

## TWO PUZZLES OF LATE DEVELOPER COUNTRIES ENTERING GLOBALIZATION OF SCIENCE ——THE CASE OF CHINA

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### Abstract

There is a tension between universality and locality of scientific knowledge, which is a puzzle issue in front of late developer countries entering globalization of science. In China, it also connects another puzzle issue which caused by tension between scientific culture and cultural tradition, the former introduced ab extra and the later characterized by humanity and ethics. This paper discusses these tensions based on recently *Survey Reports of China Civic Scientific Literacy*.

**Keywords:** scientific literacy, universality, locality, scientific culture, Chinese traditional culture

### 1. Introduction

It becomes more and more prominent that science and technology as well as their globalization are with facing the knowledge economy and economic globalization. Furthermore, "the diffusion of knowledge is equally important with its production", [1] and the public scientific literacy becomes an important foundation for social development. Measures have being taken by every country to improve the S&T communication, popularization and public scientific literacy, which be considered as an important social infrastructure construction.

In the contemporary world, the late developer countries can not avoid the worldwide main trends that caused and led by the developed countries. There is no other choice that they have to positively face the enormous challenges and to participate for seizing the opportunities so as to develop themselves. However, there are some special problems for late developer countries involving science globalization and promoting public scientific literacy. There are tensions between universality and locality of scientific knowledge as well as scientific culture and cultural tradition or traditional culture, which need to be seriously attended and treated in the construction of Chinese public scientific literacy.

### 2. The collision between universality and locality of scientific knowledge

Modern science and its tradition arise from the Western world. It is a universality that the image of science and presupposition of doing science been formed from the very beginning. "Science without Borders", which has been always encouraging scientists, is as a concise summary of the fundamental belief. In fact, for a long time, various discussions and theories about science are almost based on this kind of basic belief.

For example, in the Merton's famous summary of the scientific ethos, "universalism" is emphasized in the first place. According Merton's doctrine, scientific knowledge is a kind of knowledge which consistent with observation and been verified, which is unrelated to the person who puts forward the theory and his personal characteristic or social attribute, such as his race, nationality, religion, class and personal qualities.

Therefore, in accordance with the universalism, the communication and popularization of scientific knowledge would be a homogeneous process, without geographical, ethnic, class, historical and cultural traditions of inferences and limitations, and the claims are common created, accepted, shared and developed by human being. So the acceptance, communication of the science would only be related with the socio-economic and cultural development levels of the society, or is only positive proportional to economic status, literacy levels of a certain social group.

Based on this kind of belief, there are some formed "universal" basic test subjects in the contemporary practices of science communication and popularization and construction of public scientific literacy in countries. Of course, it is rationality for adoption of the "universal" test subjects, which is not only lies in some common sense of basic concepts of science, but also can conduce international comparison studies. "Universality of scientific knowledge" remains here as basic belief at the bottom of deeper meaning. As a matter of fact, in the light of the "universal" test subjects, "2003 Survey Report of China Civic Scientific Literacy" does its investigation and also tries to adopt the same measure. For instance, as the investigators said, in the "2003 investigation report", 16 universal test subjects adopted by countries are chosen, and been in caparisoned with the 2001 findings of European Union, Japan and the United. As shown in figure 1, the findings of every country represent a certain consistency; and taking account of the imbalance levels of national

education and development, the results of a variety of indicators show the same trend of relatively high or low. Moreover, from this consistency, these basic scientific concepts embody a certain "universality" correspondingly.

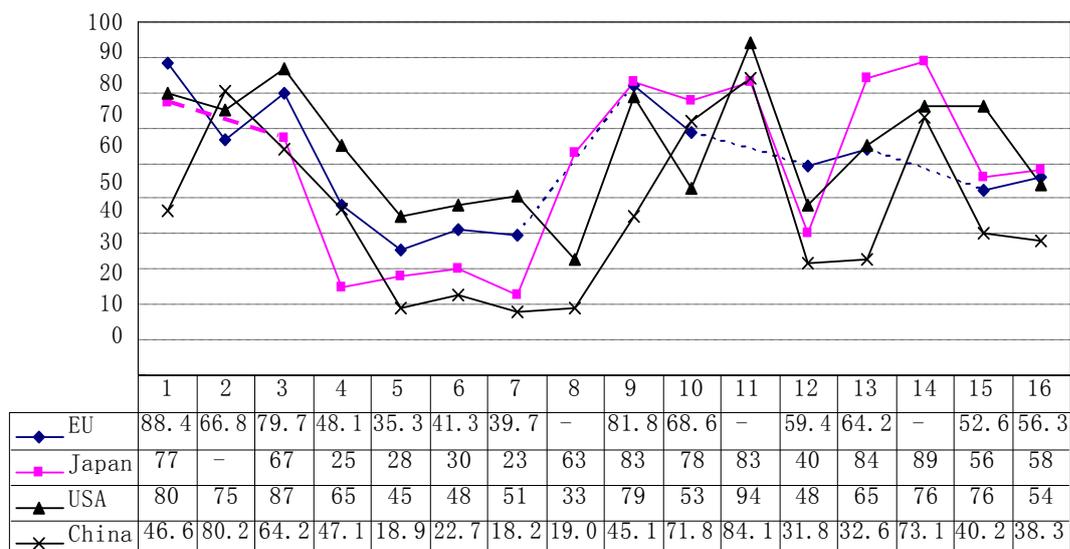


Figure 1. degree of scientific understanding of the views of the international comparison (%)

Note 1: 1- The earth's core temperature is very high; 2- The earth turns around the sun; 3- The oxygen we breathe comes from plants; 4- Father's genes determines children's sex ; 5- Laser is not produced by accumulating of sound waves; 6- Electron is smaller than atom ; 7- Antibiotics can not kill the virus; 8- The universe comes from a Big-Bang; 9- The continent we live on has been drifting slowly for millions and will continue the process.; 10- According to our current knowledge, human being evolved from the early animal; 11- Smoking will lead to lung cancer; 12- The earliest human being and dinosaurs don't live in the same era; 13- Boiled milk that contains radioactive material remains harmful to human; 14- The speed of light is faster than the speed of sound; 15- Radioactive phenomenon is not always caused artificial; 16- The earth turns around the sun in an one-year cycle.

Note 2: 《2003 Survey Report of China Civic Scientific Literacy》 points out : From the test subjects about viewpoint of science, the three countries (referring to the European Union, Japan and the United States) and international organization member countries are still using Miller's test subjects. The test subjects used by China, United States and Japan are similar; however, the EU's are of a little difference. There are lack of "The universe comes from a Big-Bang", "Smoking will lead to lung cancer" and "The speed of light is faster than the speed of sound" in EU's test subjects. There is lack of the test data about "The earth turns around the sun " in Japan. The dotted lines reflect the date missing.

Source: Chinese Science and Technology Association, Chinese Public Scientific Literacy Investigation Panel: 2003 Survey Report of China Civic Scientific Literacy. Beijing: Science Popularization Press, 2004. 7. (Originally : ①Science and Engineering Indicators 2002, Volume 1, National Science Board, 2002, NSB02-1, US Government Printing Office, Washington, DC 20402; ②The 2001 Survey for Public Attitudes Towards and Understanding of Science & Technology in Japan, December 2001, NISTEP RREPORT No.72, Shinji OKAMTO, Fujio NIWA, Kenya SHIMIZU, Toshio SUGIMAN, National Institute of Science and Technology Policy; ③ EUROBAROMETER55.2, Europeans, Science and Technology, December 2001, the European Opinion Research Group EEIG, European Coordination Office.)

But, at the same time, we should note that there is considerable inconsistency between the corresponding results, and sometimes even great inconsistency. For example, it is showed in the figure 1, which China is a late developer country, and the United States、European Union, Japan are developed countries, the current development level of China is much lower than those of the rest three. We could anticipate that Chinese public scientific literacy should be at relatively low level. From the results reflected in Figure 1, the overall situation is true. Most indicators of the public scientific literacy in China are lower than those of the United States, European Union and Japan. However, there are some important exceptions in figure 1. Among them, the proportion of being able to correctly answer No. 2: ("The earth turns around the sun") in China is higher than in the United States and the European Unions (here lack of Japan's data); and the proportion of correct answer No. 10: ("According to our current knowledge, Human being evolved from the early animal "), is higher in China than the United States and the European Unions', but is a little lower than that of Japan.

Why? There may be many various possible reasons. To correctly reveal the reasons need us to do further study. But, we could at least imagine that the Chinese citizens have given more attention to the contents of these two test subjects in their ordinary lives. In fact, linked to the first issue in the traditional mainstream culture in China, it is well known that

Confucius couldn't answer the problem of "Two children identified the sun". So, it is quite reasonable for us to suppose the Chinese citizens have given more attention to these issues such as "The earth turns around the sun". And linked to the second issue, as well known, the mainstream of Chinese traditional culture is atheism one, which obviously contrasts with the culture tradition in Europe and the United State'. In consequence, it is not unreasonable to conceive that Chinese who are easy to accept the theory of biological Darwinism rather than the doctrine of Creation.

Although this consideration is of some color of subjective, the point is that when we consider universal characteristics of the communication of scientific knowledge we should pay attention to the contexts and constraints of corresponding "local knowledge" and "cultural heritage ". In fact, these "locality of scientific knowledge" and "cultural heritage constraints " are emphasized in contemporary social studies of science, especially in sociology of scientific knowledge (SSK). There is an example as an author written down: "Modern science, as scientific and technological knowledge systems in other cultures , is else a 'local knowledge system'.....Whether modern science for the prediction of the natural order in a global context how much success it is, it can never achieve universality in the sense of modern science without cultural constraints, or their meanings and concept backgrounds are immutable in the historical process."[2]

It is worth noting that some insights of Sociology of Scientific Knowledge (SSK), in particular its various "strong programme" and relativism standpoint are often very controversial. Despite such controversy, we have to admit that SSK gives us a certain new inspiration, pushing us not only just stay in the "traditional image of science", but need further understanding of "real science" which is in the social and cultural context and even being shaped by them. Therefore, in science communication, education and prompting of public scientific literacy, the social reality should be counted in so as to adopt appropriate manners, methods and strategies, and so on.

### 3 The tension between scientific and traditional culture

It is "scientific culture" that is associated with modern science and technology which is absorbed, digested and developed when late developer countries make efforts to develop science and technology and to absorb, adapt and develop scientific and technical knowledge. There is a collision, and even fierce collision, between "external scientific culture" and "local human culture" in China because there is a long cultural tradition with thick, heavy human ethics, which will have a ever-lasting impact on the society.

Generally speaking, culture is understood in three dimensions or levels that is the level of material culture, institutional culture, and notional culture. It is from surface level to essence level that the understanding of it is from material level, institutional level to notional level. The understanding of the nature of science and technology is that from recognizing the "solid ship fearful cannon" to calling for the "Mr. Science" and "Mr. Democracy" at the same time in the modern history of science and technology in China, which has experienced such a development process of from the surface to the essence. Moreover, there was broken out the debate of "science and metaphysics"(science and philosophy of life) in the 1920s in China, even much earlier than C. P. Snow delivered his "two cultures" and triggered a debate in 1950s in Cambridge University. In recent years, the ongoing debates on two cultures which are a reflection of the conflicts between "scientific culture" and "traditional culture" in China are very intense and incessancy.

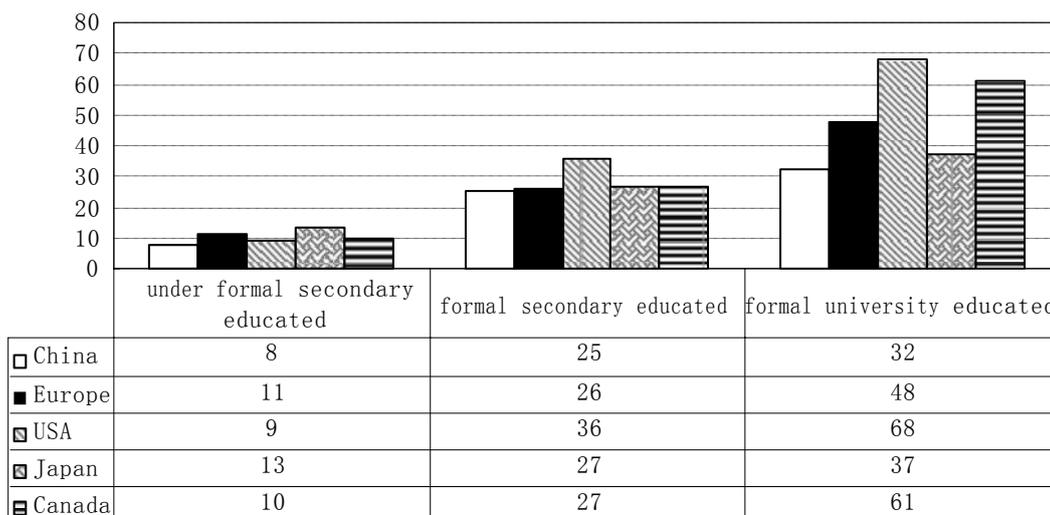


Figure 2 scientific literacy comparison of different education level public (%)

Source : Chinese Science and Technology Association, Chinese Public Scientific Literacy Investigation Panel: 2001 Survey Report of China Civic Scientific Literacy.Beijing : Science Popularization Press,2002. 69

There is full of thick and heavy human ethics in China's traditional culture and relatively lack of scientific culture in the modern sense. Just as LIU Dun pointed out, compared with modern Western culture, the most limitation of Chinese

traditional culture is lacking of scientific spirit,……As a whole, it is a humanistic culture, and with weakness in the rational criticism, the pursuit of strict logic, the respect to mathematical methods and the application of experimental techniques, etc.[3] Therefore, in China, connected to the collisions between the universality of science and local knowledge, it also demonstrates the tension between the scientific culture and traditional culture.

What we should point out here is that this conflict is not only marked by a number of well-known events, but penetrate the entire history of the modern science and technology and education development process, and even is continuing today. In fact, in Chinese scientific literacy investigation, there are some very noticeable phenomena which even should be regarded as the outcome of such tension.

The “2003 Survey Report of China Civic Scientific Literacy” shows that there are 1/5 people believe to sign, more than 1/4 people believe practice physiognomy, nearly 1/7 people believe constellations forecast, and still far from a minority of citizens believe other forms of superstition. These reflect the negative aspect of our traditional culture, which may also have effect on Chinese public scientific literacy. [4]

Formal science education is the basic channel and main means to improve the general public scientific literacy. As shown in figure 2: there is considerable consistency between China and foreign countries, that is the more the education, the higher the scientific literacy. But, compared with developed countries, the particularly noteworthy thing is that in the public scientific literacy the difference of under formal secondary educated between China and the USA is only 1%; and the difference of formal secondary educated between China and the USA is 11%; in particular, the difference of formal university educated between China and the USA is even more than 36%, the former is less than half of the later. What a astonishing result it is!

Here, the direct conclusion is obvious, i.e. the gap of public scientific literacy between China and the USA begins widening from high school, mainly in the university stage. Therefore, one of the most direct responses is that the educational system differences between the two countries, particularly the difference of university system need to be examined. Actually, Miller has analyzed the major factors that affect American public scientific literacy. He concludes the university science courses have made the greatest contribution and the general education extended to the university stage is the important reasons that public scientific literacy in the United States is higher than in Europe and Japan. [5]

Indeed, it is necessary to examine the educational manner and system. Nevertheless, we can further questioning why there are such educational manner and education system. Is this not be the result of the impact of history and tradition? In China, if linked to its cultural traditions, linked to the debates of modern science and the humanities, to explore the obstruction to improve public scientific literacy and the reason of causing the alienation between arts and science, we can not fail to see the profound long-term conflict between the "external scientific culture" and "local human culture".

Taking into account formal science education is the basic channel and the main factor to improve the public scientific literacy, therefore, this gap needs us pay more attention. If further taking into account China's university education to a large extent is still in the initial transition stage from "elite education" to "public education", in other words, who have been tested are those who accept Chinese "elite education", so this gap is really a shocking gap! Furthermore, it can be assumed that, with China's higher education transiting into the "massive higher education", if this situation is not obviously changed, it will become a true bottleneck for improving the Chinese scientific literacy.

#### 4. Conclusion

OPUS Alcatel reported that the optimisation of Public Understanding of Science raises a large number of questions, among which one important is: “Are these practices transferable to other national and European contexts? What requires adaptation and what can be regarded as a common core that can be adopted as it is?”[6]Even in the survey report referring to developed countries raises such question, then let alone in the late developer countries, in the process of entering globalization of science. The two issues or puzzles discussed above must be seriously solved so as to improve public scientific literacy innovatively and effectively on the basis of the cultural traditions, integrating worldwide achievements of civilization including all outstanding scientific culture.

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