www.jnsam.com
DOI: 10.22034/nsam.2025.550280.1051
Cite This: *Nanosc Adv Mater* 2025, 2(3): 291-297

NEWS ARTICLE

# From Initial Steps to a Sustainable Network: Pioneering International Nanotechnology Olympiads as a Tool for Science Promotion and Diplomacy

Mahyar Khadem[1,2*], Afshin Ramzi[1], Mohammad Mohammadi[1,3]

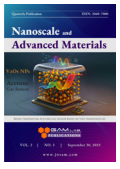
[1] Iran Nano and Micro Technologies Innovation Council (INIC), Tehran, Iran.
[2] Department of Management of Technology, Science and Research Branch, Islamic Azad University, Tehran, Iran.
[3] Department of Management and Industrial Engineering, Malek Ashtar University of Technology, Tehran, Iran.

Science and technology diplomacy (S&T diplomacy) has increasingly been recognized as a tool for fostering international cooperation, particularly through emerging scientific competitions. This paper examines the role of the Islamic Republic of Iran in pioneering national and international nanotechnology Olympiads as mechanisms for science promotion, education, and diplomacy. Drawing on more than a decade of experience with national Olympiads, Iran expanded its model to the international arena by founding both the International Nanotechnology Olympiad for University Students (INO) and the International Nanotechnology Olympiad for High-School Students (INOHS). The study outlines Iran's contributions as the originator, organizer, host, and competitor in these Olympiads, highlighting how the Iran Nanotechnology Innovation Council provided institutional leadership through permanent secretariats, steering committees, and training programs. The analysis further explores Iran's role in shaping competition models that combine scientific knowledge with entrepreneurship, sustainability, and global problem-solving. By embedding educational and cultural elements into these events, Iran has used Olympiads as platforms for innovation-driven diplomacy, creating sustainable international networks and demonstrating how science competitions can act as instruments of global engagement.

**Keywords:** Nanotechnology Olympiad; Iran; Science-driven Diplomacy; Scientific Competitions; International Cooperation

ARTICLE INFO

**Received:** August 11, 2025
**Revised:** September 14, 2025
**Accepted:** September 29, 2025




***Corresponding Author:**
Mahyar Khadem
Email Address: khadem@nano.ir, Fax Number: 00982163106310, Telephone Number: 00982163102405, Postal Address: No. 9, Motavallian Blvd., Habibollah St., Tehran, Iran.
akhlaghi.mh@aut.ac.ir

## INTRODUCTION

Science and technology diplomacy (S&T diplomacy) has emerged as a pivotal tool for fostering international cooperation, particularly for nations seeking to build bridges and enhance their global engagement. As highlighted by Flink & Schreiterer (Flink & Schreiterer, 2010), it operates at the intersection of foreign policy and science and technology strategy. A critical subset of this is technology diplomacy, which focuses specifically on leveraging technological innovation—such as nanotechnology—as both a subject and an instrument of foreign policy. This aligns with the concept of scientific goodwill, where shared scientific endeavors act as a conduit for peaceful international relations (Nazifkar, 2013). For countries with traditionally limited international ties, collaborative initiatives in high-tech fields offer a neutral platform to build trust, facilitate knowledge exchange, and create sustainable networks. This approach transcends political differences by focusing on shared scientific goals and global challenges, thereby opening new channels for mutual understanding and positioning a nation as a valuable partner in the global technology landscape.

Competitive science and technology Olympiads serve as a powerful catalyst for promoting emerging fields like nanotechnology. By engaging young minds in challenging, project-based competitions, these events demystify complex concepts and stimulate interest in cutting-edge research and applications. As highlighted by Blonder & Sakhnini (Bauer, 2021), innovative educational approaches, such as project-based learning in nanotechnology, are crucial for developing a skilled workforce and fostering public engagement with science. These Olympiads effectively translate theoretical knowledge into tangible technological solutions, showcasing the real-world impact of nanoscience. Furthermore, they create a pipeline of talent and generate visibility for the field, accelerating its integration into mainstream education and industry, thereby ensuring its continued growth and development. For decades, international science Olympiads, such as the long-standing International Physics (IPhO) and Chemistry (IChO) Olympiads, have served as cornerstone events for identifying and nurturing top-tier scientific talent globally (Campbell & Walberg, 2010). These traditional competitions have primarily focused on assessing theoretical knowledge and rigorous problem-solving skills within a controlled examination setting. While immensely successful in promoting excellence in core scientific disciplines, their format often remains siloed from the application-oriented and innovation-driven nature of modern technological fields like nanotechnology. This established model, though effective for its purposes, presents a gap by not explicitly incorporating the critical facets of technology translation and entrepreneurial mindset that are essential for driving a field from the laboratory to the market.

Given Nanotechnology's inherently interdisciplinary nature—merging physics, chemistry, biology, and engineering—nanotechnology demands an educational approach that transcends traditional curricular boundaries. National and international nanotechnology Olympiads are therefore not merely beneficial but essential to ignite passion, identify nascent talent, and provide a platform for the next generation of scientists and engineers to grapple with the complex, application-oriented challenges that define this (Bauer, 2021). While traditional Olympiads in core disciplines excel at testing theoretical knowledge, a significant gap remains for a competition format that accurately reflects the full innovation lifecycle in nanotechnology—from scientific insight and technical development to business feasibility and market translation. Our initiative aims to address this critical gap by pioneering a new model for international nanotechnology competitions.

## IRAN NANO AND MICRO TECHNOLOGIES INNOVATION COUNCIL (INIC)

INIC is the country's authority for policy, strategy, and coordination in nanoscience and nanotechnology. Operating under the Vice Presidency for Science, Technology and Knowledge-based Economy, INIC implements the national roadmap for nanotechnology, aiming to position Iran among global leaders in this strategic field. Its responsibilities span from research funding and industrial support to education, commercialization, and international cooperation. INIC plays a vital role in bridging academia, industry, and government, ensuring that nanotechnology research is translated into viable products and services. It actively supports startups and small enterprises, facilitates the development of domestic technologies, and promotes Iran's capabilities abroad through collaborations with international organizations.

A critical component of INIC is its Public Awareness Group, which focuses on science communication and societal engagement. This department ensures that nanotechnology becomes familiar and accessible to public. Its activities include organizing educational festivals, school Olympiads, media campaigns, and exhibitions to spark interest among youth and foster trust in nanotechnology applications.

This structure and its continuous activities over the last two decades, enabled Iran to pioneer the use of nanotechnology Olympiads as a tool for education and innovation at the national level as well the international one for school and university students.

## INTERNATIONAL NANOTECHNOLOGY OLYMPIAD FOR UNIVERSITY STUDENTS

For over a decade, the Islamic Republic of Iran has gained extensive experience in nurturing young talent in nanoscience through its National Nanotechnology Olympiad, held annually since 2009. By organizing 14 consecutive editions, Iran built strong institutional expertise in designing exams, training programs, and evaluation systems, while also cultivating a new generation of scientists familiar with both theory and application. This national experience became the springboard for Iran to take the initiative on a global scale, leading to the creation of the International Nanotechnology Olympiad (INO). Statistics of this national competition over the last 13 years and general trend explaining overall approaches of university students toward the competition are shown below.

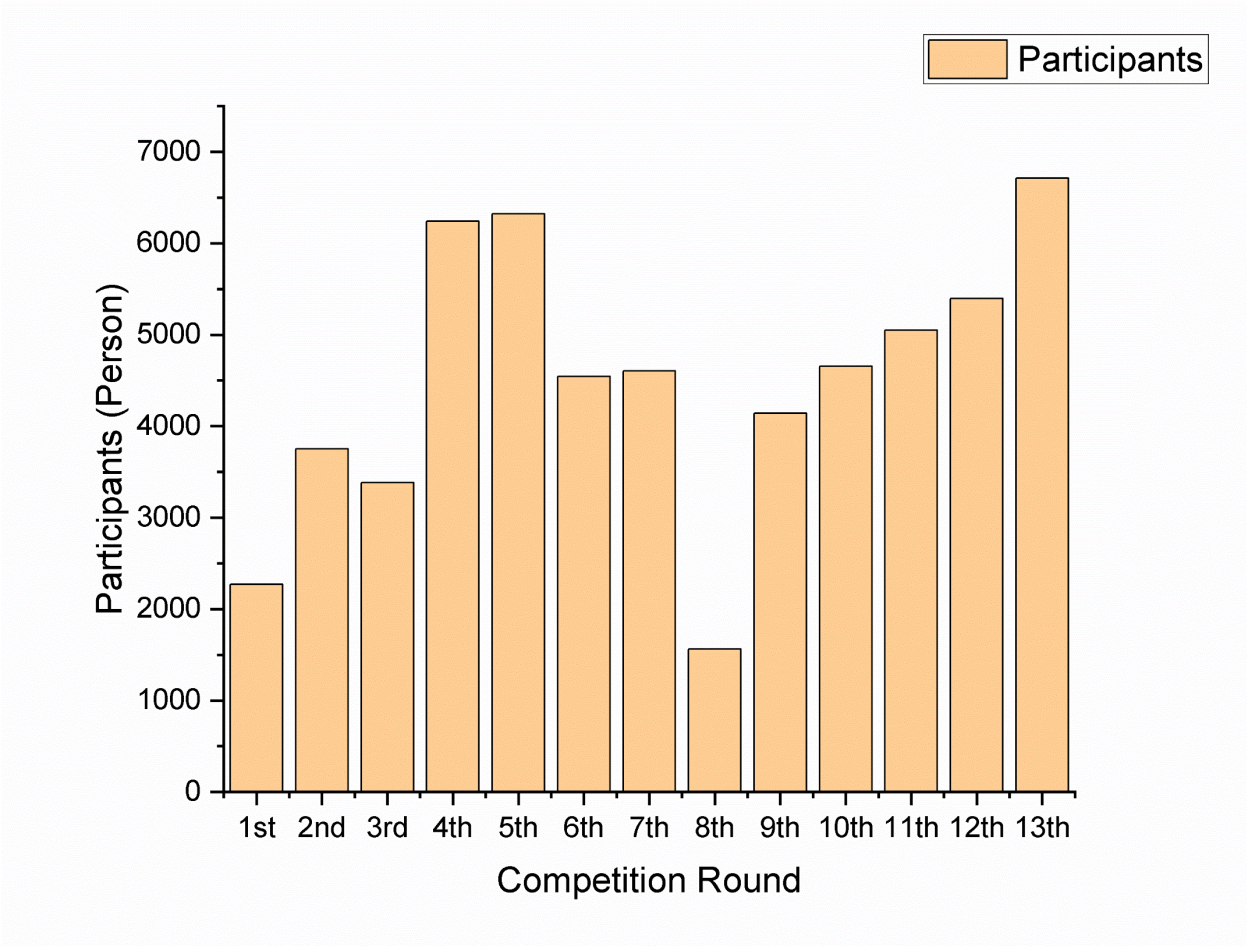



**Figure 1** | Statistics of participants in 13 rounds of the National Nanotechnology Olympiad for university students

**Iran as the Originator:** The idea of an international nanotechnology Olympiad emerged in Iran around 2014–2015, initiated by INIC. Unlike traditional Olympiads focused only on academic exams, Iran envisioned a platform that combined science, entrepreneurship, and global problem-solving. After several meetings with countries including Russia, Malaysia, Singapore, Thailand, South Korea, and Taiwan, Iran finalized the model and committed to hosting the inaugural event.

**Organizational Leadership**: Iran took the lead in forming the International Nano Olympiad Steering Committee and, through INIC as the Permanent Secretariat, became responsible for coordination, drafting bylaws, and promoting the Olympiad abroad. Core decisions—such as adopting the startup challenge format, selecting the first theme on "water and wastewater management," and designing judging criteria—were largely shaped by Iranian leadership.

**Hosting the First Olympiad** (Tehran 2018): The first Olympiad was held at Pardis Technology Park in Tehran (April 10–15, 2018). Iran oversaw all logistics, including venues, ceremonies, accommodation, and cultural diplomacy. Teams from Iran, South Korea, Malaysia, Taiwan, Russia, and the European Union (England, Germany, Italy) participated. Iran also developed

the educational program, providing both online training months in advance and in-person workshops led by Iranian experts on standards, safety, business, and commercialization.

**Iran as a Competitor**: As host, Iran fielded two teams, both presenting innovative projects. One team won a top award, proving that Iran was not only an organizer but also a serious scientific competitor addressing urgent environmental challenges.

**Influence and Legacy**: Iran's central involvement defined the Olympiad's identity: moving from academic exercises to a startup-focused challenge, fostering East–West networking, and embedding cultural elements in awards. Steering Committee sessions in Tehran decided that the Olympiad would recur biennially, securing continuity and legitimacy (INIC, 2018).

**Iran in the Second and the Third Olympiad** (Malaysia 2024): After delays caused by the COVID-19 pandemic, the second Olympiad took place in Malaysia in 2024 with teams from Iran, Malaysia, Taiwan, Thailand, and Hong Kong. Iran remained a pivotal player as a Steering Committee member and Permanent Secretariat, shaping training materials, selecting judges, and safeguarding the original competition model. Beyond competing, Iran actively contributed to policy discussions, emphasizing innovation, sustainability, and environmental challenges as guiding themes. Its role ensured that the spirit of the inaugural event was preserved and extended into the next phase of the Olympiad. The 3rd INO is planned to be hosted by Taiwan in 2026. Preliminary survey done on the participants of final stage of the 14$^{th}$ national Nanotechnology competition shows that approximately 66% of them are encouraged to participate in the competition because it could act as an entrance gate to the 3$^{rd}$ INO. This shows how INO accelerates the flow of elites entering Nanotechnology-related fields in Iran. As other countries excluding Iran, have been nominated as the host of INO for the 2$^{nd}$ and the 3$^{rd}$ round, it can be hoped that expansion of the steering committee and host countries of INO may follow. However, further investigation s are necessary to discuss INO role for Nanotechnology popularization inside other participating countries.


**Figure 2**| Iran's Team, winner of the top award in the 1st INO in 2018 (INIC, 2018).


https://doi.org/10.22034/nsam.2025.550280.1051
*Nanosc Adv Mater* 2025, 2(3): 291-297

## INTERNATIONAL NANOTECHNOLOGY OLYMPIAD FOR HIGH-SCHOOL STUDENTS

The International Nanotechnology Olympiad for High School Students (INOHS) is a newly established global scientific competition aimed at fostering creativity, innovation, and collaboration among talented students aged 16 to 19. Iran has played a central and pioneering role in initiating this Olympiad, serving not only as the founder but also as the host of its first Olympiad in 2025 (INIC, 2025).

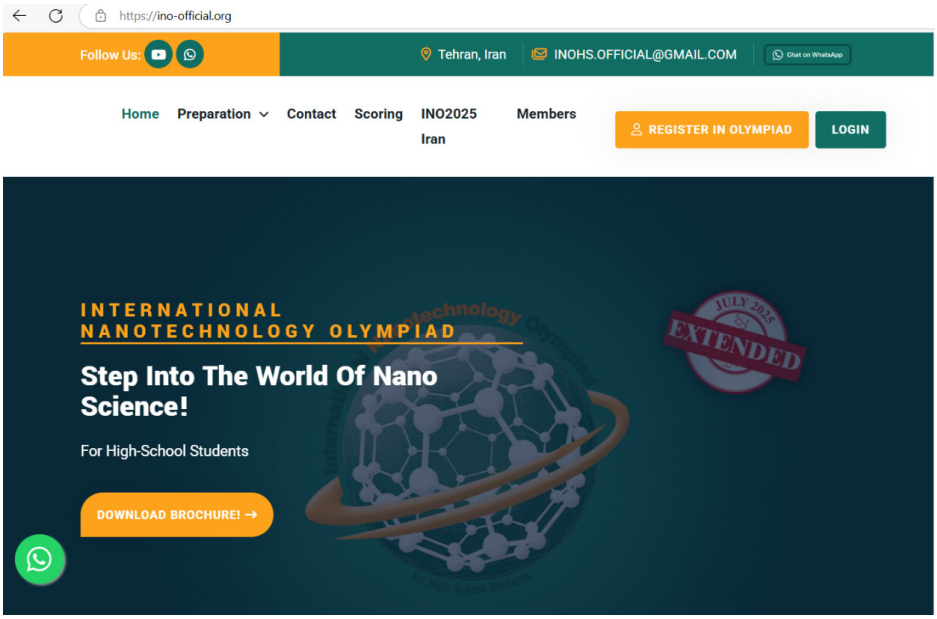



**Figure 3**| Official website of the 1st international Nanotechnology Olympiad for High-school students (INIC, 2025).

Iran is the founder of INOHS, having recognized the strategic importance of nanotechnology for sustainable development and global problem-solving. Since 2009, the country has organized 15 consecutive National Nanotechnology Olympiad for school students. More than 100 thousands of students have participated in this Olympiad over the last 15 years, making it a prestigious popular Olympiad among other interdisciplinary topics (Figure 4). This provides a strong foundation for expanding the initiative to the international stage. By establishing INOHS, Iran sought to transfer its experience to a broader arena and provide high school students worldwide with a structured and inspiring platform to learn, compete, and innovate.

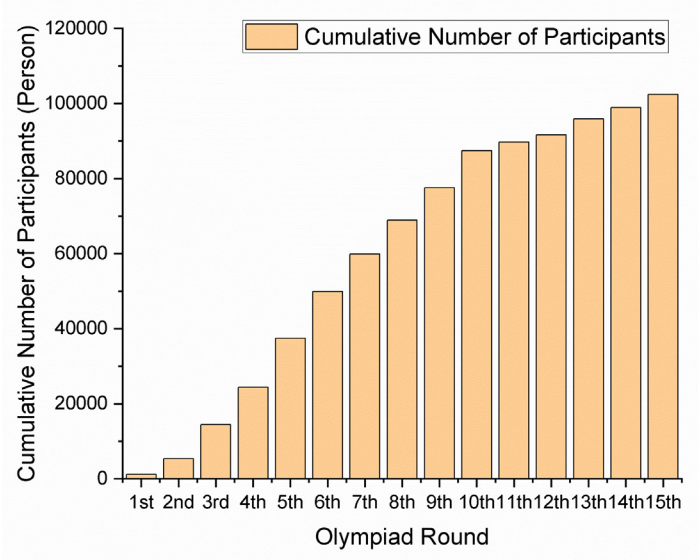



**Figure 4**| Statistics of participants in 15 rounds of the National Nanotechnology Olympiad for high school students

In this sense, Iran's role is not limited to hosting the first Olympiad, but also to designing the competition model, regulations, governance structures, and thematic axes. The executive document of INOHS reflects Iran's leadership in defining both the scientific and organizational aspects of the Olympiad.

**Hosting the First Olympiad:** Iran was the host of the first INOHS Olympiad in 2025. Due to practical considerations and in order to maximize participation, Iran decided to hold the first Olympiad entirely online, ensuring global accessibility. This decision underscores Iran's commitment to inclusivity, knowledge-sharing, and equitable scientific competition. Students from all member countries were granted free access to educational resources, including specialized training modules, booklets, and textbooks on nanotechnology. By waiving participation fees and providing educational content, Iran has lowered barriers for students, particularly from developing countries, to engage in advanced science.


**Figure 5**| Calendar Roadmap for the 1st international nanotechnology Olympiad for High-school students (INIC, 2025).

**Providing Governance and Organizational Structure:** Another key aspect of Iran's role is its involvement in creating the governance framework of the Olympiad. The INOHS Steering Committee (INOStC), Permanent Secretariat (INOPS), and Executive Secretariat (INOES) were first set up under Iran's initiative.

The Steering Committee, in which Iran is a founding member, acts as the highest decision-making authority. It sets the vision, themes, rules, and overall structure of the Olympiad.Other countries including Malaysia and Venezuela are nominated for Steering Committee membership. The Permanent Secretariat, officially managed by Iranian Young Scholars Club in collaboration with the INIC, ensures continuity, long-term goals, and international communication. The Executive Secretariat, hosted by Iran for the first Olympiad, was tasked with the practical execution of the event, including training, exams, ceremonies, and awarding medals. Through these institutions, Iran has ensured that the Olympiad has a robust structure capable of sustaining itself in future editions, even when hosted by other countries.

**Developing the Competition Model**: Iran's scientific experts played a decisive role in designing the two-stage competition model: An online multiple-choice exam assessing fundamental concepts of nanotechnology and the Sustainable Business Model Canvas with a video presentation, encouraging students to connect scientific knowledge with real-world problem-solving, innovation, and entrepreneurship. This innovative model reflects Iran's approach of integrating theoretical knowledge, practical creativity, and sustainability values. By emphasizing global challenges such as water purification, sustainable agriculture, clean air, renewable energy, and advanced healthcare, Iran has shaped the Olympiad into a forward-looking initiative aligned with the world's most pressing issues.

**Educational Contributions:** Iran has committed itself to preparing introductory and advanced training materials for participants. These include specialized booklets, videos, and textbooks covering fundamental and applied aspects of nanotechnology. By doing so, Iran has positioned the Olympiad not just as a competition, but as a learning journey that enhances the skills of all students regardless of whether they win medals.


https://doi.org/10.22034/nsam.2025.550280.1051
*Nanosc Adv Mater* 2025, 2(3): 291-297

**45Financial and Logistical Commitments**: In future physical editions, host countries will cover accommodation, meals, local transport, and cultural programs for participating delegations. For the first Olympiad, Iran has already committed to covering essential infrastructure, digital platforms, and training resources. This ensures a cost-free experience for students, making the inaugural Olympiad globally inclusive.

Iran's role in the International Nanotechnology Olympiad for High School Students is both foundational and visionary. By initiating the Olympiad, hosting the first Olympiad, and providing organizational, educational, and financial support, Iran has ensured that INOHS starts on a strong and inclusive footing. Its emphasis on sustainability, entrepreneurship, and global challenges reflects a forward-thinking perspective that will benefit students worldwide. In essence, Iran has laid the groundwork for a scientific competition that not only identifies talent but also equips the next generation with the tools to contribute meaningfully to science, technology, and society.

## CONCLUSIONS

In conclusion, this study demonstrates that the Islamic Republic of Iran has strategically established itself as a pivotal actor in the global nanotechnology landscape through its pioneering role in international Olympiads. By leveraging over a decade of domestic experience, Iran successfully transitioned from a national to an international stage, founding and institutionalizing the International Nanotechnology Olympiad (INO) for university and high-school students. Under the leadership of the INIC, Iran's contribution extended beyond mere hosting; it involved conceptualizing a unique competition model that deliberately merges deep scientific knowledge with entrepreneurship and sustainability, aiming to address pressing global issues.

The successful adoption of this framework by subsequent host nations like Malaysia and the planned expansion to Taiwan stand as a testament to the model's durability and the diplomatic networks Iran has cultivated. These Olympiads function as effective instruments of innovation-driven diplomacy, fostering international scientific cooperation and positioning Iran as a center of STEM education and initiative.

However, the assessment of this diplomatic tool is not without its caveats. The study's reliance on Iranian institutional sources and the current lack of quantitative data on long-term impacts—such as career trajectories of participants or tangible research collaborations—present limitations. Future research must incorporate comparative international perspectives and rigorous empirical evaluation to fully measure the scientific and diplomatic returns. Despite these challenges, Iran's orchestration of these Olympiads undeniably illustrates how competitive scientific platforms can be harnessed to build sustainable international networks and project scientific soft power on the global stage.

## REFERENCES

Bauer, J. (2021). Teaching Nanotechnology through Research Proposals. Journal of Chemical Education, XXXX. https://doi.org/10.1021/acs.jchemed.0c01251

Campbell, J. R., & Walberg, H. J. (2010). Olympiad studies: Competitions provide alternatives to developing talents that serve national interests. Roeper Review, 33(1), 8-17. https://doi.org/10.1080/02783193.2011.530202

Flink, T., & Schreiterer, U. (2010). Science diplomacy at the intersection of S&T policies and foreign affairs: toward a typology of national approaches. Science and Public Policy, 37(9), 665-677. https://doi.org/10.3152/030234210X12778118264530

INIC. (2018). Winners of the first International Nanotechnology Olympiad (INO) were announced. en.nano.ir

INIC. (2025). INO 2025 Iran. ino-official.org

Nazifkar, G. (2013). New frontiers in science diplomacy. Popularization of Science, 3(1), 67-71.