Narrowing the gap of the digital divide

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Narrowing the Gap of the Digital Divide: How NSTL Contributes

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Abstract:

In China, a digital divide results from geographical conditions, unbalanced economic development, individual differences, and other factors. To bridge this gap and to weaken the polarisation between the "information wealthy" and the "information poor," a federal, Internet-based library, the National Science and Technology Library (NSTL), has been founded. This paper will introduce what NSTL is and how NSTL contributes to narrowing the gaps in order to reduce differences between the two groups in access to science and technology information and resources.

NSTL consists of 9 library members, all of which are national authoritative libraries in different disciplines, respectively covering the natural sciences, engineering, agriculture, medicine, standards, and other fields. First, to narrow the gap caused by geographical conditions, NSTL has built 40 service stations covering 29 provinces, thus forming a nationwide information service network with the help of local and industrial scientific information institutions. This action not only guarantees resource sharing to the whole country, but also improves the service abilities of local providers. Second, to narrow the gap caused by unbalanced economic development, approximately 25,000 types of print resources that are state-funded can be unconditionally supplied to the public at reasonable prices, especially with low prices for remote and poor areas. Document delivery services are ordered over 400,000 times every year. Nearly 4,000 kinds of electronic journals are free for all domestic welfare and educational group users via Internet protocol address permissions. Third, to narrow the gap caused by individual differences, NSTL provides an integrated discovery system on the basis of unified cataloguing so that everyone can search literature easily. NSTL also organises trainings and seminars across the country, introducing and promoting resources to all communities. In addition, NSTL strives to explore approaches to international information access and to foster cooperation opportunities in order to close the gaps between countries.

Keywords: Digital divide, Academic libraries, China National Science and Technology Library (NSTL)

1.   **What is the digital divide**

The level of information access has become an important symbol for measuring modernisation levels and the comprehensive national strengths of countries. One of the problems caused by the rapid development of information technology is the digital divide. This issue, which has drawn global concern, is essentially due to unfair distribution and use of information resources.

Lloyd Morrisett came up with the term "digital divide" in 1995 [1] and it has been analysed from different perspectives [2-4]. Researchers have stated that economic power and socio-demographic factors are the most important elements that cause the gaps between and within countries [2, 5-6] and libraries are considered as potentially playing one of the most important roles in bridging the digital divide [7-11].

For China, the reasons for digital divide can be summarised as resulting from geographical conditions and differences in economic development and socio-demographics [2, 6, 12]. Under such circumstances, National Science and Technology Library (NSTL) has been established to try to narrow the digital divide within mainland China.

2.   **What is NSTL**

The National Science and Technology Library (NSTL) was formally established in Beijing in 2000. It is a non-profit institution that is fully funded by the national government. It is a virtual information unit based on a network platform composed of 9 core members: the National Science Library, Chinese Academy of Sciences (NSLC); the Institute of Scientific and Technical Information of China (ISTIC); the China Machinery Industry Information Institute; the China Metallurgical Information & Standardisation Institute; the China National Chemical Information Centre; the Agricultural Information Institute of Chinese Academy of Agricultural Sciences (AII, CAAS); the Institute of Medical Information/Medical Library (CAMS&PUMC); the National Institute of Metrology, China; and the National Library of Standards, China.

Since its establishment, NSTL has collected scientific and technological literature resources in the fields of science, engineering, agriculture and medicine in accordance with the principles of unified procurement, standardised processing, joint cataloguing, and resource sharing, all of which serve public scientific and technological development.

3.   **How NSTL contributes to narrowing the digital divide**

According to the three aforementioned causes of the digital divide in China, NSTL (in its role as a national academic library) contributes to narrowing the digital divide within the country, both the "access divide" and the "use divide". It also makes efforts to narrow the international gaps between China and other countries.

3.1 Elimination of the geographic divide

In the early 21st century, few users had access to the Internet in China. Network servers and other relevant facilities were insufficient. Advanced technology was not applied widely yet and it was difficult to set up network facilities in some complex terrain. According to the earliest statistics on National Bureau of Statistics of China, the number of Internet users in

China was less than 1.8% in 2000 [13]. Most people could only access local networks.

In order to provide convenient access to NSTL and to share its resources, NSTL service stations were established in important provinces and potential cities, depending on the number of pre-existing local scientific information institutions and libraries. This action not only managed to establish regional academic liaisons across the country but also was beneficial in dispersing visit flow and balancing network load levels. NSTL Information and resources were mirrored to local sites from the primary station. People were able to view all data smoothly from different local branches and registered users were managed by each regional station. During this period, service stations decreased network stress and management complexity at the primary station.

With the rapid popularity of the Internet in mainland China, network infrastructure has improved dramatically. A 1000Mbps broadband optical fibre network has been built between the management centre and each member institution. Today, the number of Internet users in China is over 55.3% [13] and there are 400,000 registered users of NSTL [14]. Resulted from the upgrading high-speed network, the roles of service stations were changed. All Internet users are able to access the NSTL primary web page directly. In addition to being responsible for user management, local stations have participated in NSTL key tasks and activities, such as projects, research, and promotions. With the help of NSTL, they contribute to the development of regional science and technology, working together and making better use of the power of provincial governments and local scientific research institutions.

At present, there are 40 NSTL service stations covering 29 provinces of mainland China [14]. The national distribution of service stations is shown in Figure 1 below. To make the range of coverage clear, there is only one red point marked in each city in the figure, but some cities such as Chengdu, Tianjin, Lanzhou, and Wuhan have more than one service station. In particular, there are two service stations located in Beijing, a transportation service station and an electronic technology service station, built in accordance with its industrial characteristics of physical distributions. These two tangible and intangible approaches to every corner of the country provide advantages for the spread of information.
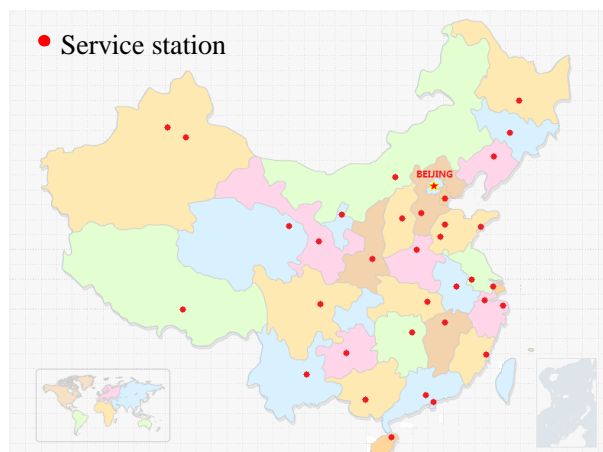

Figure 1. National Distribution of NSTL Service Stations

In recent years, NSTL has focused on enhancing the service capabilities of local stations. By evaluating service quality and strategic expectations, some stations are encouraged to provide

policy support to the local government so that they can expand their fields of service and improve service levels, while some stations that are not good enough need to rectify and reform themselves. For national strategic areas, such as the China (Hainan) Pilot Free Trade Zone, the Zhangjiang High-Tech Park, and the Greater Bay Area (GBA), new service stations have been established or are under preparation to serve local information service requirements in the future.

Nowadays, both the number of registered users of service stations and the proportion of services provided by the service stations all account for nearly half of NSTL's whole operations.

Apart from service stations, NSTL resources are also shared by 28 management platforms for universities, as well as 42 interfaces for group users [14] that together form an "information bridge" on the national scale, narrowing the digital divide resulting from geographical conditions.

3.2 Elimination of the economic divide

Due to China's economic structure, the results of economic planning, geographical conditions, traditional customers and other factors in different regions of mainland China, the problems of unbalanced economic development are already constitute an objective reality.

Similar to the terraced distribution of China, the degree of economic development in different regions of China also presents a graded distribution, but the direction is entirely opposite, which shows that eastern coastal cities are developing rapidly (most quickly, the Guangdong Province) and the western regions are lagging behind in comparison (the Xizang Province exhibits the slowest growth). As a result, two provinces, the Guangdong and Xizang Provinces, have been selected to be representatives for comparing gaps in Gross Domestic Product (GDP) per capita. GDP per capita in these two provinces in 2000 and in 2018 is shown in Table 1. It can be found that the GDP per capita in the Guangdong Province is about 2 times higher than that in the Xizang Province in both 2000 and in 2018.

Region	Representative Province	GDP (RMB per person) in 2000	GDP (RMB per person) in 2018
East	Guangdong	12,418	85,738
West	Xizang	4,566	42,954

Table 1. GDP per capita of the Guangdong and Xizang Provinces in 2000 and 2018 [13]. The reasons for the years selected are: 2000 statistics show the level of GDP at the beginning of NSTL's operation; 2018 statistics are the latest on the website of National Bureau of Statistics of China to show the current level of GDP.

With increasing, massive needs for foreign literature and its high price tag, it is not affordable for individual users to purchase foreign articles, even in 2018. To save money and to encourage scientific research, NSTL (fully supported by state funds), organises 9 members who purchase foreign scientific and technological literature and information resources, according to the division of disciplines. The number of various foreign resources purchased each year is nearly 25,000. The proportion of different types of new print resources in 2018 [14] is illustrated in Figure 2, which shows that journal and conference literature, both of

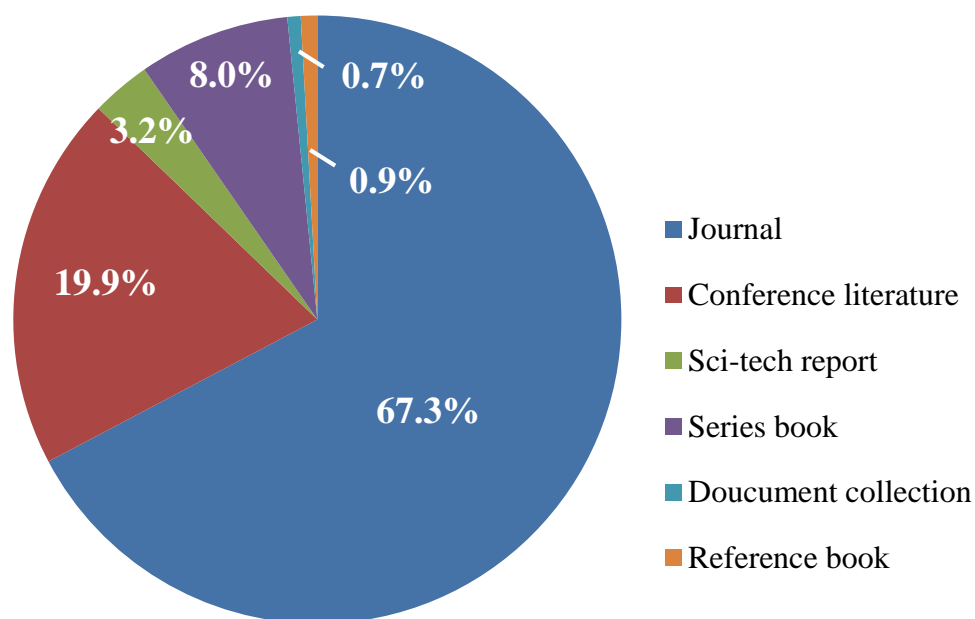which are serial resources, are the top two major resources purchased.

Figure 2. The Proportion Distribution of Different Types of Print Materials Purchased by NSTL in 2018.

Nowadays, NSTL has become an important base of national scientific and technological literature for the whole country. In addition to ensuring full support for Chinese materials, the number of foreign print resources ranks first in China. According to NSTL official statistics, the total number of types of print literature that NSTL embraces is over 275,000 [14]. All of these full-text resources can be searched on the NSTL website and can be ordered for non-commercial use at reasonable prices. For poor areas, especially remote west regions, their limited access to information and lower income is taken into account and a specific price policy is supported. Document delivery services, for example, are offered at half-price in poor areas, which is much helpful for local researchers. In total, each year there are over 400,000 orders that NSTL supplies to the public [14], solving the contradiction between the urgent need for a large amount of literature and its high price. Since NSTL is a non-profit institution, the price of document delivery has been stable for several years so that more users can use NSTL without any unexpected financial burdens.

In addition, NSTL has purchased electronic resources since 2002 in the form of "national licenses" to make up for domestic historical deficiencies. So far, NSTL has nearly 4,000 kinds of electronic journals (either current or past issues), all of which can be accessed freely by public welfare and educational group users. For current journals, full-text documents can be accessed from databases via internet protocol address permissions. Some articles are downloaded over 10,000 times annually [14]. For older journals, a retrospective platform was established and it can be visited by non-profit organisations. In total, there are more than 900 scientific research institutions, including universities and colleges in mainland China, that have applied for access to NSTL electronic resources [14]. And NSTL is continuing to expand to qualified non-profit users in southwest, northeast, and northwest China so that resources can be shared with more researchers and maximise the economies of scale.

With consideration to national strategy, authority, and comprehensiveness, NSTL focuses on integrated planning and scientific management to minimise duplicate resource purchasing, aiming to build a collaborative resources platform and to develop a sustainable process and to narrow the digital divide resulting from unbalanced economic development. It also improves the level of support to national long-term and medium-term science and technology developments such as supporting the development of subject priorities, key planning studies, and some basic frontier fields by comprehensively and continuously adjusting and increasing purchasing varieties.

3.3 Elimination of socio-demographic differences

Although the digital divides resulting from geographical and economic factors have been alleviated through various measures, socio-demographic factors are also vital causes of the gap. Even in rapidly developing regions, individuals—due to gender, age, background, experience, and so on—have uneven access to information in different fields.

To provide the public with an easy-to-use online environment, an integrated retrieval system has been built and is continuously improved. With the system, print journals, books, proceedings, dissertations, and other kinds of physical resources purchased by NSTL can be searched freely. All of these resources are processed with abstracts and catalogued in a joint way. In addition, over 7,000 kinds of open access documents have also been assembled into the NSTL page [14], which helps the public to achieve one-stop information discovery. It is worth noting that dynamic tracking and monitoring on national key industries, frontier areas, and potential research directions are reported periodically on the website, which encourages all people to acquire the latest information from different scientific fields. Therefore, NSTL tries to improve ease of use of the discovery system and decrease the threshold of use so that both teenagers and elders can operate it smoothly. NSTL received 154 million hits and 9.67 million searches in 2018 [14].

Meanwhile, improving individuals' information literacy and their ability to acquire information is conductive to overcoming digital divide. NSTL organised approximately 120 events in 2018 [14] for different types of users across the country, such as literature retrieval courses for college students, training for using software tools for research institutions, and introductions to deep information services for enterprises. All events have received positive responses.

Furthermore, a special team concentrating on providing scientific and technological information for the Xinjiang and Xizang Provinces has been set up. The working group is tasked with realising the local needs and requirements and to provide full support to them. On the one hand, brief reports of selected topics on western development are pushed periodically to over 20 local institutions [14], which helps them to obtain information about current development situations and relevant policies. On the other hand, to create opportunities for local librarians to broaden their horizons, librarian exchange trainings are held twice a year. Librarians, through these sessions, have the chance to have good experiences and to learn skills that they can apply to their local development. To benefit more local users, the working group also organises field visits and offline courses. For example, two members of NSTL, NSLC, and AII of CAAS—together with the Lanzhou service station—have held some activities locally. Training sessions on the utilisation of EndNote software and Web of Science were prepared for people who work in local scientific research institutions; activities

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of science popularisation, such as modern agricultural science videos and donated books, were warmly welcomed by local children and teenagers.

In this way, the digital divide resulting from socio-demographic differences has been narrowed by building an easy-to-use discovery system and improving individuals' information literacy skills.

3.4   Elimination of international gaps

With the development of the society and increasing international connections, new needs for accessing information emerge as each original gap is filled. Sometimes users want to be able to access documents from other libraries, and even foreign libraries, with the help of NSTL. Therefore, NSTL strives to explore information access approaches and develop international cooperation.

Take NSLC as an example: as a core member of NSTL and information centre of the Chinese Academy of Sciences, document delivery access covers not only institutional libraries within the Chinese Academy of Sciences, but also domestic public libraries, university libraries, and other specialised libraries such as the National Library, the Shanghai Library, the Academic Library & Information System (CALIS), the National Geological Library of China, and so on. For foreign approaches to information acquisition, NSLC has established cooperative relationships with Subito, the British Library, and the East Asian Library of Pittsburgh University. There have already been over 100 orders for international literature delivery this year.

It is worth pointing out that the cooperation between NSLC and Subito has achieved mutual benefits. The two parties established a relationship in 2006 whereby users registered with NSLC can apply for document delivery services. Since 2010, NSLC has become a supplier library which provides Chinese articles through Subito. The number of annual materials that NSLC ordered and supplied is shown in Figure 3. It can be seen that the number of orders has been increasing rapidly since 2017, while the number of supplies shows a downward tendency. It seems that the needs of Chinese researchers for accessing international information are significantly increasing over the past few years. It is also worth noting that all documents that NSLC supplied are focused on Chinese medicine and medicinal drugs.
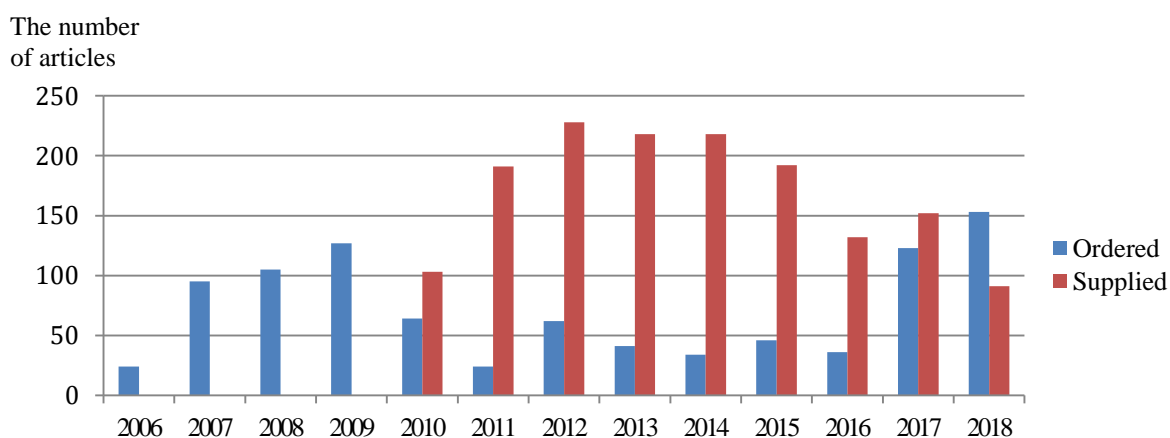
The number of articles

Figure 3. The number of orders and supplies by NSLC through Subito.

This section discussed how NSTL contributes to narrowing the digital divide in mainland China in three main areas and how it is closing international gaps, which strongly support domestic science and technology development. NSTL has adopted diverse, pragmatic approaches to bridging the digital divide in China and has achieved significant effects.

4. Future expectations

In the future, NSTL will continue to contribute to improving access to resources to the public, especially in "information backward" areas. In fact, NSTL has already made plans for field trips to certain areas, such as the Guizhou and Shanxi provinces and other cities in Midwest China.

Other planned activities include finding solutions to "long-tail" users' needs, expansion of international access to information and cooperation, and expanding the variety of service models for different researcher groups as follows:

(1) At present, the users who use NSTL frequently are focused. Some users order a large amount of articles for their institutions' studies. The number of these orders accounts for the most of proportion of the total number. This results in that the number of satisfied orders is large seemingly, but actually the number of satisfied people is small. The rest of users, the number of which is large, whose requirements are personalised, are so-called "long-tail" users. Their needs should be given more attention to in the future.

(2) Sometimes users ask for foreign articles that are not included in NSTL's collection or that are even unavailable in China. However, the present international approaches to document delivery are still limited and the price of international delivery is unaffordable for many Chinese people. Such international gaps that block access to information should be discussed and solved. It seems that NSTL should continue to expand national and international information acquisition so as to meet the needs of more users.

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(3) Expanding the diversity of service models for different user groups should be explored, including special customised service for institutional groups, information tracking for key laboratories and academics, and accurate information support for implementing national governmental strategies.

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