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RESEARCH ARTICLE

An Overview of Theoretical Researches on Science Communication and Popularization in China

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ABSTRACT

This paper discusses the development of theoretical researches on Science Communication and Popularization (SCP) in China. The article claims that the research on SCP is continuously expanding. The theoretical research looks into interdisciplinary communication and integration, the disseminators and audiences, new media and modes of SCP. The paper concludes that theoretical research becomes further systematic adapting to social development and technological progress of China.

Keywords: Science Communication, Science Popularization, New Media, Disseminators, Audiences.

Introduction

Science communication and popularization has already been involved in China's economic and social development strategies. In order to meet this demand, the researches on SCP are continuously expanding deep into interdisciplinary communication and integration. Theoretical researches have become more systematic in approach in China.

Concept Innovation and Development of SCP

In China, for a long time, there have been two different research paths for science communication and popularization. One, science communication research focuses on theoretical research which is deeply influenced by western philosophy of science, sociology and communication and two, science popularization

researches focus on practical research taking Chinese social context into account with its aim to rethink and discuss the Chinese practice of science communication.

Many researchers firmly make a point that the development stage and standpoint of the above two views are different. So, the two views are relatively independent and the development in the two areas has not reached effective consensus. However, with the development of science and technology (S&T), the increasing communication and exchange of ideas of researches into Chinese science communication and science popularization, especially more researches considering social contexts of China, makes the understanding of science communication and science popularization the combination and integration. So we use the term 'science communication and popularization' (SCP) in this paper.

Communication and Integration of SCP Concept

Science communication reflects the specific idea and value appeal of western science communication. Conceptually, the public understanding of science, science communication studies are a western import (Liu and Hou, 2004). The term 'science popularization' is derived from the Chinese practice of SCP. It is based on Chinese social context of science communication. From the perspective of the history of hundred years, science popularization is mainly a kind of activity, tool or means, rather than a theory (Liu and Hou, 2004). Moreover, with development of science communication in China, its meaning is becoming more and more abundant and inclusive. Although the concepts and contents of science popularization and science communication were different in written narratives, their nature is the same (Zhu, 2010). It was believed that science popularization was a product with Chinese characteristics.

In other countries, the contents that were part of science communication were actually included in the concept 'Chinese science popularization'. In China, 'science popularization' was a term with Chinese characteristics. It was not possible to replace 'science popularization' completely by any other concept. Actually 'Public Understanding of Science' was 'science popularization' in Britain (Zhu, 2010). In fact, the two traditions

cannot have complete demarcation, but they have many overlapping parts (Liu, 2002). Professor Ren Fujun directly treated science communication and science popularization as the same (Ren and Zhai, 2012). He believed that this expression of science popularization could adapt to the needs of scientific, technological and social development in China. Science popularization laid the important foundation for improving scientific literacy, promoting public understanding of science and developing scientific culture in the society. It can act as an important tool for democratic dialogue and public participation in science. This expression 'popularization' helped to emphasize the importance of S&T popularization in China.

The authors made a point that using the term to discuss issues in China, aimed to make a corresponding concept with a maximum inclusiveness. It not only reflects the requirements of modern S&T for social development, adapted to the actual conditions of Chinese contemporary SCP, but also facilitated us to discuss the problems on the traditional science popularization and public understanding of science at different levels. Science popularization is a process and **its** concept is developing. Therefore, the author considered that 'science popularization had not been 'science popularization' in traditional sense but modern science communication beyond the traditional 'science popularization' (Ren and Zhai, 2012)

Ontology Trace of Science Communication and Concept Development of Three Types of Science Popularization

Why is science communication possible? Professor Huang Shijin tried to lay the foundation for SCP from the perspective of ontology. Historically, it is believed that technology is a way of revealing. Technological communication 'was not just a means but also a revealing method of 'In-der-Welt-sein' (Huang, 2012). From the epistemological point, he believed that rationally and irrationally, the combined effect should run through the whole process of science communication. He also added that the value of science communication is the integration of the 'spirit of science' and the 'spirit of democracy' (Huang, 2012). The ontological discussion of SCP enables us to understand deeper the meaning of science communication and popularization. Hong

Yaoming further extended understanding of science popularization. He pointed out that science popularization should include three aspects: practical science communication, cultural science communication and civic science communication. In fact, three aspects of science communication reflect China's (as a developing country) demands on S&T development in the age of 'post-academic science' (Hong, 2012).

Introducing 'Risk Society' Concept into SCP and Highlighting the Integration of Natural Science and Social Science

With the rapid development of S&T, many technologies have gradually exposed the risks associated with these technologies. The 'risk society' concept makes us realize that SCP is always disseminating limited information and thus transforming into incomplete knowledge. Risks often occur beyond the scope of knowledge, so we can never eliminate risks. Scholar Yuan Juzheng believed that the origin of SCP was not an issue about 'how should do', but about 'how to get the most probable safety.' Therefore, the application of science was no longer an issue about improving the national scenario, but how to strengthen the public recognition of science in order to trust scientific development (Yuan, 2012). In fact, Science Squirrels Club used network media to disseminate scientific knowledge at the time of Japanese nuclear leakage, which is the best reflection of science communication under risk society.

In the risk society, there is a growing need to combine SCP with humanities (Yuan, 2012). Scholars such as Sun Yu believed that traditional science popularization is entering a stage of science communication. The contents of communication should not only comprise natural science knowledge, but also increase the scientific contents in humanistic vision. This vision paid attention to the relationship between science, society and scientific ethics that reflected the new humanism (Sun and Zhang, 2012). These new features of modern science require science communication to combine natural science, social science and culture and should integrate the spirit of science and humanity (Chen, 2012). The introduction of 'risk society' concept has been reshaping our understanding of traditional science popularization in China.

Researches on the Disseminators and Audiences of SCP in the Process of Social Transformation

With the transformation of China's economic and social development, some researchers reexamined the subject and object and discussed the issues about the responsibility and trust in SCP.

Expanding the Researches into the Subjects of SCP

The subject of science communication is the initiator of science communication behavior. The communicator of information plays an important role in science communication activities. Governments, universities and institutes constituted the most important subjects of SCP in China. It has been a focus of scholarly discussion on 'how to have the subjects, a role in SCP'. Professor Li Haoming stressed that Natural Science Foundation of China (NSFC) had become an important part of national knowledge innovation system (Li, 2012). He proposed an idea to build the science communication system of NSFC.

The author claimed that the information of results, talents, platforms generated from NSFC were worthy to be disseminated to the public. In addition, the scientific idea, method, spirit, management system and experiences generated by scientific community in the process of scientific exploration should also be communicated to the target groups (Li, 2012). Master Li Simin made a comparative study on the science communication education of NSF in USA and China. She pointed out that science communication of NSF established a system of public participation, adopted diversified ways of communication and encouragement of researchers' participation and improved external and internal organizational system in America. Comparatively, there had been the insufficiency of science communication, incomplete security system and limitation of channels of communication for audiences in China (Li, 2012). Jia Hepeng believed that China should enhance quality-oriented education of science communication in higher education. He thought that internationally renowned universities such as Massachusetts Institute of Technology and Columbia University provided proper experiences for Chinese colleges and universities (Jia, 2011).

Researcher Li Han Jin pointed out that the service capacity of science popularization should be improved in two aspects:

'soft skills' such as policy, management and system, and 'hard skills', such as science popularization talents and encouraging college students to carry out science popularization. In China, universities and scientific research institutes had always played an important role in national scientific and technological innovation, but it is still limited in respect to SCP (Li, 2013). Professor Xie Qingguo pointed out the importance of scientific community in activities related to SCP. He believed that, on one hand the scientific community creates platform for scientists to disseminate their scientific achievements, and on the other hand it is an ideal communication stage for scientists to obtain information and stimulate innovation. It was very conducive for scientists to join a scientific community to spread their ideas. On the contrary, innovative achievements of scientists outside the scientific community would always be obstructed and questioned in the dissemination process (Xie, 2009).

Dr Sun Hongxia considered that the role of female scientists has been ignored in China for SCP activities. Moreover, from the audiences' point their psychology and scientific orientation were ignored and the image of science communication has been misunderstood (Sun, 2012). With the further development of China's market economy, the subjects of SCP are also gradually changing from the government to enterprises. With the development of the relationship between technology and society, the research funds for promoting the development of S&T knowledge are gradually converted from the original research programmes to private enterprises. So information providers responsible for science communication have been changing from country to enterprises (Bauer, 2008). It represented a paradigm shift in the field of science communication for the main body changing from the government to enterprises (Yuan, 2012).

Responsibility of Science Communication and the Mass Media Need for a Code of Conduct for Science Communication

The codes of conduct and ethical issues have become increasingly prominent in the process of SCP, so more and more researchers focus their research on these issues. Zhang Zeqi believed that the Chinese media is lacking in fulfilling social

responsibility, and has serious tendency to scientism, apart from the poor scientific literacy among S&T journalists (Zhang, 2011). These factors led to the decline in the quality of media reporting, which could mislead readers/viewers in some ways. The author thought that the media which acts as a bridge between the public and science, should shoulder social responsibility, such as weakening the scientism, raising science and technology awareness, improving the scientific literacy of S&T journalists so as to make the public understand science. Li Weiwei believed that the national government is not sensitive to science communication subjects and also lacks in taking effective measures. There were some problems on the part of the media as journalists do not have appropriate science background, utilitarian nature of the media and insufficient supervision on media (Li, 2012). Therefore, the author put forward the strategies to enhance the responsibilities of government, scientists, media and non-governmental organizations from policy, mechanism, management and training. There is an urgent need for mass media to develop science communication code of conduct. Researcher Wu Yishan believed that scientists are the main actors of science communication, but the effects of communication can only be observed after being reported by the mass media. Because of the lack of a clear code of conduct in scientific communication, the mass media has not played appropriate role in communication. He took *Code of Conduct and Guideline for Science Communication and Health Care Communication* issued by Research Center of Social Issues of Britain under the support of British Royal Academy, as an example, and summarized nine aspects of codes of conducts in S&T.

Diversified Development of Audiences of SCP

Changing from the transmitter-oriented phase to the receiver-oriented phase, audiences of science communication are diversified. Researchers noted that the relationship between science and citizens is under shift: SCP is changing from semi-closed status to fully open one; from the trend of transmitter-oriented to that of audience-oriented; from unitary value to multiple values; from cultivation of S&T talents to improvement of scientific literacy; and from ‘teaching students in accordance

with their aptitude' to 'people-oriented education' etc. (Sun and Zhang, 2012).

With the development of S&T, contemporary audiences of science communication have broadened horizons. Higher level of education and more independent capacities for thinking and judgment among audiences has a significant impact on science communication. The development of network technology has made a fundamental change in the relationship between the communicators and the audiences. The pattern of science communication is shifting; 'audience-based' is being replaced by the 'transmitter-based' communication (Zhang, 2012). 'Network communication' is quite prevalent in the country and it has become a new member of the audience. In the network communication, whether it is the communicators or receivers of scientific information, all were the users of network media. More and more audiences were able to receive or spread information through the network media. They were both, the participants of communication activities and the cryptographers of communication symbols. They were both, the consumers of information and the respondents of communication effect (Zhang, 2012). The challenge on 'Spiral of Silence' issued by the network audiences can show the 'Matthew Effect'. The role of passive information recipients, consumers and objects would be terminated, however it would be replaced by the role of searchers, interlocutors and conversationalists (Zhang, 2012).

The actual strategies of SCP suitable for Chinese conditions should be implemented for the peasants. Scholar Hou Bingnao pointed this out using peasant-oriented strategies where the focus is on narratives. The traditional science popularization lags far behind the development and prevailing conditions of rural areas in enhancing the scientific literacy of the peasants. He believed that the current rural science popularization should be changed from traditional mode of 'mandatory enlightenment' to 'non-mandatory influence'. The communication strategy should pay more attention to include agricultural development and use of language accepted by the peasants, easily (Hou, 2009). Moreover, in Chinese rural areas, interpersonal communication still plays an important role in science communication and popularization. Scholar Zhang Feng discussed the importance of

conversation in improving the scientific literacy of the peasants. He specially suggested that we should give emphasis on the cultivation of 'opinion leader' in science communication and popularization under the influence of both traditional media and new media (Zhang, 2013).

Researchers have attached importance to make SCP for college and university students. Researcher Li Chengfang pointed out that the China government neglected science popularization education for university students with lack of guarantee mechanism and incentive mechanism (Li, 2013). He claimed that there were two points for strengthening science popularization among university students; firstly, to improve their scientific literacy; secondly, raising university students' awareness of science popularization work and making them play an important role in promoting science. Therefore, Li Chengfang suggested that the support mechanism should be improved (Li, 2013). At the same time we should explore different effective forms of science popularization, as well as special incentives for teachers and students in universities and colleges, so as to encourage them to join the creation and implementation of SCP.

Emergence of Researches on New Media in SCP

The new media is changing the ways and objectives of SCP. It can be reflected in two aspects: one, it is 'new' when compared to traditional media; and two, it is characterized by new situations, new features and new functions (Wei, 2012). Wei Feng believed that the new media not only signified 'magnanimity', 'timeliness', 'multimedia', 'hypertext', 'globalization' and 'mobility', but also diversification of communication subject, diversity of communication contents, initiative, interaction and asynchronism of communication behavior. Compared to the four major traditional media, the new media is also virtually called 'fifth media'. It could be divided into digital television new media, Internet new media, and cell phone new media, etc. (Wei, 2012).

New media function reflects its social role in SCP, which can achieve an in-depth combination of science and technology with human society. Wei Feng pointed out that new media

functions not only spread scientific information but also reshaped scientific information. In other words, the new mass media would guide us how to understand and pay attention to it (Wei, 2012). New media allowed the audiences to make their voices heard and also affected the information communicators. It not only went beyond the functions of traditional media, but also greatly broke through the role of the Internet and mobile. It has made close association with human society and become national socialized media to promote comprehensive change (Wei, 2012). 'Scientific Squirrels Club' actually has established a social network 'circle' and shaped the new media communicator at the time of science communication.

The new media has changed the communication pattern of scientific community. Scholar Chu Jianxun analyzed the 'open access' model. He believed that open access is a new model of reference publishing. It requires the author to pay the charge instead of the users and it also allows free access to the academic resources anywhere in the world (Chu, 2013). Through open access, research achievements could be directly made available to the public. Open access could avoid the publishers and other intermediaries, and promote information dissemination directly to the target group. Under the effect of the network, reference searching becomes more convenient and book reservation was provided with better technical assurance (Zhang, 2012). In addition, the public can obtain S&T information under the new media using two-dimensional code technology, NFC technology, geo-fencing technology, augmented reality technology and so on. These technological forms have been developed by scholars such as Bi Hongyu and Li Wen. Among these technological forms, geo-fencing technology would closely connect the users and science popularization knowledge together (Bi and Li, 2012).

New media can establish a self-organized model of SCP. It has built a mechanism to adapt to new media network communication. Chu Jianxun believed that cyberspace had a self-purification mechanism in a certain sense. The author thought that the most valuable feature of the network was that it has the potential of self-organization. Science communicators' self-organization had hierarchy and point system, virtual value

exchange system and establishment of an independent pricing of network resource sharing incentive mechanism. It allows the balanced value distribution of intellectual and labor contribution of the public participating in the science communication. Science communication contents are self-organized. There is collaborative organization and edition from Wikipedia, community blog, as well as the classification generated from socialized bookmarking. It stored the scientific information resources in a structured and standardized format (Chu, 2013). The audiences of science communication are self-organized and achieved self-organized study from their own values and actual needs. The search engine provided entrance for self-organized study, diversified platforms of science communication, and formed personalized knowledge of SCP.

The most direct impact of the new media is the diversification of information, complicated sources of scientific information and the increase of scientific information in the process of SCP. Chen Peng believed that the symbol, quantity and quality of science communication contents for the new media had big changes (Chen, 2012). The network could play its advantages in spreading hot issues. Some scholars such as Zhan Zhengmao and Jin Yizhu, especially, pointed out that the new media had some incomparable advantages in the dissemination of important issues compared to traditional media. 'These issues could often attract a larger public through the media reporting, when the public demands for information would become large (Zhan and Jin, 2009). Tang Qi holds that hot Internet issues could provide materials and opportunities for science communication. As the information is usually not sufficient and uncertain, the public and the media are facing the problems of information source and quality (Tang, 2012).

Moreover, the development of new media makes the social network communication possible. Social network has become one of the important forms of current science communication. With the development of network community, service platform for SCP, Internet, and Internet application efficiency extend infinitely, which will make science communication universal in future (Chen, 2012). A new and popular network community of university students had already come into existence (Chu, 2013).

With the development and application of computer multimedia technology and network communication technology, teachers and students had formed a large campus network community, where you can share resources, interact with the team and entertain; where 'knowledge sharing' is no longer limited by time and space (Zhang, 2012).

Socialized network service can provide each user with a personalized space for creation, communication and exchange. That is precisely a cloud computing service model — Software-as-a-Service (SaaS). Chinese Academy of Sciences (CAS) has been constructing 'cloud creation service platform for science communication.' One of the biggest advantage of cloud computing was that users could use cloud computing resources according to specific demands. That can inevitably promote the development of mobile terminals and mobile applications (Apps). At present there are thousands of types of science popularization Apps in the Apple Store and the Android Market, such as American NSFscience360, Science Squirrels Club App, etc. Science communication cloud will be regarded as one of the important information research and construction tasks of CAS during the period of the 12th Five-year Plan. During this period, CAS would take full advantage of cloud computing technology to create a ubiquitous and integrated service platform for scientific creation and communication cloud. CAS has also tried to use new modes of science communication to achieve a balance between the credibility of science popularization and the participation of the public, which ensured that scientists and the public, both, would like to participate actively, conduct equal exchanges and take use of the correct opinions of scientists to guide the public. Thus, it could provide the public with the ubiquitous and integrated cloud service of science communication (Xiao and Wang, 2012).

In fact, the new media development has brought fresh challenges for science communication. Some scholars pointed out that both the traditional media (Audio-visual and Print) and the emerging network media lacked the feedback links in the process of SCP. And the media also lacked a comprehensive understanding of science that spreads only the positive effects of S&T, ignoring the negative effects of S&T. In the current

situation, we still rely on traditional newspaper, radio and television media, at the same time we are also looking towards network and mobile media (Hou, 2009).

Therefore, Tang Qi suggested that, in the new media environment, we should pay more attention to establishing a scientific team and enhancing the authority of the information. We should also strengthen website management and make information checks. We should improve the mechanism of information feedback and pay attention to guiding public opinions. We should achieve information communication via multiple channels by network communication means (Tang, 2012). Zhang Nan and other scholars pointed out the art and culture appeal of new media in SCP. The authors proposed that science communication required deeper humanistic and emotional interaction. It reflects the collision and transmission of ideas and cultural values rather than physical interaction by simple use of interactive technology of the new media. The author stressed science communication could bring multi-dimensional and multi-sensory 'immersive' experiences to the audiences. Science communication pursues a knowledgeable, interesting and artistic communication. In the application of new media art, its cultural attribute should be continuously improved and integrated so as to form special media with 'scientific temperament' and 'artistic taste' (Zhang and Zhang, 2012). Luo Hong took the science communication of Chinese social communication organization as an example and maintained that we should make science spread out of the ivory towers. She considered that the target of 'Science Squirrels Club' made science get out of the ivory towers and stepped into people's lives to make science popular (Luo, 2011).

New Exploration of SCP Mode

In contemporary China, at this point of national development, social progress and public interests are closely related to each other. That can be confirmed by the debates on complicated interest-related topics in SCP. Li Daguang proposed that the evolution of science communication not only showed its institutional and cultural restrictions, but also illustrated the interests of science communication, even the parochialism

interest (Li, 2010). He suggested that non-transparency of science communication information will lead to decrease in trust in science, so there is an urgent need for transformation of China's science communication approach (Li, 2010).

The discussion of the scientific mode shifted from three stages to four levels. It implicitly, reflected the relationship between standpoint and interests. Tian Song made a profound point that traditional science popularization is based on a national standpoint, the public understanding of science based on the standpoint of the scientific community, while the science communication is the citizens' standpoint. There is the interest behind the standpoint. This opinion breaks the blind spot of science philosopher and historians, and touches a deep connection between science communication and social life (Tian, 2011).

The idea of three stages and fourth subject of science communication were put forward. Li Daguang believed that there are four development stages of science communication. He added to a mode of 'science massification' based on three communication modes of science popularization, public understanding of science and science communication. Science massification mode was put forward by scientists of the Victorian era, such as Faraday, Huxley and Tyndall in UK during the industrial revolution (Li, 2010). Liu Huajie proposed a new science communication approach based on the three-stage mode. It is a new communication model that goes far beyond the government system, manufacturers, household interests, and takes 'global ecosystem model' and is based on the standpoint of 'civilized elite' (Tian, 2011). Tian Song believed that 'citizen's standpoint' was a juxtaposition of the interests of household, government and manufacturers. This mode actually makes the citizen standpoint more practical (Tian, 2011).

In formal scientific communication, the structure of 'Open Access' is proposed. Wang Xirong pointed out that open access model came into being because of the non-profit communication of scientific researchers and the motivation to obtain academic resources with the development of information technology after the 1990s. Open Access included research achievements or academic works, digitized electronic documents that are

accessible and transmitted via internet. Open Access references are free and its access is not hindered by copyright or licensing. In order to understand this complex structure of 'Open Access' correctly, it could be regarded as a socio-technical product or Social-Technology Interactive Network (STIN) (Wang, 2010). Therefore, the campaign of open access had changed the modern system of science communication into STIN. The author made an analysis on open access system of science communication based on the idea of STIN.

Conclusions

Theoretical research becomes further systematic adapting to social development and technological progress of China. However, as mentioned by Liu Bing in his preface of *Introduction to Science Communication* in 2010, a book by Huang Shijin, in China the discipline of science communication is still in its emerging stage of development (Huang, 2012). Different people have different views on science communication, and there is also some conflicting understanding of science communication. We especially, should advocate science communication with understanding of new concept and a proper understanding. Lu Yongxiang also pointed out in the preface of the *Chinese Report on Science Communication* in 2008, 'I continue to hope that those from science and technology circles, education circle and press circle can do more and more research into science communication and it is a new and arduous task to build science communication theory with Chinese characteristics' (Zhan and Jin, 2008).

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