

Research on the Operation Mechanism of Science Popularization Bases Based on Actor-Network Theory

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Abstract: Government-led, multi-stakeholder participation in social mobilization mechanisms and market-oriented operational models are important characteristics of the development of science popularization in the new era. Based on Actor-Network Theory, this paper employs methods such as questionnaires and structured interviews to analyze and sort out the relationships between various actors through the four steps of problem definition, interest allocation, recruitment, and mobilization in the translation process. The study examines the role of the Science and Technology Association (STA) as the core actor in the operational process, identifies the interests and obstacles of various actors, and proposes suggestions to better improve the operational mechanism of science popularization bases from aspects such as strengthening policy guidance, establishing alliances of science popularization base interests, and enriching the forms of activities at science popularization bases.

Keywords: Science Popularization Base, Actor-Network Theory, Operation Mechanism

1. Introduction

Science popularization bases play a crucial role in enhancing national science literacy and the scientific knowledge of the general public. In recent years, the government has introduced several policies emphasizing the strengthening of science popularization base construction, encouraging various industries to establish science education and research bases, improving the capacity for science popularization services, and expanding the science popularization functions of public facilities. In 2021, the China Association for Science and Technology (CAST) issued the “Measures for the Creation and Recognition of National Science Popularization Education Bases,” defining science popularization education bases as exemplary sites established by institutions from various fields and open to the public. Existing research on science popularization bases primarily focuses on policy formulation related to the construction of these bases, summarizing experiences, identifying existing problems, and evaluating assessments. This paper employs Actor-Network Theory (ANT) to systematically organize the unequal and opposing relationships among various elements during the operation of science popularization bases, aiming to fully leverage the roles of these elements to form an organic and dynamic network. Based on this framework, the elements of science popularization bases are transformed into “actors,” and the operation mechanism of these bases is reconstructed.

Each actor's interests and obstacles are analyzed individually to provide valuable insights for further improving the operation mechanism of science popularization bases.

2. Theoretical Foundation and Literature Review

2.1. Overview of Actor-Network Theory

In the mid-1980s, the Paris School of the Sociology of Scientific Knowledge, represented by French sociologists Bruno Latour, Michel Callon, and John Law, proposed Actor-Network Theory (ANT)[1]. According to ANT, actors include both human actors (such as organizations and individuals) and non-human actors (such as materials and concepts). In this system, human and non-human actors hold equally important positions[2]. Michel Callon introduced two key concepts of ANT: "translation" and "obligatory passage point." "Translation" refers to the process by which actors describe the problems and interests of other actors using their own symbolic systems, while the "obligatory passage point" refers to the crucial juncture that must be navigated during the translation process. The translation process involves four main steps: problematization, interessement, enrollment, and mobilization. ANT emphasizes "connections" rather than "entities" in its critical analysis, viewing actors themselves as translators within heterogeneous associations. Through "obligatory passage points," actors create an instantaneous network of translations that connect them[3]. The application of ANT in the field of science communication includes analyzing public participation in science projects[4], researching the moralization of technology and science popularization mechanisms[5,6], and studying science communication media. These applications provide valuable insights for the feasibility of this study.

2.2. Research Progress on Science Popularization Bases

Firstly, activities related to science popularization bases. Bernard Schiele emphasizes the participatory nature of the public in science communication, suggesting that activities at science popularization bases such as lectures, exhibitions, competitions, forums, science experiences, and science popularization dramas are effective ways for the public to directly engage in scientific activities[7]. Open laboratories in universities and research institutes, science popularization projects at tourist attractions, and science activities in primary and secondary schools as well as enterprises and public institutions utilizing their unique resources all play significant roles in enhancing public interest in science. Moreover, science popularization bases backed by enterprises focus on providing interactive experiential activities, forming unique markets[8,9].

Secondly, the operation of science popularization bases mainly focuses on evaluating operational mechanisms[10], exploring market-oriented operation models[11], innovating management mechanisms[12], and examining development models and operational statuses domestically and internationally[13]. These studies provide valuable references for domestic contexts. However, despite in-depth analyses of the operational mechanisms and policy recommendations for science popularization bases, there is still a lack of research exploring the interests, obstacles, and interaction processes of stakeholders from a systematic perspective. This offers a new perspective for future research directions.

3. Research Design

This study utilizes questionnaires and structured interviews to identify and summarize the issues present in the operation of science popularization bases. By applying Actor-Network Theory, the study deeply analyzes the operational mechanisms, examining the relationships between various actors as well as the obstacles and benefits they face. The research investigates the operational status

of science popularization bases in Area A, involving project managers of science popularization bases, government departments, Science and Technology Association (STA) organizations, and the general public. Area A, as the core district of Beijing, is endowed with abundant science popularization resources and advantageous geographical and research conditions, making it a suitable subject for this investigation. The survey covers 60 science popularization bases in Area A, including research and development, education, and media bases. However, the questionnaire response rate was relatively low at 21.67%. To enhance the acquisition of valid information, the research team conducted field visits and interviews with seven bases. The interview content was aligned with the questionnaire design, and all sessions were recorded and transcribed into written materials.

4. Data Analysis and Discussion

4.1. Data Analysis

Based on the data collected from questionnaires and interviews, the main findings are as follows:

(1) Low Participation Enthusiasm Among Management Entities: During the survey, the participation of science popularization base managers was low, facing issues such as outdated information, unclear attitudes, and low communication efficiency. The busy summer period also affected their willingness to participate.

(2) Insufficient Investment in Construction:

Infrastructure: Nearly half of the bases lack sufficient equipment.

Talent: Over 60% of the bases have fewer than 20 science popularization personnel.

Funding: Most units have an annual budget of less than 300,000 yuan for science popularization activities, indicating limited actual investment in science popularization.

(3) Limited Forms and Audiences of Science Popularization Activities:

Target Audience: Activities primarily target adolescents, with a lack of programs for other demographic groups.

Activity Forms: Activities are mainly in the form of courses and lectures, lacking interactivity and diversity.

Online Resources: There is insufficient development of online science popularization resources and low utilization of digital resources.

(4) Prominent Issues of Policy Support and Funding:

Policy Support: The main difficulty identified is the insufficient support from government science popularization policies.

Funding: Financial shortages are a significant constraint on the development of science popularization bases. Future improvements should focus on broadening funding sources, expanding the talent pool, establishing incentive mechanisms, and accelerating content updates.

4.2. Case and Interview Analysis Based on Actor-Network Theory

4.2.1. Identification of Actor Components in the Operation of Science Popularization Bases

Actor-Network Theory focuses on the practical activities of various actors within science popularization bases and their dissemination processes. This study reveals that actors within science popularization bases include governmental bodies, scientific associations (SciTech associations), businesses, public participants, organizers as human actors, as well as research equipment, venues as material actors, and policies, systems as consciousness actors. These actors interact through the following mechanisms: governmental bodies, SciTech associations, and other institutions provide support and resources; project organizers and public participants are the main actors in activities, enhancing public scientific literacy and skills through policy guidance and activity design; science

popularization exhibits serve as the foundation for activities; and policies and systems ensure the smooth operation of science popularization activities. See Table 1 for details.

Table 1: Composition of the Actor-Network in Science Popularization Bases

Type	Category	Examples
Human Actors	Organizations	Government departments STA organizations Enterprises and other market entities
	Individuals	Project organizers Public participants
	Material Realm	Science popularization exhibits
Non-Human Actors	Conceptual Realm	Policies, systems

4.2.2. Analysis of the Translation Process

This section analyzes the obstacles and interests of actors and proposes solutions based on the four translation steps: problematization, interessement, enrollment, and mobilization. It provides an in-depth explanation of the interest alliance within the actor-network of science popularization bases. The analytical framework is shown in Figure 1.

(1) Problematization – Identifying Core Actors:

In Actor-Network Theory, core actors hold authority, responsible for proposing common goals, resolving conflicts, and coordinating the network's actors. The construction of science popularization bases requires resources and equipment from various forces to support activities. Although policies, equipment, and resources play leading roles, they are not core actors. The public, due to differences in knowledge and skills, cannot assume a coordinating role. Based on the goals of science communication and societal needs, government departments and STA organizations establish common goals to enhance the effectiveness of science popularization activities. STA organizations play a key role in the planning, construction, resource coordination, and product development of science popularization bases and act as a bridge to strengthen communication between bases and the public. Therefore, STA organizations are identified as core actors.

(2) Interessement – Analyzing Interests and Obstacles:

In constructing the actor-network of science popularization bases, actors' interest motivations are diverse. By addressing the interest needs and obstacles faced by each actor, the actors can be reshaped to form the "key points" for the operation of the science popularization bases.

This study first collects and organizes interview data, starting with the question "What do you think is the role of identifying science popularization bases?" and categorizes the interest factors in their answers into: enhancing recognition and visibility; convenience and coverage of science popularization activities; and improving resource utilization efficiency. The data collected from the interviews on "current problems encountered in science popularization activities" is classified into several aspects: differences in audience cognition; lack of technical support; lack of institutional guarantees; lack of funding; and difficulties in coordination and management. Based on the interview data, this study summarizes the interests and obstacles of the actors in science popularization bases, identifying the key point in interest allocation as "enhancing the operational capability of science popularization bases and improving their operational mechanisms." The analysis of interests and obstacles is detailed in the "Interessement" section of Figure 1.

In the actor-network of science popularization bases, the STA organization, as the core actor, organizes and coordinates science popularization resources, guides the participation of government departments and institutions, and ensures active participation from all parties. The STA organization

coordinates resource flow to project organizers and enterprises, granting certain permissions to market entities and forming a model of multi-stakeholder participation.

(3) Enrollment – Incorporation of Actors

The core actors attract other actors into the network through negotiation, removing obstacles, clarifying goals, and assigning corresponding tasks. As a core actor, the STA organization plays a crucial role in the activities of science popularization bases. On one hand, it needs to attract human actors such as public participants and project organizers into the network based on the project plans. On the other hand, by coordinating research resources, scientific research equipment, and policies, it provides the necessary support in terms of resources, equipment, and guarantees for the operation of science popularization bases.

(4) Mobilization – Formation of the Interest Alliance

Mobilization occurs after the core actors have negotiated with other actors, leading them to act according to the established plan and efficiently organizing all actors within the network to form an interest alliance aimed at achieving the goals. Public participants and project organizers are the main participants in science popularization bases. Research has found that the enthusiasm for science activities, especially among young people, needs to be enhanced. Project organizers can use online platforms to design diverse participation modes and interactive games to stimulate public interest. Enterprises and other market entities should utilize their diversified management capabilities to efficiently use science popularization resources. As the core actor, the STA is responsible for guiding, task allocation, and resource coordination to ensure the stable operation of the entire actor network. Thus, the actor network for the operation of science popularization bases is established, with the STA evolving from an initial mobilizer to the most central actor within the network. It guides other actors, allocates tasks, coordinates resources, and through attraction and encouragement, ensures the smooth operation of the entire actor network until the completion of activities.

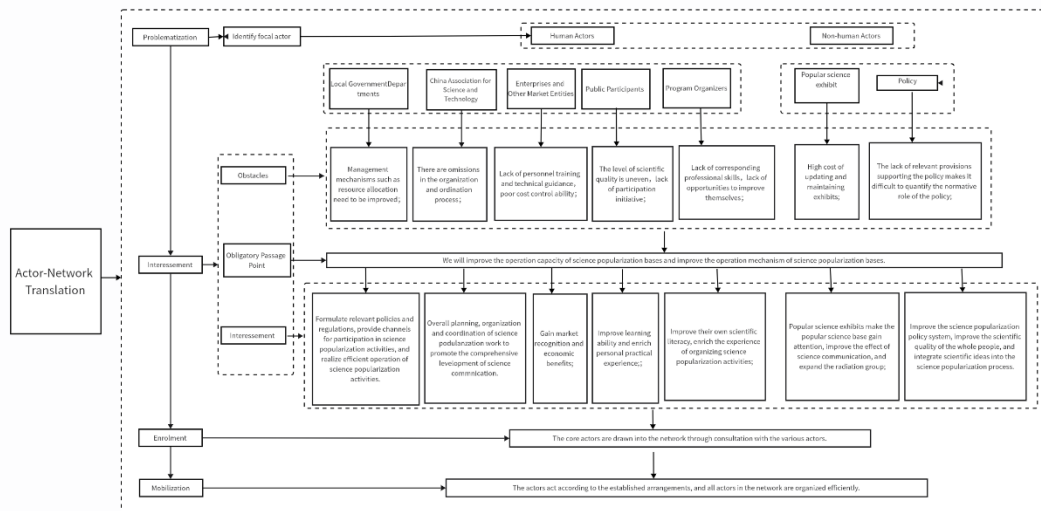


Figure 1: Translation Process of the Operational Mechanism of Science Popularization Bases

5. Conclusion and Recommendations

Based on Actor-Network Theory, this study examines the operation of science popularization bases in District A of Beijing, summarizing the current status and issues. It identifies the core actors in the operation of these bases, clarifies the obstacles and interests of each actor, and analyzes and reconstructs the operational mechanism of science popularization bases through the four translation steps: problematization, intersement, enrollment, and mobilization.

The study finds that the construction and operation of science popularization bases in District A face challenges such as relatively insufficient investment, a limited audience and activity formats, and inadequate policy support. The reconstruction results based on Actor-Network Theory highlight the pivotal role of STA organizations as core actors in the operation of science popularization bases. They are crucial for the overall planning and management of these bases, coordinating the interests and obstacles of various actors, driving the efficient operation of science popularization bases, promoting policy formulation and improvement, and advancing the development of science popularization efforts.

To further improve the operational mechanism of science popularization bases, this study proposes the following recommendations:

(1) Strengthen Policy Guidance and Financial Investment: Ensure that funding for science popularization bases is included in the annual budget and increase investment to guarantee daily operations and maintenance. Clarify the details of fund usage, such as equipment updates and talent development, to enhance science popularization capabilities. Encourage science popularization bases to expand publicity efforts and attract diverse funding from social organizations and enterprises.

(2) Establish a Science Popularization Base Interest Alliance: Share resources and cooperate interactively to encourage the investment of social resources in science popularization work, facilitating orderly resource flow. Build an information-sharing platform to promote the coordinated development of public welfare science popularization and commercial science popularization industries, thereby enhancing the scientific literacy of the general public.

(3) Diversify Science Popularization Activities: As the key actor, STA organizations should actively promote various science popularization activities, make full use of science popularization resources, and innovatively tailor the science popularization methods of bases. This will support the high-quality and sustainable development of national science popularization bases.

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