Chapter 12
An Examination of National Policy on Youth Science Learning in Informal Education Settings and Its Implementation in China

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12.1 Introduction

The Chinese government has always devoted much attention to youths' science learning in the context of informal education. In 1949, just a few days before the founding of the new China, the *Common Program*, which was the precursor to the constitution of the country, was laid out by Chinese People's Political Consultative Conference (CPPCC). It stated an intent in Article 43 "to strive to advance natural sciences to serve the country in its industrial, agricultural, and national defense construction, to reward science discoveries and inventions, and to popularize scientific knowledge" (CPPCC 1949). In 1981, the Central Committee of the Communist Party of China (CCPC) and the State Council (SC) issued the *Outline of the Chinese Science and Technology Development Approach* drafted by the State Science and Technology Commission. In Article 6, Part 2, the report aimed at "strengthening youths' science activities, such as various science lectures, science competitions, extracurricular science inquiries" (CCPC-SC 1981). In 1991, the NPC formulated the *Law of the Juveniles' Protection of the People's Republic of China*, which stated in Article 30 that "the educational bases, libraries, and youth and children's centers should be free for visiting children and youth; science museums, exhibition halls, art galleries, gyms, cinemas, zoos, parks, and the like should be free or provide discount tickets for children and youth." Moreover, Article 32 states that "the state should encourage science research institutes and science and technology associations to carry out science popularization activities for youth" (NPC 1991).

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In late 1994, the *Instructions for Strengthening Engagement in Science and Technology Popularization* (the *Instructions*) was jointly issued by the CCPC and the SC, calling for "improving science popularization activities in three aspects of popularizing education: science knowledge, scientific methods, and scientific thought." The *Instructions* clearly stated the importance of youth in science popularization, namely, "providing a variety of ways for youth; cultivating their thinking ability, practicing, and creating; helping them shape appropriate attitudes towards science, philosophy, and a world outlook" (CCPC-SC 1994). The *Instructions* was the first-ever science popularization policy at the state level dealing comprehensively with all types of science popularization practices in China. At that time, China was at a critical moment in its ongoing economic and social reforms. The *Instructions* raised the importance of scientific culture to a strategic height in order to promote national prosperity and strength.

Entering the twenty-first century, Chinese informal science learning entered the diversified developmental stage and became increasingly important in improving youths' scientific literacy. In November 2000, the *Guideline for China's Youth Science and Technology Popularization Activities between 2001 and 2005* was jointly issued by the Communist Youth League of China, the China Association for Science and Technology (CAST), and three other governmental departments. Its purpose was to standardize and guide youths' science learning activities for government departments, schools, communities, public media, enterprises, rural areas, and families. In 2006, the SC issued the *Outline of the National Scheme for Scientific Literacy* (*2006-2010-2020*) (the *Outline*). It regarded youths as one of the key groups to carry out scientific literacy action plans and considered youths' informal science learning as an important way to improve youths' scientific literacy. The *Outline* has great significance in Chinese informal science education, creating a positive social environment for youths' science learning. This chapter takes the *Outline* as an example of a national policy, reviews the development of youths' science learning, and discusses the importance of youths' science learning in the context of Chinese informal education.

12.2 Background to the Outline

12.2.1 Domestic Background

During the development of the *Outline*, the *Law of the People's Republic of China on Popularization of Science and Technology* (the *SP Law*) and the *Outline of the National Program for Long- and Mid-Term Scientific and Technological Development* (*2006–2020*) were promulgated and implemented. These played an important impetus toward the development of and provided guidance for the *Outline*.

The NPC enacted the *SP Law* in June 2002, taking on scientific culture improvement from a legislative perspective, and sought to bring science and technology popularization into the realm of laws and institutions. For informal youths' science learning, its third chapter encouraged schools, research institutions, media, national organizations such as trade unions, women's federations and youth leagues, enterprises, rural grassroots organizations, urban communities and public places such as parks and shopping centers, and airports to perform science popularization within their resources. "[All] schools and other educational institutions should consider science popularization as an important content of literacy education; should organize students for various science outreaches, especially science and technology museums, science and technology activity centers, and other science popularization bases; and should organize youths' science and technology popularization activities outside schools" (NPC 2002). The *SP Law* clearly declares science and technology popularization to be a social task, creates social responsibility, and emphasizes how science and technology popularization plays an important role in mobilizing initiatives in all social sectors.

In January 2006, Beijing hosted the National Science and Technology Conference. It explicitly stated that its 2020 goal for China was to strengthen its innovative ability and become one of the most innovative countries worldwide. In February of the same year, the SC promulgated the *Outline of the National Program for Long- and Mid-Term Scientific and Technological Development*, which incorporated into the law the improvement of the quality of the national scientific culture and the establishment of important policies and measures for the social environment of science and technology innovation. It clearly stated its intent to carry out the national scientific culture action plan for science and technology popularization education for farmers, youths, and leading cadres and civil servants as its main tasks. It set a proper approach and provided fundamental references for formulating the *Outline*.

12.2.2 International Background

Since 1984, the European Union (EU) has been implementing research policy through successive "Framework Programs." In the EU's Framework Programs (FPs), dissemination of results to the public, especially to youth, is a contractual obligation for participation in research initiatives. Since FP6 (European Commission 2002), beneficiaries of EU funding are also required to develop public communication activities. With a view to enhancing the impact of research funded by the EU and to foster dialogue and debate, the FP7 grant agreement requires project participants to communicate and engage with stakeholders beyond the research community. Plans for these outreach activities for the public, especially for youth, should also be outlined at the proposal stage. These plans are taken into account during the evaluation process. The specific aims of this provision are to promote knowledge sharing, greater public awareness, transparency, and education. Consortia of researchers are required to provide tangible proof that collaborative research not only exists but also pays dividends in terms of academic excellence, industrial competitiveness, employment opportunities, environmental improvements, and enhanced quality of life for all. The EU also formulated and promulgated other series of important documents, such as *Science*, *Society and the Citizen in Europe*; *Strategic Objectives 2000–2005*: *Shaping the New Europe*; and *Plan of Science and Social Action*. These documents try to promote citizens' scientific literacy appropriate to the developmental strategies of all EU countries.

In 1985, the American Association for the Advancement of Science (AAAS) founded Project 2061, a long-term initiative to help all Americans become literate in science, mathematics, and technology. In 1989, *Science for all Americans* (Project 2061, 1989) was published by the AAAS, showing what a scientifically literate person should know about science, mathematics, and technology. In 1993, *Benchmarks for Science Literacy* (Project 2061, 1993) demonstrated how scientific literacy may develop from kindergarten through Grade 12. To ensure a STEM-skilled workforce for the future, the US Federal Government has considerable assets that can engage youth so that the pathway through their education leads to challenging STEM-related careers. Investments that focus on engagement are designed to increase learners' involvement and interest in STEM, inform their view of STEM's value in their lives, or positively influence the perception of their ability to participate in STEM. The scope of STEM engagement is vast and includes investments in a wide range of areas, such as development of learning materials; programs at museums, science centers, or parks; games, simulations, and virtual environments; public talks; and educational broadcast programming. Thus, there are many avenues available to the Federal Government for reaching learners and many possibilities for STEM-learning youth.

In the UK, the House of Lords issued the report *Science and Society* in 2000. The report defines public understanding of science as the understanding of scientific matters by non-experts, and it includes understanding of the nature of scientific methods, including the testing of hypotheses by experiment. It may also include awareness of current scientific advances and their implications. The issue of *Science and Society* report resulted in a wide development of public engagement with science, for example, *Café Scientifique* by Wellcome Trust from 2002 to 2005 and RCUK public engagement with research team in 2005.

These documents provided useful references for the *Outline*. "All of these documents inspired the formulation of the *Outline*, which is based upon China's situation and will create a great improvement in general national science and technology literacy by implementing a long-term plan" (Report on National Action Plan for Science Literacy 2011).

12.3 Tasks of and Approaches to Youths' Informal Science Learning

The *Outline* is the most ambitious science popularization scheme ever enacted with the aim of greatly advancing science popularization. The long-term objective of the *Outline* is that by 2020 it will see an enhanced development of science- and technology-related education, communication, and popularization that will bring its citizens' scientific literacy up to the early twenty-first century level of major developed countries. It points out that "scientific literacy makes an important part of the quality of a citizen. The basic scientific literacy of citizens generally refers to having key knowledge of science and technology, mastering basic methods of science, building up scientific thoughts, advocating a scientific ethos, and having the ability to apply these to solving practical problems and participating in public affairs." Today, the *Outline* is a dominant policy for running science communication across the country. As the document states, the principal strategy in carrying out the *Outline* is "Boosting the government, creating mass participation, raising scientific literacy, and promoting harmony" (State Council 2006).

Funding for science communication soared after the issuance of the *Outline*. According to statistics from the Ministry of Science and Technology, the total investment in science and technology popularization was about 2.4 billion yuan in 2004, 4.6 billion in 2006, 10 billion in 2010, and 13 billion in 2013 (DPR 2010, 2015). Table 12.1 sheds some light on the results.

The *Outline* lists youths as one of the four key groups (the other three being farmers, the urban workforce, leading cadres and public servants) and includes the *Youths' Scientific Literacy Action Plan*; it considers youths' informal science learning as an important way to improve youths' scientific literacy. The *Youths' Scientific Literacy Action Plan* outlines a set of missions, tasks, and measures for youths' informal science learning.

The missions stated in the *Youths' Scientific Literacy Action Plan* are to familiarize primary and middle school students with important basic scientific information and skills and to allow them to experience the process and method of scientific

Table 12.1 Output of science popularization investment in 2004–2013

Year	S&T museum		Science book (title)	TV program (h)	Science website	Lecture (m)	Exhibition (m)
	Number	Visitors (m)					
2004	185	N/A[a]	2,523	74,959	995	38.13	7.06
2006	239	17	3,162	113,758	1,465	72.33	10.31
2008	380	39	3,888	219,168	1,899	95.51	11.53
2009	505	54	6,787	243,094	1,978	84.94	13.02
2013	678	98	8,423	223,610	2,430	91.21	16.13

Source: Science popularization statistics of China 2010, Science popularization statistics of China 2014, Department of Policy and Regulations of the Ministry of Science and Technology

[a]There is no individual number of visitors for a comparison with 2004. The total number of visitors who visited science centers, science and technology museums, and youth centers or science stations in that year was less than 30 million

exploration activities. It states that efforts should be made to foster a scientific attitude, passion, and sense of value among youths; to develop their preliminary capability for scientific explorations; and to enhance their awareness of innovation and practice.

Specifically, the tasks that are needed to accomplish the missions are initiating science outreach activities and social practices in diverse forms; enhancing youths' enthusiasm and interests in science and technology; allowing them to gain knowledge of the nature of science and the relationship among science, technology, and society; enhancing youths' sense of social obligation and communication and cooperation abilities; and enhancing their ability to solve problems by integrating newly learned information.

The means of accomplishing these tasks are:

- Developing informal educational activities for youths outside the formal rural educational system and initiating science outreach activities for improving youths' general living and working skills.
- Organizing extracurricular science and technology activities to increase youths' innovation awareness and useful skills through an array of initiatives, including hand in hand between scientists and adolescents, teenager science outreach actions for youths, and middle school students visiting research institutes and labs.
- Institutions and organizations such as media and culture organizations should strengthen their efforts in the communication and popularization of science and technology by attracting youths using excellent, beneficial, and vivid public communication of science and technology works and creating a favorable public opinion environment for healthy youth development.
- Consolidating science education resources outside schools and establishing an effective mechanism linking outside school science and technology activities with school science courses and improving youths' scientific literacy by taking advantage of diverse education resources, including science and technology museums, research institutes, and other science and technology education bases.
- Strengthening the popularization of science and technology function of such comprehensive after-school activity sites for youths as the youth and pioneers' palaces and children's centers, establishing exclusive science and technology activity centers for children and youths where conditions permit, and taking advantage of the role played by community education in youths' science education outside the context of school.

12.4 Major Implementation Models

The following account of science activities, carried out by the Children and Youth Science Center (CYSC) of CAST, was developed from the ideas described in the *Outline*. CYSC is engaged in the spread of science knowledge for youths and the public, organizing pilot science activities as well as science contests. As a nongovernmental organization of scientists and engineers, CAST performs its obligations according to the *Law of the People's Republic of China on Popularization of Science and Technology* and the *Outline* and considers the promotion of public understanding of science and the enhancement of science literacy as its missions. The CYSC is a driving force of CAST for youths' science education outside the school, as well as the popularization of science and technology in the general public.

Since the 1970s, the CYSC has developed various science activities for youths to nurture their interest in science, build up their scientific mindset and spirit, as well as promote their scientific literacy as future citizens.

12.4.1 China Adolescents Science and Technology Innovation Contest

The China Adolescents Science and Technology Innovation Contest (CASTIC) is a national contest focusing on adolescents' science education and science research. It has a nearly 30-year history and is jointly organized by CAST, the Ministry of Education, the Ministry of Science and Technology, the National Environment Protection Administration, the National Sports Administration, the Chinese Natural Science Foundation, the Central Committee of the Chinese Communist Youth League, the All-China Women's Federation, and provincial and municipal governmental sponsors. Now CASTIC is one of the most popular science education activities for all students in China. Every year there are more than ten million students engaged in different levels of contest, and around 500 students and 200 teachers among them participated in national level of contest.

12.4.2 Youths' Scientific Investigations and Experimental Activities

In 2006, the Youths' Scientific Investigations and Experimental Activities program was jointly launched by the Ministry of Education; the Civilization Office of the CCPC; the State Administration of Radio, Film, and TV; the Communist Youth League of China; CAST; and other organizations, with the aim of improving youths' scientific literacy. Scientific investigation, scientific experience, and scientific exploration were the main content. Through these activities, youths master basic science and technology knowledge and skills, experience the process of the scientific method and scientific exploration, cultivate a positive scientific attitude, and improve basic scientific research ability. To organize youths to gain relevant knowledge, they develop their own scientific investigation activities at home and in schools (classes or groups), launch relevant scientific experiences and scientific explorations in the agricultural industry, and learn how to collect and arrange relevant material and data. Based on these activities, they perform data summaries and analyses and provide investigation reports with proposed reasonable suggestions. These activities have been held in 31 provinces nationwide, and more than three million students engaged in these activities.

12.4.3 Science Activities from Science and Technology Museums on Campus

By 2010, the number of museums in China had reached 900, of which about 300 were science and technology museums. The CYSC of CAST set up and developed the "Science activities from science and technology museums on campus" project in 2006. The activities include training, science show, hands-on experimentation, and science workshops and clubs which aim to integrate the resources of science and technology museums into school curricula, especially science courses, comprehensive practical activities, and research studies. It also improves the effective connection between science and science education technology activities inside and outside school.

In 2014, the second competition of museum-based science education projects was held. There were 145 projects from 130 science museums and centers nationwide. After two rounds of preliminary competing, there were 64 projects from 48 science museums and centers that participated in the final competition in Beijing with three parts, which were online voting, promotion of the project, and face-to-face debating. The judges were from the public, school teachers and professionals. Furthermore, two training programs were given by the experts at home and abroad to advance project leader's capacity in design and implement science activities from science and technology museums on campus.

12.4.4 Science and Technology Activity Popularization for Youths' Interest in Space

To stimulate youth interest in aerospace technology and promote more talent in science and technology innovation, CAST, the China Manned Space Program Office, and the Chinese General Company of Astronautics Science and Technology directed a series of science and technology popularization activities intended to involve youths in space flight. Running from 2010 to the end of 2013, it was named "Opening the Dream of Space" and was intended for all youths. It included four parts:

(1) Exploring space: science and technology experiment activities for youths.
(2) Seeking space: a space flight-related science and technology competition for youths. This competition was widely promoted by TV, the Internet, journals, magazines, and so on, to encourage more youths to learn about astronautics science and technology.
(3) Searching space: youths researching articles to increase their science and technology knowledge about space flight.
(4) Realizing space: an experiential activity for youths in astronautics science and technology. From 2011 and annually thereafter, various youth groups are organized to participate in experiential activities about astronautics science and technology. These include visiting an astronautic control center, a spacecraft launching base, and an astronaut training base and communicating with astronautics experts.

In 2014, 80 tour reports of popular science of space were given by scientists and experts to students in Jiangsu, Qinghai, Inner Mongolia, and Chongqing, with the audience of 100,000. It stimulated students' learning interest of space science.

12.4.5 Youths' Informal Education Programs in the Countryside

Since 1982, CAST has cooperated with the United Nations Children's Fund to advocate youths' education and development in poor areas of China. From 2011 to 2015, joint programs have been developed in 22 poor counties in 11 provinces and autonomous regions in the central and western regions of China, with the purpose of helping youths aged 14–17 years transition from school to work, improving their work and social lives, strengthening their sense of participation with social problems affecting them, and guiding them to become socially responsible citizens.

This program plans to fulfill this purpose by a series of activities, such as establishing "youths' development training centers," organizing expert groups, developing informal educational training courses and youths' science and technology popularization activities in a program named *Go to Society—Life Job Development*, holding youths' development forums, promoting participation for countryside youths, and appointing and retaining good role models.

In 2014, 188 training programs with 5,518 trainees from rural areas were held; the educational programs embedded in school curriculum were promoted in four counties; moreover, the relating training programs was given to 514 rural young people. The revision of *Guidebook of Girls*' *Living Capacity and Skills* started as well in 2014.

12.4.6 Youths' Science and Technology Camps in Colleges and Universities

In 2012, CAST and the Ministry of Education, with the support of the Chinese Academy of Science, organized youths' science and technology camps in colleges and universities. Several colleges and universities and many provincial science and technology associations and educational bureaus took part in the program.

This program aims to explore the essence of science and technology camps and gain experience in doing activities such as integrating scientific research with science popularization; promoting the development and sharing of science education resources; utilizing the abundant educational resources of colleges and universities to advance the function of colleges and universities in disseminating scientific knowledge, scientific ideas, and methods in order to improve youths' scientific literacy; inspiring youths' interest in science and encouraging youths to enter science-related careers in the future; encouraging youths' engagement in scientific research; cultivating youths' scientific spirit, innovative mindsets, and problem-solving ability; and laying a solid foundation for science and technology talent.

In July of 2014, 10,610 high school students from four regions across the straits (9,050 from mainland, 200 from Taiwan, 1,000 from Hong Kong, and 360 from Macau) from 1,500 schools spent a week of science and technology camp in 49 first-class universities and colleges in mainland. There were 176 seminars held, and 17 national key laboratories were open to these students, with 139 hands-on science and technology activities, 44 outreach activities, and 452 arts and sports activities carried out; 325 college campus and cultural sites were toured as well.

12.5 Discussion

12.5.1 Impact of Science Popularization Activities

In the context of informal science learning, the extent of students taking part in science activities plays an important role. A nationwide survey, sponsored by CAST, was done by the China Research Institute for Science Popularization in 2009. The survey was conducted in a total of nine provinces, four middle/high schools (two urban and two rural) and four primary schools (two urban and two rural) in each province. It aimed to study the progression of Chinese students' creative imagination from elementary through high school. With regard to extra-curricular science activities, the study (Ren et al. 2012) shows that students who actively participated in science project competitions (including CASTIC) and Olympiads on various subjects and those who visited science venues (including science and technology museums, natural history museums, zoos, and botanical gardens) had a higher level of creative imagination. Students who "have no idea" about science project competitions and Olympiads got the lowest total creative imagination scores, those who "know about" got higher total scores than those who "have no idea," and those who "have participated" got higher total scores than those who "know about." Those who "have won prizes" got the highest total scores. Students who "always" go to science venues got the highest scores, students who "sometimes" go to those places got the second highest scores, and students who "seldom" go to those places got the lowest scores.

Since China is a huge developing country, however, the regional development of culture and economy is not balanced; therefore, the allocation of these educational resources such as these science venues is far from balanced. Most qualified science venues are located in big cities; few of these places are seen in towns and counties in China. Therefore, the form of science venues should be flexible, using mobile science museums, science wagons, online science museums, etc., which can do science exhibitions, tours, and virtual visiting for youth in small towns, counties, and villages.

12.5.2 Implementation of Chinese Youths' Informal Science Learning

Shi and Zhang (2012) argue that science popularization in China has developed in an idiosyncratic way, as part of an organized and mobilized effort. They state that after the *Outline* was implemented, a state-leading group was formed, including 23 members from cross-border governmental departments and national organizations. Tasks were divided among the 23 members, and 9 guidelines corresponding to each action and project were developed in detail. Local governments soon took up the *Outline* as a state assignment. Each province worked out similar working patterns and corresponding packages of programs. Furthermore, a series of national policy documents had been issued and enacted in accordance with the *Outline*, such as *Instructions on Opening of Institutes*, *Colleges and University to Society and Developing Science and Technology Popularization* (*2006*), *A Program of Science Activities from Science and Technology Museums on Campus*(*2006*), *Instructions on Strengthening the Ability of State Science and Technology Popularization Establishment* (*2006*), *Implementation on Youths*' *Science Literacy Action* (*2007*), and *Information on Promoting Provincial Youths*' *Outside School Activity and Developing Sharing a Place of Science and Technology Popularization Education* (*2008*). These documents dealt with specific aspects of informal education, such as place, institute, members, activity, support, and promotion of the development of informal education.

An example is the "Science activities from science and technology museums on campus" program, which was started as a way to implement the *Outline* in

June 2006. In August of that year, CAST expanded this program countrywide. During 2006–2009, more than 30 science and technology museums, youths' science and technology centers, and youths' science offices took part annually in this program. In total, 48 pilot units joined in the 3 years. In May 2010, the Ministry of Education and CAST jointly issued a program to extend the pilot unit for "Science activities from science and technology museums on campus" from 2010 to 2012. Through applications, selections, and reviews, they formally established 36 demonstration pilots spreading to 15 provinces, autonomous regions, and centrally administrated municipalities and deepened pilot units in 19 science and technology museums. This program had already become one of CAST's important assignments for youths' science popularization and has promoted some of the relevant youths' educational programs, further strengthened the science education function of places of youths' activities outside of the school context, and engaged in the public enterprise of science and technology popularization.

12.5.3 Flexible and Diverse Forms for Youths' Informal Science Learning

In informal science learning, youths learn science outside schools. Therefore, this kind of learning must be flexible and diverse. It could involve producing and broadcasting science programs for youths; organizing and developing science experiential activities, lectures, reports, and competitions; cultivating innovative ideas in youths; carrying out practical activities for youths' science and technology popularization; fostering youths' science ideas; connecting museums with schools for education; etc. These youths' science experiences support, strengthen, and play an important role in improving their science literacy.

Taking the experiential activities of youths' scientific investigation as an example, the main forms are "scientific investigation," "scientific experience," and "scientific exploration." One scientific investigation takes a low-carbon theme. Through visiting recycling stations, youths develop an understanding of ways to recycle and its global significance. For the scientific experience, there is a "farm tour" program with the theme of "saving food." This affords youths the experience of working on a farm, becoming familiar with the types and processes involved in growing food, and teaching them about the challenges in producing food. One scientific exploration is about water conservation, giving youths the opportunity to design 15 mini scientific experiments about water using the aid of the *Guideline of Fun Water Experiments*, which guides youths through water experiments to improve their understanding of water.

12.5.4 *Attracting More Youth Participation in Informal Science Learning, Especially Those of Lower Social Economic Levels*

Sixty-two percent of people aged 15–30 years in the Chinese countryside are estimated to leave their villages seeking jobs in cities and towns (International Labor Organization 2009). The program for countryside youths' informal education outside schools has launched informal educational course training and youth science and technology popularization activities, but some vulnerable groups may not participate. The most vulnerable group is teenage girls with the least education and skills who drop out earlier than teenage boys and then gradually become more vulnerable to violence. While some policies and practical programs may encourage participation of these groups, they are insufficient, thus missing the goal of reaching these vulnerable groups. Therefore, in order to comprehensively accomplish the goals of the *Outline*, more optimally practical programs in informal science learning need to be established that are geared toward vulnerable groups. To achieve this goal, the main effort is devoted to building a mechanism that emphasizes the best allocation of human and material resources and to constructing the required infrastructure.

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