].

Collaborating with international researchers provides access to experts, resources, and funding and enhances productivity and visibility. Borderless scientific mentorship supports young students [5].

In the past three decades, there has been a notable rise in the quantity of papers written through international collaboration. This increase can be attributed to the growing trend of scientific specialization, decreased communication and travel expenses, and the necessity of accessing diverse databases and interdisciplinary ideas [8-11].

Collaboration among investigators with diverse scientific backgrounds and perspectives is increasingly crucial in biomedical research to solve complex biomedical problems [12,13].

Citations are crucial in promoting international collaboration among researchers, allowing individuals to receive recognition for their work. Citations guarantee that the academic community has access to and is knowledgeable about all authors' work. The increasing inclination towards global cooperation in academic research has benefited the quality and quantity of research papers generated [14].

For instance, astronomy is a highly international field; more than 50% of its publications are co-authored internationally. Similarly, more than 20% of scientific papers from geosciences, mathematics, biological sciences, and physics result from international collaborations [15].

However, despite its immense benefits, international cooperation can face challenges. Some of the significant difficulties identified are related to the physical distance between people and the variations in culture, language, and career level [16].

This review aims to analyze the benefits and challenges associated with international scientific collaboration and to identify strategies for effective collaboration.

Benefits of international scientific collaboration
The general public's interest in comprehensive bibliometric research on scientific output has grown recently. This is attributed to the globalization of science and the convenience of accessing data on overall scientific production through index databases such as Web of Science (WoS) and Scopus [17]. From 2000 to 2020, global production nearly tripled to over 2.9 million publications annually [18,19].

International research collaborations offer graduate students unique opportunities for research, personal growth, cultural awareness, networking, and skill development that are not typically available at their home institutions [20].

Collaborations between students and their partners benefit both parties as they provide a valuable learning experience. Collaborations allow students and their partners to explore new ecosystems and work environments. The intricate nature of ecosystems necessitates that scientists from different fields collaborate to address present-day issues.

Exploring new research approaches can be possible for researchers through collaborations with international partners. This leads to endless possibilities that can be applied back home. Both parties have the chance to exchange valuable knowledge through this collaboration. This exchange of knowledge not only improves the research project but helps establish connections between them [21].

Interinstitutional research collaboration allows researchers to share resources, costs, knowledge, and skills among institutions. Enhanced productivity and superior research quality can be the potential outcomes of this. Working with colleagues from different countries has contributed to improving the quality indices of universities, which has increased the likelihood of researchers receiving internal and external financing [22-29].

Scholars have identified various reasons for the growing trend of international collaborations. C.S. Wagner put forward five essential reasons why scientists engage in collaborations. These include enhancing visibility, distributing project expenses, acquiring or sharing access to a costly or unique physical resource, exerting more influence by sharing data, and fostering creativity by exchanging ideas. Additionally, scientists seek international collaborations to expand the range of their research, partner with desirable collaborators, and undertake more extensive global projects [34-36].

Challenges of international scientific collaboration
Collaborations between individuals from different cultural backgrounds benefit all parties involved. However, such partnerships can also pose unforeseen
challenges. Cultural and international diversity involvement in projects can be advantageous for scientific progress. However, it also brings specific difficulties, potential hazards, and drawbacks [37].

Conducting research and generating knowledge in a common language is a universal practice. However, communication barriers arise when working in multilingual teams, mainly when the members aim to publish in reputable peer-reviewed journals [38].

Scientists face funding obstacles for international collaborations owing to the need for more funding programs and travel grants. Grants often limit funding to more than one country in the partnership, which can result in higher costs for collaborations across borders. Collaborators must seek funding independently instead of pooling their efforts for one large grant [34].

Obstacles related to the government, excessive paperwork, and a shortage of opportunities and assistance within institutions and local universities where scientists are based are impeding progress [31].

Demonstrating integrity in research requires conducting culturally responsible research. When research misconduct occurs, it is crucial to develop the capacity of all countries to manage it effectively [39].

According to a study by the Baker Institute, scientists face obstacles from their governments and institutions when collaborating across borders.

Researchers from the United States, China, Taiwan, Hong Kong, and Singapore collaborated on a study to identify the perceived obstacles that impeded their work. Participants faced challenges related to funding and various cultural differences that hindered their progress. Standards for peer review, research ethics, accreditation, and policy and regulatory obstacles, including visa-related issues and intellectual property rights, varied among the differences [30,31].

In 2017, clinical researchers conducted a workshop and survey to identify international collaboration challenges. The primary obstacles identified by most participants were funding, time limitations, academic variations (e.g., cultural disparities and distinct timelines), and research proficiency. Moreover, language significantly impacted the researchers’ capacity to interact and cooperate efficiently [32,33].

Successful models of multinational scientific collaboration

International scientific collaboration has been successful in several instances. One such instance is the Human Genome Project (HGP), which began in 1990. The primary objective of HGP was to sequence DNA and identify and map genes in the human genome. The project was conducted under the joint coordination of the U.S. Department of Energy and the National Institutes of Health, and it was concluded in 2003.

Scientists from 20 institutions across six countries, namely, France, Germany, Japan, China, the U.K., and the U.S., collaborated to carry out the International Human Genome Project [40].

Using a cooperative approach, HGP has transformed the field of biology by decoding the complete sequence of a reference human genome and the sequences of essential model organisms. This endeavor exemplifies the efficacy, significance, and triumph of interdisciplinary and large-scale efforts, commonly known as "big science," to accomplish complex and significant goals. HGP has paved the way for the development of various comprehensive data acquisition initiatives, including the International HapMap Project, 1000 Genomes, The Cancer Genome Atlas, the Human Brain Project, and the Human Proteome Project [41].

In 1954, 12 European countries joined to establish CERN, the European Organization for Nuclear Research. In the aftermath of World War II, collaboration and shared responsibility became essential, forming the basis of CERN's strength and long-term success. CERN has always been an excellent platform for scientific cooperation involving countries beyond the founding members. Over time, more European nations have joined CERN, and several non-European nations have become associate members [42]. CERN's primary focus is on fundamental research in particle physics. However, it also strives to apply its knowledge and technology to other areas, such as healthcare, to increase the social benefits of its research. The laboratory's core objective is to conduct primary research in particle physics. However, it looks for opportunities to transfer its expertise and technological advancements to other domains, including healthcare, to amplify the societal impact of its research [43].
Strategies for effective international scientific collaboration

Recognizing potential conflicts of interest that can arise when collaborating internationally is essential. In addition to issues surrounding authorship and intellectual property rights, sharing medical data between countries and partners can present significant obstacles. Establishing clear data exchange policies in the early stages of collaboration is vital [44].

Developing a strong sense of cooperation and teamwork demands considerable time and energy, particularly in multinational collaborations where language and cultural differences can be obstacles. Trustworthiness, impartiality, and responsibility are crucial elements of fruitful research collaborations, regardless of location [45,46].

Developing and promoting international collaborations can be significantly aided by scientific associations and organizations. Colleagues can communicate science and engage with each other through scientific conferences, making them an essential platform. These conferences provide researchers from various parts of the world with an opportunity to interact with each other and collaborate in the future. Resource-poor countries can benefit from scientific organizations prioritizing speaker invitations and travel awards, which can promote international collaborations. Additionally, scientific organizations can include geographic diversity in their scheduling of sessions [31,36].

Crossing international borders for research requires cultural openness, flexibility, and cooperation owing to differing educational backgrounds, funding patterns, and public policy concerns. When conducting research across international borders, it is essential to maintain cultural transparency, flexibility, and collaboration. This is necessary owing to differences in academic experiences, funding practices, and general policy considerations [47,48].

When pursuing international collaborations, learning the best approaches for achieving successful results is crucial. One key factor in an effective partnership is ensuring that the work styles of the partners involved are compatible. Many researchers opt to collaborate with individuals they are already familiar with and trust, which is why informal interactions frequently result in joint projects [49]. Effective communication between partners is imperative for the success of a collaboration. This involves unambiguous delineation of roles, responsibilities, and recognition for the end product.

Furthermore, effective leadership should properly delegate responsibilities and guarantee that every team member fulfills their obligations and receives adequate evaluations. Team members should refrain from certain behaviors to keep the project on track. Individual variances in personality and the inclination to micromanage colleagues can obstruct collaborative scientific efforts [5,49].

Strategies for practical international scientific cooperation also include creating clear communication channels, building relationships and trust, setting realistic goals and deadlines, and developing a shared vision and mission.

CONCLUSION

Global collaboration among researchers is essential for faster progress on research projects. International collaborative research is standard in many fields, and building intergenerational networks is crucial to ensure that its benefits outweigh its challenges [16]. In conclusion, international scientific collaboration benefits all parties, but careful planning of research cooperation and consideration of human diversity are crucial to its success.

FUNDING

None

References


МЕЖДУНАРОДНОЕ СОТРУДНИЧЕСТВО: ПРЕИМУЩЕСТВА И ПРОБЛЕМЫ

Резюме
Современное состояние науки характеризуется широким диапазоном стилей и практик командной работы. Совместная работа, преодолевая организационные и культурные границы, расширяет горизонты научных открытых. Совместные исследовательские инициативы, выходящие за пределы международных границ, часто дают результаты, превосходящие достижения отдельных команд, работающих в одиночку. Сотрудничество между ученными является важным аспектом развития всех научных дисциплин, особенно в области клинической медицины. Вовлечение культурного и международного разнообразия в проекты может быть полезным для научного прогресса. Однако это также сопряжено с определенными трудностями, потенциальными опасностями и недостатками. Некоторые из выявленных существенных трудностей связаны с физическим расстоянием между людьми и различиями в культуре, языке и карьерном уровне. В этом обзоре будут обсуждаться преимущества и трудности международного научного сотрудничества и стратегии эффективного сотрудничества.

Ключевые слова: международный, сотрудничество, наука, общество, исследования, междисциплинарность.