Academicians' Science Popularization Practices Under the Grand Science Popularization Strategy: Reflections and Recommendations (Postprint)

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Abstract

Science and technology popularization (hereinafter referred to as "science popularization") serves as the two wings of integrated development and has become one of the most fundamental factors determining the level of national material and cultural development and national creativity. Academicians of the Chinese Academy of Sciences and Academicians of the Chinese Academy of Engineering (hereinafter referred to as "academicians"), as outstanding representatives of China's scientific and technological community, have actively undertaken social responsibilities for science popularization and played important roles during different historical periods of development in our country. As we enter the stage of high-quality development and face numerous challenges brought by the knowledge explosion and the digital era, promoting the transformation of science popularization concepts, achieving high-quality supply of science popularization, constructing a grand pattern of science popularization, planning a grand strategy for science popularization, and empowering the process of Chinese-style modernization with high-quality science popularization have become important tasks for the new era. Based on the characteristic analysis and practical experience of science popularization conducted by the academician community (hereinafter referred to as "academician science popularization"), this article reexamines the role and significance of academician science popularization from a new historical perspective, and proposes reflections and recommendations on better leveraging the role of academicians to promote the prosperous development of science popularization undertakings.

Full Text

Preamble

Throughout the history of technological development and human civilization, major scientific discoveries and technological innovations have profoundly influenced the rise and fall of great powers while transforming human production, lifestyle, and modes of thinking. In the historical process where science reshapes human cognition and technology drives global transformation, science popularization (hereinafter referred to as "popularization") plays a vital role in enlightening public wisdom and promoting comprehensive human development. The Party and the state have always attached great importance to popularization work. Particularly since the 18th Party Congress, General Secretary Xi Jinping has repeatedly issued important instructions on popularization work and put forward a series of new ideas and judgments. The 20th Party Congress has drawn a grand blueprint for comprehensively advancing the rejuvenation of the Chinese nation through Chinese modernization, explicitly emphasizing the strengthening of national popularization capacity building, which points the way for promoting high-quality development of China's popularization cause at a new historical starting point.

Since the founding of the People's Republic of China, China's popularization cause has made considerable progress, with citizens' scientific literacy continuously improving. In 2022, the proportion of citizens with scientific literacy increased to 12.93% . Scientific and technological workers, especially academicians of the Chinese Academy of Sciences and the Chinese Academy of Engineering (hereinafter referred to as "academicians"), while making scientific and technological innovations, have actively engaged in popularization at the front line and made positive contributions to building an innovative country. As China enters a new stage of high-quality development, the height of scientific and technological innovation and the cultivation of innovative talents urgently require strong support from popularization. People urgently need to improve their scientific literacy to cope with the drastic changes in production and lifestyle brought about by rapid technological development. Ultimately, modernization is the modernization of people. Facing the needs of the times and the expectations of the people, better leveraging the role of the academician community to assist the Chinese modernization process through high-quality popularization has become an important proposition. Based on analysis of the characteristics and practical experience of popularization conducted by academicians (hereinafter referred to as "academician popularization"), this article reexamines the role and significance of academician popularization within the broad science popularization strategy, and proposes thoughts and suggestions for better leveraging the leading and driving role of the academician community to serve Chinese modernization with high-quality popularization.

Characteristics of Academician Science Popularization

Social psychologist Hovland and others established the two-dimensional Source Credibility Model (SCM) theory through experimental research based on the two decisive factors of information source "professionalism" and "trustworthiness," which has become a classic in mass communication theory. SCM theory holds that when audiences subjectively perceive an information source as more professional and trustworthy, they are more likely to believe or accept the information—in other words, higher source credibility leads to better communication effects. For popularization work, popularization personnel are important information sources. High-quality popularization depends on their solid foundation of scientific knowledge, profound understanding of science, and ability to transform this knowledge into popularization language and presentation forms easily accepted by the public. As outstanding representatives of China's scientific and technological community, the academician community is not only an important force in promoting high-level scientific and technological self-reliance but also a crucial group practicing high-quality popularization, possessing unique characteristics and significant advantages.

(1) Unique Demonstration and Leading Effect. As leading figures in China's scientific and technological innovation, academicians possess strong academic influence, team cohesion, and personal charisma. Through personal practice and leading by example, they convey popularization concepts, dispel the misconception that scientists engaging in popularization is a "waste of talent," and will radiate to drive more scientific and technological workers to participate in popularization. Simultaneously, by combining popularization practice, academicians can keenly grasp the relationship between popularization and scientific and technological innovation, further promoting government and society-wide attention to popularization work. For example, in the 1950s, Academician Hua Luogeng actively advocated for the application and popularization of science, transforming profound mathematical principles into understandable and easily applicable coordination methods and optimization methods (collectively called the "double methods"). He took these to fields, factories, and mines for promotion, mobilizing government, enterprises, scientists, workers, and peasants to participate together. The effective promotion of the "double methods" became an important force serving national economic development. Hua Luogeng's philosophy—"I will use one shoulder to carry the load of delivering goods to the doorstep, bringing scientific knowledge and tools to workers; the other shoulder can serve as a ladder for young people to climb higher peaks of science"[1]—had a tremendous influence on encouraging more scientific and technological workers to actively participate in popularization.

(2) Unique Scientific Authority Effect. Gustave Le Bon, founder of group psychology, pointed out that when individuals form a group, they become emotionally infected by each other, causing individual behavior patterns to differ greatly from when they are alone. People readily accept group opinions and ideas and blindly imitate others' behaviors and attitudes within the group.

Therefore, one important psychological characteristic of group behavior is the worship of authority[2]. Meanwhile, group actions also influence the direction of individual behavior. Each academician has deep expertise in their respective field, remains active at the international forefront of science and technology, and possesses profound academic achievements and broad scientific perspectives. They can transform the latest research results and academic hotspots into relatively accessible popularization knowledge, providing more professional and rigorous scientific explanations. For example, at the end of the 20th century, when feudal superstitions resurfaced, academicians raised the banner of science and provided scientific basis for the nation's countermeasures[3]. The *Academician Popularization Book Series*, compiled by over a hundred academicians, won the second prize of the 2005 National Science and Technology Progress Award . This was the first popularization work to receive a national science and technology award and was widely praised by the media as "great scientists writing small books." In recent years, in response to public concerns about hot technological topics such as genetically modified organisms and artificial intelligence, the "Science and Technology Hotspot Reviews" organized by the Academic Divisions of the Chinese Academy of Sciences represent exemplary works of academician popularization that address public cognitive needs.

(3) Unique Spiritual Inspiration Effect. The history of China's scientific and technological development since the founding of New China fully illustrates the patriotic dedication and innovation-for-the-people sentiments of generations of scientific and technological workers, as well as their ideals and beliefs in pursuing truth and climbing scientific peaks. Academicians serve as a banner for the pursuit of scientific spirit, possessing rich life experiences and scientific research expertise. They are particularly likely to generate "role model effects" and "inspiration effects" for adolescents in their scientific enlightenment period, better stimulating young people's curiosity, imagination, and desire to explore, making more youth fall in love with science and aspire to research. For example, academicians frequently visit primary and secondary schools in remote mountainous areas to conduct face-to-face popularization activities with students, broadening their scientific horizons and building their scientific dreams. Many well-known and respected academicians have personally written popularization works. For instance, Li Siguang's *Geological Light*, Zhu Kezhen's *Marching Toward the Desert*, Mao Yisheng's *Chinese Stone Arch Bridges*, and Hua Luogeng's *Coordination Methods*, all published in the 1950s and 1960s, have become renowned classics that convey innovation spirit and stories through academician popularization.

Practical Experience of Academician Science Popularization

For a long time, the prevailing view both domestically and internationally has been that the scientific community should become the main body of popularization. Especially with the rapid development of science and technology, the role that the scientific community can play in society will continue to increase[4]. For

example, the Royal Society's publication *The Public Understanding of Science* established the basic theory of public understanding of science and represents a landmark document in the history of popularization[5]. In recent years, the Royal Society has fully leveraged its members to actively carry out public understanding of science movements, establish dialogue between science and all sectors of society, and set up annual science communication awards. The U.S. National Academy of Sciences, National Academy of Engineering, and National Academy of Medicine have also actively leveraged the role of academicians in organizing and publishing book series, science and technology exhibitions, and establishing communication awards for the public[6].

The "Science and China" Academician and Expert Lecture Tour (hereinafter referred to as "Science and China") is a typical case of China's academician community fulfilling its social responsibility for popularization. Initiated in 2002 by the Chinese Academy of Sciences and jointly organized with the Publicity Department of the CPC Central Committee, Ministry of Education, Ministry of Science and Technology, Chinese Academy of Engineering, and China Association for Science and Technology, "Science and China" is a high-level public welfare popularization activity aimed at leveraging the leading and driving role of academicians in popularization. It has been awarded the honorable title of "National Advanced Collective in Science Popularization"[7]. The activity has organized over 2,000 popularization lectures by academicians and experts in primary and secondary schools, Party schools, government agencies, industrial and mining enterprises, military barracks, and rural towns and villages. Its footprints cover more than 30 provincial-level administrative regions in China, generating extensive and positive social impact, particularly in Hong Kong and Macao. Through extensive cooperation, it has organized various types of activities combining online and offline formats, including lecture tours on innovation-driven development, ecological civilization construction, face-to-face meetings between academicians and primary and secondary school students, series lectures on scientific thinking and decision-making, and lectures on scientific ethics and academic style construction. These activities have played a positive role in implementing major national strategies, cultivating innovative talents, and improving citizens' scientific literacy.

(1) Focusing on Major National Strategies to Serve Innovative Development. Centering on the revitalization of Northeast China's old industrial base, Western Development, ecological civilization construction, and Guangdong-Hong Kong-Macao Greater Bay Area development, "Science and China" has organized academicians and experts to conduct popularization lecture tours at the grassroots level. For example, in 2004, a lecture tour covering over 5,000 kilometers was conducted around the old industrial base in Northeast China, focusing on ideological concepts, industrial structure, and development models. It was praised as "illuminating the white mountains and black waters with the light of wisdom" . In series activities such as the Tianshan North-South Academician Tour and the Academician and Expert Bamin Tour, academicians and experts actively offered suggestions and advice

on major, difficult, and hot issues concerning regional economic development. Many scientific and reasonable opinions and suggestions were incorporated into local economic and social development plans.

(2) Focusing on Key Populations to Help Build a Talent Power. For young people, academicians and experts have been organized to conduct face-to-face exchanges in primary and secondary schools and universities. According to statistics, popularization lectures for primary, secondary, and university students account for about 46% of the total "Science and China" lectures, with those for primary and secondary students accounting for 27%. Particularly, the face-to-face activities between senior academicians (academicians aged 80 and above) and primary and secondary school students have allowed young people to experience the spiritual demeanor and personal charisma of veteran scientists up close, cultivating not only their scientific knowledge but also their patriotism. Meanwhile, the *Science Enlightenment* micro-lectures produced for different educational stages—primary school, junior high school, and senior high school—have been used in classroom teaching by hundreds of schools in Guangdong, Hong Kong, Macao, and other regions, enriching and expanding the content and forms of science education. For leading cadres, academicians and experts have been organized to conduct series lectures on scientific thinking and decision-making at state organs such as the National People's Congress, as well as at the Party School of the CPC Central Committee and local Party schools, helping them understand scientific and technological development trends and further improving their scientific decision-making capabilities. For teachers, students, and researchers in universities and research institutes, hundreds of lectures on scientific ethics and academic style construction have been organized. For military officers and soldiers, activities have been actively organized to bring popularization into military camps, forming targeted series of courses.

(3) Focusing on Public Concerns to Meet Social Needs. In response to hot technological topics of social concern, the professional advantages of academicians have been fully utilized to guide the public in correctly understanding and scientifically recognizing hot issues and emergencies through television interviews and new media communication. For example, in 2003, multiple television interview programs on "Relying on Science to Overcome SARS" were planned in cooperation with China Central Television and broadcast in 18 other countries and regions, timely publicizing and reporting Chinese scientists' efforts in fighting SARS and responding to domestic and international public needs and concerns. In 2020, the "Science and China" Cloud Lecture Hall was launched to provide online explanations and interactions on safeguarding children's and adolescents' mental health during the COVID-19 pandemic, viruses and vaccines, carbon neutrality and climate change, volcanic eruptions, etc., with simultaneous live streaming through multiple media platforms, generating enthusiastic responses.

Overall, from individual actions to collective actions and from individual knowledge to collective knowledge aggregation, "Science and China" has fully lever-

aged the cohesion and appeal of the academician community, forming a comprehensive, systematic, multi-field, and multi-level popularization lecture system. The advantage of leveraging the scientific community for popularization lies in the fact that academicians' expertise covers all fields of natural sciences and engineering technology, meeting the popularization needs of different populations and enabling more comprehensive and systematic popularization in specific directions. Particularly, video courses developed for young students can serve as extensions and supplements to school science education, forming synergy with it. Meanwhile, exchanges and collisions within the scientific community help reduce barriers caused by highly specialized disciplinary divisions, promote a favorable ecosystem for collaborative innovation, and thus stimulate the endogenous momentum of scientific and technological innovation. More importantly, when individual knowledge merges into collective wisdom, it will help provide strategic consulting research solutions for important propositions in the high-quality development of the popularization cause.

Contemporary Needs for Academician Science Popularization

Currently, science and technology are developing rapidly, research paradigms are evolving at an accelerated pace, knowledge is exploding, knowledge update cycles are constantly shortening, and the complexity and uncertainty of both domestic and international environments continue to increase. The nation urgently needs more high-quality talents with greater innovation vitality to empower high-level scientific and technological self-reliance, and society urgently needs high-quality popularization to help substantially improve public scientific literacy. Particularly in the face of the basic national condition of a huge population size, using high-quality popularization to enhance people's scientific literacy, transform their ideological concepts, and promote their comprehensive development is not only an important mission in advancing Chinese modernization at the current stage but also highlights the tremendous potential and severe challenges of empowering modernization with a huge population through popularization. In the process of empowering Chinese modernization through popularization, from value guidance to high-quality popularization supply, to broad popularization framework construction, and then to broad popularization strategy planning, there is an urgent need for the academician community to play a greater leading role.

(1) The Transformation of Popularization Concepts from Knowledge Dissemination to Value Guidance Requires Greater Roles for Academicians. From the proposal to popularize scientific knowledge in the *Common Program of the Chinese People's Political Consultative Conference* in 1949 to the "March Toward Science" and "Springtime of Science"[8,9], from the promulgation and implementation of the *Law of the People's Republic of China on Science and Technology Popularization* to General Secretary Xi Jinping's emphasis at the 2016 National Conference on Science and Technology Innovation, Academician Conference of the Two Academies, and the Ninth National Congress

of the China Association for Science and Technology (collectively known as the "Three Science and Technology Conferences") that "scientific and technological innovation and science popularization are the two wings of innovative development, and science popularization should be placed on an equal footing with scientific and technological innovation," and then to the 20th Party Congress report's identification of "strengthening national science popularization capacity building" as an important measure for improving the social civilization level, China's popularization work has always adhered to a people-centered approach and fulfilled its historical missions in various periods[10,11]. Entering the new development stage, the interactive integration of popularization with scientific and technological innovation and science education has become closer. The public's ability to identify social risks and participate in social governance, as well as the demand for lifelong learning, has become more urgent. Innovative talents need to be cultivated, and the fertile ground for innovation needs to be continuously enriched. The concept of popularization must inevitably shift from focusing primarily on disseminating scientific knowledge to establishing scientific concepts, cultivating scientific spirit, fostering innovative spirit, and creating an innovation atmosphere. To shift the focus of popularization work to the grassroots level and make science the underlying logic and conscious habit of rational thinking and action for the vast majority of the public, the academician community needs to play a greater role as pioneers in practicing the new era's popularization concepts.

(2) The Shift from Extensive to Intelligent High-Quality Popularization Supply Requires Greater Roles for Academicians. Currently, popularization resources such as science and technology museums, museums, popularization education bases, and major infrastructure open to the public are flourishing, while new media and online popularization resources are increasingly abundant, continuously broadening public access to information. Popularization content creation has become more diverse, with initiatives like "Science Cafés" that promote scientist-public interaction in a harmonious atmosphere, popularization supporting rural revitalization, and livelihood-focused popularization giving the public greater sense of identification and gain. Popularization is moving from the traditional media era into the integrated media era. However, we must also be keenly aware that misconduct in science and technology news reporting occurs from time to time, making it difficult for the public to distinguish authentic from false scientific information, and the spread of "pseudo-popularization" online poses significant harm. Popularization supply must inevitably shift from a "flood irrigation" approach to professional, timely, and precise high-quality popularization. To integrate intelligent information technology, create a batch of high-quality popularization works, strengthen emergency popularization, promote the organic integration of popularization with culture and art, and provide rich content and diverse forms of high-quality popularization supply for the general public, the academician community needs to play a greater role as leaders in high-quality popularization.

(3) The Construction of a Broad Popularization Framework from

Government-Led to Whole-Society Collaboration Requires Greater Roles for Academicians. For a long time, China's popularization work has relied primarily on government promotion. With the continuous deepening of popularization concepts and missions, an increasing number of social forces have actively participated in the popularization cause. Market-oriented and industrialized operation models for popularization supply have continuously emerged, adding strong momentum of multi-subject participation and whole-society action to popularization work in the new era, and providing more solutions to problems such as inefficient resource allocation and insufficient vertical coordination, as well as helping to overcome the "last mile" challenge in popularization services. Currently, lifelong learning has become a public necessity, the application of scientific and technological achievements to benefit people's livelihood has become a public aspiration, and issues such as climate change, life and health, and scientific ethics have become major global concerns. Seeking the broadest social consensus[12], maximizing innovation vitality, promoting shared scientific and technological achievements, and advancing sustainable development all urgently require popularization capacity support. The construction of a broad popularization framework featuring Party leadership, government promotion, multi-subject participation across society, and an international perspective requires the academician community to play a greater role as pioneers in building this framework.

(4) The Strategizing of Broad Popularization from Concrete Practice to Top-Level Design Requires Greater Roles for Academicians. In recent years, China's popularization cause has achieved considerable development with fruitful practical results. However, understanding of popularization across society still needs strengthening, and the institutional construction to place "science popularization" on an equal footing with "scientific and technological innovation" requires continuous improvement. Under the new situation of building future development through continuously improving citizens' scientific literacy, adhering to the joint efforts of popularization practice and strategic research and doing well in top-level design are important tasks for promoting the prosperity and development of the popularization cause. General Secretary Xi Jinping pointed out the need to "strengthen the national high-end think tank functions of the two academies and give play to the role of strategic scientists." Conducting strategic, forward-looking, and reserve research on important propositions such as popularization serving economic and social development, popularization serving comprehensive human development and innovative talent cultivation, popularization talent team building, and popularization rule-of-law construction[13-15], and giving play to the guiding role of popularization strategy on popularization practice, requires the academician community to play a greater role in providing solutions to both practical and long-term development issues facing the high-quality development of the popularization cause.

Suggestions for Academician Science Popularization to Better Fulfill New Missions

Whether as individuals or through the scientific community, academicians have persisted in disseminating advanced scientific culture, vigorously promoted scientific spirit and scientist spirit, shouldered the missions of the times, actively practiced social responsibilities, and implemented the "Two Wings Theory" and "Broad Science Popularization Strategy" through practical actions, generating demonstration, driving, and cohesive radiation effects across society. Facing new requirements for strengthening national popularization capacity building and better leveraging the role of academicians, the leading role of academician popularization will become more prominent. To promote high-quality development of popularization work, it is also necessary to strengthen popularization team building, formulate popularization action plans, promote high-quality popularization creation, and do well in popularization strategy planning.

(1) Build a Number of Popularization Teams with Multi-Party Collaboration Among Academicians, Young Scientific and Technological Workers, Popularization Professionals, and Media Workers. Relying solely on the academician community to achieve continuous supply of high-quality popularization content and reach expected effects is far from sufficient. Consideration could be given to forming several large popularization teams with academicians as the core and young scientific and technological workers as the backbone. Among them, young scientific and technological workers would be responsible for content production, while popularization professionals and media workers would handle content transformation and use new media to achieve broader dissemination. Meanwhile, relying on the academician expert team, explore the establishment of a popularization information review and approval mechanism to avoid phenomena such as "pseudo-science."

(2) Launch and Implement a Number of Organized Popularization Action Plans. It is recommended to further leverage the cohesive force of popularization platforms such as "Science and China," mobilize academicians and experts to systematically carry out popularization activities, and spread the seeds of science across the motherland. Further organize academicians to enter primary and secondary schools and universities to develop science education, continuously contributing to the strategy of invigorating the country through science and education and strengthening the nation with talents. Further promote the popularization of high-end scientific research resources from national strategic scientific and technological forces, provide appropriate policy support, drive more enterprises and industry sectors to participate, and bring more scientific and technological achievements to benefit the broader public.

(3) Promote the Creation of a Batch of High-Quality Popularization Works. Rapidly evolving digital technology is continuously driving changes in human thinking patterns and providing broader space for the creation forms and functional roles of high-quality popularization. It is recommended to sup-

port academicians and other scientists and engineering and technical personnel in creating original popularization works, encourage collaborative creation between scientific and technological workers and literary and artistic workers to produce popularization content that is accessible and enjoyable to the public, and make full use of modern information technology to promote the new media transformation of popularization content and the visualization of expression methods, telling China's innovation stories at multiple levels and from multiple perspectives.

(4) Produce a Batch of High-Level Popularization Think Tank Outputs. Give full play to the role of academicians and other strategic scientists, hold high the banner of the "Broad Popularization Concept," and further enhance the whole society's understanding that "science popularization" and "scientific and technological innovation" are equally important. Conduct forward-looking research on the internal relationships between popularization and the in-depth implementation of the strategies for invigorating the country through science and education, strengthening the nation with talents, and driving development through innovation in the new era, and provide more strategic and actionable opinions and suggestions for better promoting the integrated development of national education, science and technology, and talent.

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Note: Figure translations are in progress. See original paper for figures.