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Characteristic Analysis and Optimization Path Analysis of Emergency Science Popularization

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Abstract: As a basic project to improve public awareness of disaster prevention and reduction and self-rescue capabilities, emergency science popularization has important practical significance in the context of severe disaster risks in my country. This article analyzes the current status of domestic emergency science popularization and points out that there are problems such as loose legal system, unbalanced communication channels, uneven layout of venues, and insufficient public emergency literacy. On this basis, combined with the uniqueness of emergency science popularization - emphasizing experience and skill training, paying attention to "disaster weak", focusing on scene construction and time sensitivity, an optimization path is proposed: from the aspects of rigid constraints of regulations, integration of communication channels, balanced layout of venues, content segmentation and skill-based design, etc., promote the transformation of emergency science popularization from theoretical indoctrination to practical empowerment, and provide support for the modernization of the national emergency management system.

Keywords: Emergency Science Popularization; Vulnerable Groups; Optimization Path.

1. Introduction

Humanity has had to face disasters since its existence. In the second decade of the 21st century, human society is facing more and more profound risks and disasters. As a large country with a vast territory and a large population, China suffers from frequent natural disasters, multi-modal risks and intensified secondary hazards. According to statistics from the official website of the Ministry of Emergency Management, natural disasters across the country caused a total of 25.037 million casualties in the first half of 2025, with direct economic losses reaching 54.11 billion yuan [1]. It can be seen that it is very urgent to improve people's awareness of disaster prevention and reduction and their ability to save themselves. Relevant knowledge is the basis for disaster prevention and reduction awareness and self-rescue capabilities. Therefore, in the face of current severe disasters, the widespread and popularization of emergency knowledge has become a systematic basic project.

Emergency knowledge is the most directly relevant knowledge for ordinary people to deal with disasters. Emergency science popularization is a key bridge connecting scientific knowledge, public policies and public actions. Therefore, exploring the current status of the promotion and popularization of emergency knowledge (i.e. emergency science popularization) in China is the basis for in-depth research. So look back at the history of domestic emergency science popularization. In the early days, the dissemination of emergency science knowledge was generally classified as a broad science popularization undertaking. Since the SARS incident in 2003, when the country first proposed the construction of an emergency management system at the government level, emergency response knowledge is taking shape as part of the emergency science knowledge dissemination system [2].

2. Current State of Emergency Science Popularization in China

The current domestic promotion and popularization of disaster knowledge generally have the following characteristics and problems:

First of all, at the national level, since the "Overall Implementation Plan for Emergency Management Science Popularization" issued by the State Council in 2005, various laws and regulations on emergency science popularization have gradually taken shape. At present, a regulatory framework for emergency science popularization with the "Emergency Response Law of the People's Republic of China" as the core and covering more than 60 laws and regulations has been initially formed [3]. However, the legal framework surrounding emergency science popularization still faces structural dilemmas such as a loose system, many flexible advocates but a lack of rigid constraints, ambiguous rights and responsibilities mechanisms, and "emphasis on disposal and neglect of prevention."

Secondly, due to historical development reasons, the dissemination of domestic emergency knowledge is mainly concentrated on online platforms, and traditional media represented by newspapers and radio and television stations are still relatively small, so that some scholars believe that in China, "mainstream media emphasizes propaganda, and platform self-media emphasizes science popularization." [4]

Thirdly, since 2005, the construction of domestic bases and venues for emergency science popularization has achieved certain results. Especially since the establishment of the Ministry of Emergency Management, various venues for emergency science popularization have developed to a certain extent. However, the construction of domestic venues for emergency science popularization experience is still unevenly distributed. That is, there is sufficient development of emergency science popularization experience halls in economically developed provinces, but there is a certain lag in economically underdeveloped provinces. Cities are

relatively complete, but there are certain gaps in rural areas.

Finally, under the existing emergency science popularization framework, public emergency literacy is still significantly insufficient, with significant differences among various age groups and obvious differences between different educational backgrounds. For example, a survey in 2022 showed that younger groups are more accepting. 50.8% of those aged 6-25 have received crisis education, while only 12.3% are over 60 years old. The proportion of people over 60 who have not received education reaches 7.2%, the highest among all age groups. The higher the education level, the higher the degree of attention and understanding. 29.3% of the undergraduate group are "very concerned and understand", and only 2.3% of the junior high school and elementary school groups [5]. These data not only reveal the seriousness of the reality of disasters, but also reflect that the people's ability to prevent and reduce disasters and save themselves is a weak link in disaster prevention and control.

3. Characteristics of Emergency Science Popularization

Although emergency science popularization is a type of popular science knowledge in a broad sense, the popularization of emergency knowledge is the basis for awareness of disaster prevention and reduction and self-rescue ability, and is of "significant importance" in daily life. The effectiveness of emergency science popularization is related to the "vulnerability" of society, and is an important foundation for the modernization of the national emergency management system. Therefore, to determine the difference between emergency science popularization and general science popularization, it is particularly important to anchor the characteristics of emergency science popularization:

1. Emergency science popularization should not be a one-dimensional knowledge transfer, but should be integrated into self-rescue skills training, so that correct response measures can be taken in the event of a disaster or accident. Therefore, in view of the seriousness of the knowledge and skills imparted by emergency science popularization, science popularization itself should go beyond the scope of cognitive construction, based on enhancing the risk awareness of ordinary people, improving the knowledge system related to disasters and accidents, and expanding the emergency skills of ordinary people [6]. Therefore, the biggest feature of foreign emergency science popularization is its emphasis on experience based on traditional knowledge teaching. For example, a similar emergency science popularization education in Japan, namely DIG disaster safety training, refers to the integration of Disaster (disaster), Imagination (imagination), and Game (game). Around the unfolded map, we jointly discuss known information and simply think about disaster response strategies. It is a science popularization activity that emphasizes disaster response training methods [7].

2. Compared with general science popularization, emergency science popularization should pay more attention to the "disaster weak". That is to say, the form and content of emergency science popularization should target the elderly, women and children, as well as the weak in the sociological sense of disasters such as those with low education. Surveys have proven that people over 60 years old and with low education receive less or less disaster education, and the popular science content they know is severely limited, and most of it is theoretical. The disasters involved are almost all disasters of high social concern such as fires, floods, earthquakes, etc., but the public lacks coping skills [8]. In particular, the vulnerable people affected by disasters, represented by the elderly, are limited by their own physiological conditions. These people have a serious lack of self-rescue ability and will be seriously threatened by their lives once they are hit by a disaster. A report jointly released by the United Nations Office for Disaster Risk Reduction (UNISDR) and HelpAge International on October 13, 2014 pointed out that the proportion of elderly victims in disasters such as floods and hurricanes is very high, but the elderly are ignored in disaster management planning. Report statistics show that three-quarters of the deaths caused by Hurricane Katrina in 2005 were over 60 years old. In the 2011 earthquake and tsunami in Japan, 56% of the dead were over 65 years old [9]. At the same time, a major disaster accident that occurred in a nursing center in a city in North China in July 2025, resulting in the death of 31 people [10], once again proved that the elderly, a type of disaster-vulnerable people, should become an important target of emergency science popularization.

3. Emergency science popularization needs to fully consider the construction of trigger scenarios. After entering the 21st century, with the continuous advancement of science and technology and the continuous popularization of new technologies, the promotion and development of emergency science popularization is, in a sense, concentrated in the restoration of the emergency response environment, that is, the construction and restoration of scenes during the outbreak of disasters and accidents, which have achieved considerable development with the help of various scientific and technological means. Under the traditional model, disaster emergency science education tests the imagination and abstract thinking ability of ordinary people [11]. The lack of imagination and abstract thinking ability is directly reflected in the cognitive construction and imaginative restoration of scenes such as natural disasters and accidents. Therefore, from the perspective of the effect of emergency science popularization alone, the realistic experiential science popularization at science popularization sites is bound to be better than the emergency science popularization through VR/AR display, even better than the emergency science popularization based on various video media dissemination, and should be far better than the textual science popularization through traditional paper media.

4. The time factor is particularly important in the construction process of emergency science popularization. Compared with the general form and content of science popularization, the premise of emergency science popularization due to its emergency characteristics should be to gain time. Time is the lifeline in the face of disasters and accidents. In the face of any disaster, "racing against time" is the optimal consideration for emergency response actions. For example, the internationally recognized "golden 72 hours" after the occurrence of geological disasters, taking the rescue and disaster relief after the Tangshan earthquake as an example, the relationship between rescue time and rescue rate is: the rescue rate within half an hour is 99.3%, the rescue rate on the first day is 81%, the rescue rate on the second day is 53.7%, the rescue rate on the third day is 36.7%, the rescue rate on the fourth day dropped to 19%, and the rescue rate on the fifth day was only 7.4% [12]. It is precisely because of the suddenness, urgency, and destructiveness of disasters that the

construction of the emergency science popularization process should fully consider the self-rescue time concept of ordinary people. Fully implementing self-rescue measures in a short period of time should be the capability goal of the emergency science popularization construction. As far as emergency science popularization is concerned, the more fundamental thing is to allow the public to construct risk perceptions about disasters and accidents from the time dimension, that is, the subject's subjective psychological cognitive activities in the time dimension about the presence or absence of a specific risk, the source of the risk, the degree of risk level, the evolutionary path and even the future outcome of the risk [13].

Objectively speaking, after entering the 21st century, emergency-related science popularization has actually been widely developed. However, based on the many major emergencies in my country in recent years and the high number of disaster victims, it can be judged that there is still a large gap between the actual situation and the goal of establishing a complete awareness of disaster prevention and reduction and building self-rescue capabilities. Ordinary people have biased perceptions of major disasters and accidents, and their self-rescue capabilities and skills in emergencies are still weak.

4. A Preliminary Study on Pathways for Enhancing Emergency Science Popularization

So based on the current status of emergency science popularization and the unique characteristics of emergency science popularization itself, the directions for improvement are generally as follows:

1. Improve the legal system and shift from "soft advocacy" to "hard constraints". It is necessary to incorporate emergency science popularization into the rigid constraints of the top-level system design, that is, to promote special legislation or regulations revision from the perspective of emergency science popularization construction: to further incorporate emergency science popularization into consideration in the next revision of the implementation details of the "Emergency Response Law of the People's Republic of China", or to formulate a similar "National Emergency Science Popularization Work Regulations" to clarify the statutory responsibilities and obligations of government departments at all levels, enterprises, universities, middle and primary schools, and various media in emergency science popularization, and to solve the problem of ambiguous rights and responsibilities.

2. Integrate communication channels and build a “all-area, all-time” communication matrix. It is recommended that top-level designs such as legislation should be used to further give play to the core role of domestic mainstream and authoritative media in the process of emergency science dissemination, and further clarify the social responsibilities of newspapers, radio, television and other authoritative media, and use their credibility to make up for the shortcomings of platform self-media information fragmentation and lack of accuracy through the establishment of relevant emergency science columns (such as "Crisis Moments" and "Safety Lectures", etc.), and further realize the integration of mainstream media "propaganda" and "science popularization".

3. Optimize the setting and layout of science popularization bases and promote the "balanced and inclusive" layout of experience venues. Since science popularization venues are the most colorful emergency science popularization experience and theoretically have the best effect, it is recommended that the national level coordinate the implementation of regional support plans, and focus on supporting the construction of emergency science popularization experience halls (centers) in the central and western regions and underdeveloped provinces through fiscal transfer payments, "East-West Collaboration" counterpart support, etc., to narrow regional gaps; promote the digital upgrade of existing science popularization halls, and comprehensively popularize the use of AR\VR experience equipment, and then Simulate earthquakes, fires, floods and other disaster scenes that are difficult to reproduce at low cost, achieve "immersive" science popularization, and break through site and cost constraints; further promote diversified science popularization platforms based on the development of large RVs, which can be equipped with AR\VR experience equipment to simulate earthquakes, fires and other scenes, and regularly go into rural areas, schools, and remote communities, thereby using a flexible method to deliver science knowledge and "emergency experience" to people's doorsteps.

4. The dissemination forms and links of popular science content are “focused” and “skilled”. The embedding of big data and artificial intelligence technology provides support for accurately distinguishing audiences for emergency science dissemination in the new era. It can promote the implementation of “applying policies based on people” and achieve the “focused” and “skilled” form and links of popular science content dissemination. In the specific implementation, it is necessary to focus on the "disaster vulnerable" such as the elderly and disabled people to carry out targeted assistance: combine their cognitive characteristics to design popular and easy-to-operate emergency science content and presentation styles; rely on big data to correlate actual scenarios for accurate push, and use AI to analyze individual learning behaviors to dynamically optimize content output to help this group improve their cognitive level and practical skills in dealing with sudden disasters.

5. The communication form of emergency science popularization should also focus on strengthening "scenario construction" and "skill training": combined with the characteristics of emergency science popularization analyzed above, the content of emergency science popularization must be centered on "how to do it", and pure theoretical indoctrination in the implementation of science popularization needs to be avoided. "Experiential" venue science popularization should be promoted on a large scale in areas with mature conditions, which can effectively improve the general public's ability to deal with emergency situations. For example, by setting up multi-level simulation scenarios (such as initial fire disposal, secondary disaster chain reaction response, etc.), the public can be guided to complete practical skills training such as standardized operation of fire extinguishers, emergency avoidance, emergency evacuation route planning, etc. in an immersive experience. It can also be equipped with a "training-assessment-review" closed-loop mechanism to strengthen muscle memory and conditioned reflexes through repeated practice. At the same time, communities and schools can be combined to regularly carry out periodic and targeted training, and key skills such as emergency avoidance and emergency self-rescue can be transformed into some form of competition to increase public participation enthusiasm in an interesting way and ensure the

in-depth transformation of emergency skills from "knowing" to "being able to use". In order to achieve the ultimate goal of emergency science popularization, we can enhance the public's awareness of disaster prevention and their self-rescue ability in the face of sudden disasters.

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