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Promoting China-U.S. Arctic education cooperation: challenges, opportunities and recommendations

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Abstract Arctic education refers not only to the teaching, but also to research, communication, dissemination as well as popularization of knowledge related to the Arctic. This article reviews joint efforts between Chinese and American educators and researchers to promote cooperation and understanding in Arctic education and research, and examines the facing challenges of China-U.S. Arctic education cooperation which include current political or economic tensions between the two countries, the differing perspectives and priorities on Arctic policy, the disproportion in Arctic scientific research, different research methodologies and discourse system in social science. This article also argues that there are opportunities for the two countries to cooperate in Arctic education. Common goals and interests in the Arctic, Arctic-dedicated institutions with significant Arctic research capabilities and partnerships around the world provide foundations for Arctic education cooperation. The implementation of a new science-based Arctic treaty of the Arctic Council is an opportunity for China-U.S. Arctic education cooperation. As for future cooperation, it suggests that in addition to promoting the direct bilateral cooperation, cooperation within international cooperation platforms and mechanisms, especially within the Arctic Council also needs to be further promoted.

Keywords **China-U.S. relations**, **Arctic education**, **international cooperation**, **Arctic policy**

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1 Introduction

Since the end of the Cold War, the Arctic has been a unique zone of peace and a leading site for the advancement of international cooperation and multilateralism. However, after the outbreak of the Russia-Ukraine conflict in February 2022, the "Arctic exceptionalism", which means the long-standing post-Cold War perception that the Arctic would benefit from a disconnect from security concerns, has lost its essence. The geopolitical importance of the Arctic region is coming back into focus with enhanced NATO military cooperation and the military confrontation between Russia and other Arctic states, all members states of NATO. The joint statement by seven states of the Arctic Council in March 2022 to pause participation in all meetings of the Arctic Council indicates suspension of international cooperation in the Arctic (Hong, 2022).

The China-U.S. relationship is the most important and complicated bilateral relationship in today's world, due to different sociopolitical systems and development experiences of these two large economies. Relations between the U.S. and China has been deteriorating in recent years (Congressional Research Service, 2021). As one part of China-U.S. relationship, Arctic cooperation has been

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inevitably being influenced and constrained by evolving bilateral relations. For instance, the Alaska Gasline Development Corporation didn't renew its 2017 agreement with three Chinese state-owned companies for $43 billion liquefied natural gas development project in Alaska (Brehmer, 2019). Non-traditional security issues and low-politics issues concerning the Arctic, such as Arctic education, could serve as a catalyst for the improvement of both China-U.S. Arctic relations and China-U.S. relation.

The Arctic education discussed in this paper refers to the teaching, research, communication, dissemination as well as popularization of knowledge related to the Arctic. Arctic education can be divided into two types. The first type is education that relates to issues regarding science and technology, social science and human science in the Arctic. The second type is educating the general public. The Arctic education area needs greater attention and will help build awareness of the many challenges facing the Arctic (Conley et al., 2017). Arctic education cooperation means that different countries, organizations and individuals work together on programs, research and academic activities that focus on the Arctic region, to address the challenges and opportunities that arise in the Arctic. China-U.S. Arctic education cooperation is a joint effort between Chinese and American educators and researchers to promote cooperation and understanding in Arctic education and research.

This paper first reviews theories of international cooperation in higher education from the perspective of international relations and past China-U.S. Arctic education cooperation, then examines the challenges and opportunities of China-U.S. Arctic education cooperation, and finally proposes suggestions for future collaboration. This paper aims to shed some light on future China-U.S. Arctic education cooperation and seeks to enrich the understanding the China-U.S. Arctic relations from a perspective of Arctic education.

2 The theories of international cooperation in higher education from the perspective of international relations

From the perspective of international relations (neorealism, neoliberalism, constructivism, and international cooperation for capacity building), Zhang and Liu (2019) proposed that there are "power cooperation theory", "institutional cooperation theory", "cultural cooperation theory", and "capacity cooperation theory".

"Power cooperation theory" emphasizes the power structure as the basis. That is, the party with more educational resources takes the initiative in cooperation and selectively exports personnel, technology and services. On the other hand, the recipient needs to provide political or economic support and return to the donor on specific occasions to form a power distribution based on the supply and flow of educational resources. The dilemma of "power cooperation theory" is that one country's fear of becoming dependent on another country for the distribution of benefits or the exchange of goods and services may limit international cooperation.

"Institutional cooperation theory" emphasizes the foundation of institutional statute. With the formation of global networks in higher education, international institutions with authority, constraints, and relevance facilitate cooperation through "consistent and interconnected sets of rules that define roles, define activities, and influence expectations" (Keohane, 1989). This theory is often used to explain the international cooperation in higher education reached by international organizations through the conclusion of conventions and agreements. The dilemma of "institutional cooperation theory" is that there may be defects in the fairness and legitimacy of international institutions. If a country blindly follows the cooperative system in order to keep up with the pace of other countries' educational development, there may be unequal cooperation limited by "institutional authority".

"Cultural cooperation theory" emphasizes the foundation of cultural understanding. That is, on the basis of interpreting the world, state actors form a shared cultural consciousness through cooperation that "weakens egoistic identity and creates collective identity, such as interdependence, common destiny, homogeneity and self-constraint" (Wendt, 1999). The dilemma of "cultural cooperation theory" is that the theory solidifies the discourse hegemony beneficial to Western society, leading to the survival of cultural hierarchy. Especially when the clash of civilizations spreads around the world, the collective identity in the theory of cultural cooperation is deeply influenced by Western society, and only by Westernization can non-Western societies form a common culture with the Western society.

"Capacity cooperation theory" emphasizes the aim of capacity building. That is, by introducing higher education services, one country accumulates academic and human resources for itself, and builds educational development on the basis of individual and organizational learning and mastering skills. The dilemma of "capacity cooperation theory" is that capacity cooperation always focuses on the benefits that countries can obtain in cross-border education, and only emphasizes one-way capacity construction, which will eventually lead to utilitarian tendency or formalism in higher education cooperation.

3 Past collaborations and partnerships of China-U.S. Arctic education cooperation

China and the U.S. signed the first agreement on cooperation in science and technology as early as 1979 when the two countries just established formal diplomatic

relations, which was one of the first agreements China signed with foreign governments. Since then China and the U.S. have maintained a good tradition for scientific research cooperation in the past three decades, which laid a foundation for education and research cooperation in the Arctic (Zhang, 2017).

China and the U.S. both attach great importance to the improvement of international cooperation in Arctic education. China's Arctic Policy white paper stresses the importance of personnel training along with the role of universities, education centers, and research institutions in training professionals specialized in Arctic studies (The State Council Information Office of the People's Republic of China, 2018). The Chinese government encourages Chinese universities, research institutes, individual scientists and researchers to join international network projects and participate in academic exchanges and cooperation on the Arctic (The State Council Information Office of the People's Republic of China, 2018). On the American side, Implementation Plan for the 2022 National Strategy for the Arctic Region, issued on 18 October 2023 by the White House, proposes to utilize the Ted Stevens Center for Arctic Security Studies to develop security-related Arctic educational programs for U.S. and international participants; initiate discussions among international funders of Arctic science, and with international science organizations, to identify high priority areas conducive to collaborative research; facilitate sessions at upcoming international scientific conferences to mobilize joint research projects (The White House, 2023).

At the bilateral level, key actors involved in China-U.S. Arctic education cooperation include government agencies, education and research institutions, and individual scientists and scholars. There have been several successful Arctic education collaborations between China and the U.S.. Some typical examples of cooperation are listed below by type of cooperation: academic activity, joint research project, memorandums of understanding signed at national levels and between research institutions, cooperation between individual scientists and scholars.

China-U.S. Arctic Social Science Forum hosted by Tongji University has served as the primary regular mechanism for bilateral education cooperation in social sciences since 2015. The forum has been successfully held six times and has promoted the cooperation and development of the Arctic education between China and U.S. through knowledge exchange, cooperation opportunities exploration, personnel training, research level improvement and cultural exchanges.

The Joint Center for Arctic Research established by the University of Alaska Fairbanks and Harbin Engineering University in China in 2016 is considered as a model of Arctic research and education cooperation between Chinese universities and American universities. The joint research center focuses on research related to Arctic climate change, marine biology, and Arctic policy. The collaboration has resulted in joint research projects and academic exchange programs between the two institutions.

In addition, Chinese Arctic and Antarctic Administration affiliated to the State Oceanic Administration of China and the Office of Polar Programs of the National Science Foundation of the United States signed a memorandum of understanding on bilateral cooperation in the polar field on 25 May 2017. The memorandum of understanding covers a wide range of fields including polar education, such as field expedition, scientific research, logistics support, environmental protection and management, personnel and technical exchanges, policy planning, and science education (The State Oceanic Administration, 2017).

Education cooperation can move forward with partnerships between Chinese and American research institutes, such as the memorandum of understanding between the University of Alaska Fairbanks' International Arctic Research Center and the Chinese Academy of Sciences signed in February 2017. This agreement is meant to bridge research divides and create a stronger environment for academic collaboration and people-to-people exchanges between the institutions (Bowman and Xu, 2020).

Individual scientists and scholars are also key actors in promoting China-U.S. Arctic education cooperation through their involvement in academic activities such as lectures, symposiums, interviews and academic and information exchange. Table 1 shows that except for 2016, scholars and officials from American research institutions, universities and government agencies visited the Polar Research Institute of China (PRIC) every year from 1996 to 2020 for academic and information exchange.

At the multilateral level, the North Pacific Arctic Conference (NPAC), organized by the U.S. East-West Center in Honolulu each year since 2011 could be considered as a good platform for the two countries in Arctic education. NPAC has been bringing a diverse group of Arctic specialists, officials, researchers, practitioners, policymakers, private-sector representatives, and Indigenous Peoples and other community leaders from a variety of countries including China and the U.S. to get together for wide-ranging discussions on Arctic issues. Besides, helping foster a new generation of Arctic leaders is its critical component. Since 2017, NPAC has supported the participation of selected early and mid-career NPAC Fellows who bring fresh perspectives and insights to the meeting so that their Arctic networks are strengthened and they interact substantively with more senior Arctic specialists and each other.

Chinese universities and polar-related government agencies are also committed to promoting China-U.S. Arctic education cooperation under multilateral cooperation mechanisms. Here are two examples to illustrate this point.

Table 1 Visits from American institutions to Polar Research Institute of China

No.	Year	Institutions	Purpose
1	1996	University of New Hampshire	Academic exchange, Memorandum of Understanding
2	1997	Columbia University, Lowell University, National Science Foundation (NSF), University of Maine, University of New Hampshire	Academic exchange
3	1998	Columbia University, National Oceanic and Atmospheric Administration (NOAA), New Mexico State University	Academic exchange
4	1999	Columbia University, University of Maine	Academic exchange, agreement
5	2000	Catholic University of America, Columbia University, Lowell University, University of Alabama in Huntsville, University of Maryland	Academic exchange, research cooperation
6	2001	South Dakota State University, University of Arizona, University of Utah	Academic exchange, symposium
7	2002	University of Colorado	Lecture
8	2003	Columbia University, Lowell University, South Dakota State University, University of Alasky Fairbanks, University of Utah	Academic exchange, lecture, research cooperation
9	2004	NOAA, SeaSpace, University of Alasky Fairbanks	Academic exchange, research cooperation
10	2005	Boston University, Columbia University, Massachusettes Institute of Technology (MIT), National Snow and Ice Data Center, South Dakota State University, U.S. IPY Program	Academic exchange, IPY cooperation
11	2006	Editor of *Science*，Johns Hopkins University, Lowell University, National Aeronautics and Space Administration (NASA), NOAA, NSF, College of William and Mary, University of Georgia, University of Maine, University of Tennessee	Academic exchange, symposium, lecture, interview
12	2007	Civil Society Organizations, Coast Guard, Columbia University, University of Alabama, University of Arizona, University of Chicago, University of Maine, United States Geological Survey	Academic exchange, symposium, lecture, visit
13	2008	Columbia University, Woods Hole Oceanographic Institution (WHOI)	Academic exchange, lecture
14	2009	Hawker Beech Craft Corporation, South Dakota State University, University of California, WHOI	Academic exchange, business visit, lecture
15	2010	Coast Guard, Department of Commerce, Michigan State University, National Center for Atmospheric Research, NOAA	Visit, academic and information exchange, lecture
16	2011	Coast Guard, Columbia University, Georgia Institute of Technology, Princeton University, University of California at Los Angeles, University of California Santa Barbara, University of Florida, MIT, NOAA, U.S. Consulate in Shanghai	Academic exchange, visit, lecture
17	2012	Coast Guard, U.S. Consulate in Shanghai	Information exchange
18	2013	Colorado State University, NSF, South Dakota State University, University of Washington	Academic exchange, visit, lecture
19	2014	Butler University, NOAA, NSF, Princeton University, Stimson Center, University of Florida, University of Texas at Dallas, University of Virginia, University of Wisconsin, U.S. Consulate in Shanghai, U.S. Naval War College	Academic and information exchange, lecture, visit
20	2015	University of Colorado, U.S. Consulate in Shanghai	Research cooperation, information exchange
21	2016	None	
22	2017	American Geophysical Union, Montana State University, NOAA, University of Texas, U.S. Consulate in Shanghai	Academic and information exchange, lecture
23	2018	University of Florida, University of Texas at Austin, Yale University	Academic and logistic cooperation
24	2019	Kenn Borek Air Ltd., NOAA, Pennsylvania State University, University of Florida, University of Texas at Austin, U.S. Consulate in Shanghai	Academic and information exchange, research cooperation
25	2020	U.S. Consulate in Shanghai	Information exchange

The International Arctic Summer School and Winter School initiated and organized by Harbin Institute of Technology (HIT) are cases to illustrate this point. International students including American students improved their understanding of China's Arctic policies and research, and Chinese students improved their understanding of Arctic issues by taking part in distinguished professors' courses, special lectures, experiment courses, group discussions, cultural trips and other learning activities at the HIT International Arctic School. Meanwhile, HIT International Arctic School helps strengthen understanding, friendship and cooperation between students from universities in China and the U.S. by providing a unique and advanced platform for educational cooperation (Harbin Institute of Technology, 2020).

The Ministry of Natural Resources of China took advantage of the opportunity of hosting the Arctic Circle China Forum in May 2019 to specially organize a sub-venue activity of "Arctic Education Cooperation", providing a platform for international Arctic academic

exchanges and cooperation, including China-U.S. cooperation (Harbin Institute of Technology, 2019).

Past successful collaborations and partnerships of China-U.S. Arctic education cooperation at the bilateral and multilateral levels led to promote better and deeper understanding of challenges and opportunities facing the Arctic, contributed to ideas exchange and knowledge sharing, as well as helped enhance mutual understanding and bilateral relations between the two countries.

4 Challenges of China-U.S. Arctic education cooperation in current phase

Although collaborative efforts between China and the U.S. in Arctic education have had many benefits, these efforts do face the following challenges.

First, recent tensions have cast a shadow over China-U.S. Arctic education cooperation. The two countries have had a long-standing rivalry in economic and other spheres, and the Arctic has become yet another arena for this rivalry to play out. Any political or economic tensions between the two nations could disrupt ongoing collaborative efforts and impede the development of Arctic education cooperation. One of the challenges affecting China-U.S. Arctic education cooperation in most recent years is "China Initiative" launched by the U.S. Department of Justice in November 2018 under Donald Trump Administration, in response to what it called foreign security and technological threats. In the following three years, hundreds of scientists had been investigated by the government, and dozens had been arrested on criminal charges, and the vast majority of them were Chinese-Americans or Chinese nationals (Liu, 2022). As a result, Chinese scientists and Chinese-American scientists are increasingly fearful about working in the U.S. and conducting research and education collaborations with Chinese universities and research institutes for fear of being accused of spying.

Another challenge that continues to impede China-U.S. Arctic education cooperation comes from suspicions among Arctic states, including the U.S., about China's expanding presence and rising influence in the Arctic as well as China's real intentions toward the Arctic. Tremendous skepticism that China faces in the Arctic (Koivurova and Kopra, 2020) may get worse in the era of strategic competition between China and the U.S. and in the context of long COVID and the Russia-Ukraine conflict, which hinders China's bilateral and multilateral cooperation in the Arctic.

China-U.S. education cooperation and exchanges have been greatly affected by the COVID-19. In 2020, as of the end of September, the U.S. had issued only 808 visas to Chinese students, compared with 90410 visas in 2019, before the COVID-19 pandemic. By reducing the number of visas issued, the U.S. has restricted Chinese students and scholars from studying and exchanging in the U.S. (Cen, 2021).

The Russia-Ukraine conflict has further affected China-U.S. relationship. Washington and Beijing have profound differences about the origin and responsibility of the Russia-Ukraine conflict, which is in essence a major difference between the two sides on the nature of the current international order and future development vision.

Second factor affecting China-U.S. Arctic education cooperation is the differing perspectives and priorities on Arctic policy. The U.S. views the Arctic mainly through a security lens. The United States' National Strategy for the Arctic Region launched in October 2022 by the White House places Arctic security as its first pillar, and the protection of the American people and Arctic sovereign territory and rights as its highest priority (The White House, 2022). Accordingly, the U.S. will continue to enhance and exercise its military capabilities in the Arctic. In fact, the U.S. military forces have been paying greater attention to the Arctic since 2019 which is reflected in all the Arctic Strategies released by the U.S. Department of Defense and its subordinate branches including the Coast Guard, Navy, Air Force, and Army (The Department of the Air Force, 2020; United States Coast Guard, 2019). Two things are noteworthy about these Arctic military strategies, as Dr. Yuanyuan Ren pointed out that: first, these strategies view the Arctic through a prism of a great power rivalry and particularly depict China as a principal "near-peer competitor" in the Arctic; second, these strategies highlight international cooperation with allies and partners among the Arctic states rather than with non-Arctic states (Ren, 2023).

China's spectacular economic growth since the late 1970s has made it one of the largest importers of energy and raw materials to fuel its growth, which has been overwhelmingly export-driven. Energy security, supply security of raw materials and open sea lanes for export are therefore key interests of China. The Arctic is one possible source region of energy and raw materials for China and although production costs are high in the Arctic, political stability is much better compared to volatile regions in the Middle East, Africa or parts of Latin America especially before the Russia-Ukraine conflict. Consequently, China sees the Arctic as a vital component of its economic development strategy.

While pursuing its own interests, China pays due regard to the interests of other countries and the broader international community. At the same time, China's Arctic policy released in 2018 also emphasizes the proper balance between economic development and protection of the Arctic, and the proper balance between current and long-term interests in the Arctic, so as to promote the sustainable development of the Arctic. Chinese President Xi clearly defined that the polar regions, together with cyber space, the deep seabed and outer space, are a part of "new frontiers for cooperation to collectively build a community of shared

future for mankind" in his Geneva speech on 18 January 2017 (Xinhua Net, 2017).

These differing priorities and perspectives of the U.S. and China on their respective Arctic policies have resulted in a lack of agreement on key issues such as resource development, and indigenous rights. This policy gap has slowed down progress on projects and dampened the enthusiasm and willingness for further collaboration.

Third, the disproportion between China and the U.S. in Arctic scientific research, different research methodologies and discourse system in social science, cultural differences and language barriers make it challenging to develop a standardized approach and a structured curriculum for Arctic research and education which could be adaptable to both countries' academic and research institutions.

5 Discussions and suggestions for future China-U.S. Arctic education cooperation

Despite above challenges, there are ample foundations and opportunities for further cooperation. First, both China and the U.S. share some common goals and interests in the Arctic, which are the basis for China-U.S. Arctic cooperation. The convergence of interests of the two countries in the Arctic centers on tackling climate change, advancing scientific research, protecting the environment, and promoting sustainable development in the Arctic region. The pressing issues such as climate change, environment degradation, transboundary pollution in Arctic cannot be solved by Arctic states working in isolation from non-Arctic states. International cooperation is crucial to reducing human induced damage to the Arctic ecosystems. The nature of Arctic governance, solving these transboundary issues, means that Arctic states and non-Arctic states should pursue all the human beings' interests rather than its individual interest.

Climate change in the context of the Arctic opens a window for China-U.S. education cooperation. The Arctic is a huge region with complex global connections, no individual state can conduct Arctic education and research alone (Yang H G, 2021). The Arctic is one of key regions for understanding global climate systems. Recent climate change statistics regarding the Arctic show that the Arctic is warming faster than other parts of the world. China's Arctic Policy white paper stresses China's determination to address climate change in the Arctic. The Biden Administration appears eager to restore American leadership in the Arctic on climate change. Immediately following his inauguration, Biden signed two executive orders on climate change: the Executive Order on Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis and the Executive Order on Tackling the Climate Crisis at Home and Abroad (Executive Office of the President, 2021a, 2021b). Both China and the U.S. agreed that one of the several areas where China and the U.S. interests intersect is the climate crisis and both expressed their willingness to enhance cooperation in tackling climate change at the 2021 the U.S.-China High-level Strategic Dialogue in Alaska. After that, the two countries had a series of meetings and talks on climate change, including the release of the April 2021 China-the U.S. Joint Statement on Climate Crisis, virtual Leaders' Summit on Climate on 21 April 2021, and the U.S. Special Presidential Envoy for Climate John Kerry's visits to Beijing for further discussion in 2021 and 2023. China-the U.S. education and research cooperation to tackle climate change in the Arctic is achievable by establishing a high-level dialogue on Arctic climate research to maintain communication on each countries' research tendency in the Arctic and provide much-needed data sharing; reviving The U.S.-China Climate Change Working Group, which was suspended by the Trump Administration, and facilitating easier movement for educators and researchers by reducing visa requirements and restoring closed consulates and diplomats working in educational and scientific exchanges (Hong, 2022).

Second, both China and the U.S. have a number of institutions dedicated to Arctic research and education, including universities, government agencies, and non-profit organizations. These institutions have developed significant Arctic research capabilities, collaborated with partners around the world to advance Arctic research and education and accumulated a wealth of Arctic knowledge, providing a foundation for Arctic education.

Few Chinese social scientists paid attention to Arctic social sciences and human sciences before 2007. But a gradual awakening took place among Chinese government officials and social scientists when Russian explorers planted a national flag on the seabed below the North Pole in 2007 (Jakobson and Peng, 2012). Chinese Arctic and Antarctic Administration has been directing a huge systematic research project named "Chinese Polar Environment Comprehensive Investigation & Assessment Programmes" since 2012 (China News Service, 2012). One motive of this project is to integrate and develop domestic polar institutes and researchers, especially majoring in social and humanity sciences. Supported by this project, China now has a growing pool of polar experts and networks of polar research institutes nationwide. Since then, Chinese Arctic research has formed a rationally structured research team and recruited a group of mature social scientists and human scientists, as well as cultivated a group of budding young scholars at home and abroad. In recent years, there has been a significant increase in the number of Chinese universities and research institutes focused on Arctic issues, including Tongji University, Ocean University of China, Dalian Maritime University, Wuhan University, Shanghai Jiao Tong University, Harbin Engineering University, Liaocheng University, Shanghai Ocean University, Guangdong University of Foreign Studies, Shanghai Institutes for International Studies (SIIS),

and PRIC.

Arctic-dedicated universities, non-governmental institutions and organizations in the U.S. mainly include: Center for Strategic and International Studies, Arctic Law and Policy Institute of University of Washington, Institute of Arctic and Alpine Research of University of Colorado, Institute for Arctic Studies of Dartmouth College, Polar Center of Pennsylvania State University, the Arctic Institute, Institute of the North, University of Alaska Fairbanks, University of Alaska Anchorage, University of Alaska Southeast, Polar Institute of Wilson Center, Arctic Initiative, Belfer Center of Harvard Kennedy School, Alaska Pacific University, University of Northern Iowa, and Arctic Research Consortium of the United States.

As an Arctic state, the U.S. has played a leading role in generating knowledge on the Arctic; although as non-Arctic state, China has made some incremental contributions in the field of Arctic education and research during the past decades. Since the first scientific expedition to the Arctic in 1999, China has successfully carried out 13 research expeditions in the Arctic. The research areas of China's previous Arctic research expeditions have focused on marine chemistry, biology and geology, Arctic pollution and marine resources, evaluation of the Arctic environment and climate, sea ice, biodiversity, ocean acidification, plastic waste, etc. (Guo and Erokhin, 2021). Chinese scientists have developed significant Arctic research capabilities. They are carrying out long-term observations of key environmental elements, studying a wide range of topics, including the impacts of climate change on Arctic ecosystems, and implementing atmospheric, sea ice, marine, and sediment environmental surveys through Arctic scientific expeditions.

The U.S. has long been one of the world's leading states in Arctic scientific research. It has a long history of Arctic research, and has established its own Arctic research policy and priorities. These priorities include understanding the impacts of climate change on Arctic ecosystems, improving scientific understanding of Arctic processes, and developing sustainable resource management practices.

The third opportunity for China and the U.S. to develop cooperation concerning the Arctic education lies in the implementation of a new science-based Arctic treaty. The Agreement on Enhancing International Arctic Scientific Cooperation (ASCA) negotiated under the auspices of Arctic Council (AC), adopted by the eight Arctic states in 2017 and entered into force in 2018 provides a framework for Arctic education cooperation in a broad sense (Arctic Council, 2017). ASCA is regarded as a strong signal to "promote scientific cooperation even when diplomatic channels among nations are unstable" (Berkmen, 2017). Although China is a non-Arctic state, it was invited to participate in the negotiating process as an AC observer. The awareness of ASCA is presently quite low in both China and U.S. (Ren, 2023). According to Article 2, ASCA aims to enhance cooperation in scientific activities between Arctic states and non-parties countries in order to increase effectiveness and efficiency in the development of scientific knowledge about the Arctic (Arctic Council, 2017). So this agreement could be fully invoked by China and U.S. to overcome political tensions to promote Arctic education cooperation in the future.

Fourth, there have been frequent high-level contacts between China and the U.S. in recent months. U.S. Secretary of State Antony Blinken, Secretary of Treasury Janet Yellen and Special Presidential Envoy for Climate John Kerry visited Beijing one after another in June and July 2023. These contacts and America's cooperative posture in the talks might be a necessary cushion and positive sign, especially in low-political areas such as education cooperation. One of the five consensus which came from Foreign Minister of China's meeting with U.S. Secretary of State on 18 June 2023 relates to China-U.S. education cooperation and exchange, that is: "Both sides agreed to step up more people-to-people and educational exchanges. Both sides welcome more mutual visits by students, scholars, and agreed to provide support and facilitation to this end." It's a positive step and we expect that both sides will convert positive statements into actions as soon as possible.

Only on the premise of adhering to diversity and equality, on the basis of promoting democratic coordination, on the motivation of dispelling misunderstanding of ideas, and on the purpose of achieving mutual benefits, can we get out of the dilemma of traditional education cooperation theories (Zhang and Liu, 2019), and promote further cooperation in China-U.S. Arctic education. In view of this, the governments and academic institutions of both countries need to work together to develop policy initiatives, provide more funding for academic exchange programs and joint research projects, expand more academic exchange programs and develop more joint research projects; additionally Arctic natural scientists, social scientists, indigenous knowledge holders, industrial representatives and diplomats have chances to engage each other to exchange Arctic knowledge and are able to create cooperation networks when needed. So, involving more individual actors and organizations of both countries in joint research projects, educational programs, Arctic-related conferences and events is a crucial way of promoting China-U.S. Arctic education cooperation too.

China Nordic Arctic Research Center (CNARC) has established a successful model for Arctic education cooperation between China and Nordic countries. The CNARC is an open platform and is composed of an Executive Committee, and Assembly of the Representatives of Member Institutes, Directors, and a Secretariat. It undertakes various forms of cooperation such as academic symposia, fellowships for visiting scholars and joint publications (Shan et al., 2023). Since its establishment in 2013, the CNARC has effectively promoted the transfer of Arctic knowledge from the Nordic countries to China and formed a network for academic exchange, policy

coordination, knowledge dissemination and information release among member countries.

CNARC fellowship program has been launched since May 2014, offers opportunities for excellent researchers from both China and Nordic states, to conduct joint research within leading research institutes in Arctic studies. The program allows researchers to advance their own research projects while contributing to an increased awareness, understanding and knowledge of the Arctic and its impacts for both China and Nordic States. Since 2014, 22 researchers have successfully taken advantage of the CNARC platform (Tables 2 and 3), and have strengthened research projects and partnerships of CNARC members in return (CNARC, 2023).

Table 2 Chinese scholars visiting Nordic institutions under CNARC platform (2014–2023)

No.	Chinese scholar affiliated institution	Visiting Nordic institution
1	Tongji University	Fridtjof Nansen Institute, Norway
2	SIIS	Norwegian Polar Institute, Norway
3	SIIS	Arctic Centre, University of Lapland, Finland
4	Shanghai Jiao Tong University	Stefansson Arctic Institute, Iceland
5	Shanghai Ocean University	Fridtjof Nansen Institute, Norway
6	Tongji University	Arctic Research Centre, Umea University, Sweden
7	Dalian Maritime University	Lapland University, Finland
8	Shanghai International Studies University	Umea University, Sweden
9	SIIS	Nordic Institute of Asian Studies, Denmark
10	Tongji University	Fridtjof Nansen Institute, Norway
11	Shanghai Ocean University	University of Akureyri, Iceland
12	South China Business College	Lapland University, Finland

Table 3 Nordic scholars visiting Chinese institutions under CNARC platform (2014–2023)

No.	Scholar affiliated institution	Visiting Chinese institution
1	University of Iceland	SIIS/PRIC
2	Arctic Center, Lapland University	Ocean University of China
3	The Arctic University of Norway	Tongji University/SIIS/PRIC
4	University of Copenhagen	PRIC
5	University of Turku	China Ocean University
6	University of Copenhagen	Tongji University
7	The University of Faroe Islands	Shanghai Ocean University
8	Umea University	Shanghai Jiao Tong University
9	The Arctic University of Norway	Shanghai Jiao Tong University
10	University of Akureyri, Iceland	Shanghai Ocean University

Other than the CNARC fellowship program, China-U.S. Arctic education cooperation can also learn the successful practices from the CNARC model by (1) carrying out joint research projects in accordance with research themes with respect to Arctic climate change, Arctic resources, shipping and economy, as well as Arctic policy-making and legislation; (2) developing Arctic research networks and frontiers by providing opportunities for Chinese and American scholars to conduct Arctic research through fellowship programs; (3) convening regularly with the China-U.S. Arctic Cooperation Symposium and at other workshops; (4) facilitating information sharing and cultural exchanges between China and U.S. in an Arctic context (Yang J, 2021).

Moreover, cooperation between the two countries within international cooperation platforms and mechanisms needs to be further promoted. Taking the University of the Arctic (UArctic) as an example: UArctic is a cooperative network of 201 universities, colleges, and other organizations committed to higher education and research in the North. Through UArctic, members share resources, facilities, and expertise to provide relevant and accessible post-secondary education for the North; work in partnership with indigenous peoples, seek to engage their perspectives and participate in all activities; promote excellence in knowledge generation and application in areas relevant to the North; promote cooperation in a context in which recognized degrees are granted by the members themselves.

Dr. Yuanyuan Ren, associate fellow at UArctic Chair of Arctic Legal Research and Education, found out in her work that China and the U.S. rarely interact and cooperate at the University of the Arctic cooperative network. At present, 15 Chinese universities and research institutions

and 26 American universities and research institutions are UArctic members (Table 4), ranking first among non-Arctic countries and third among Arctic countries respectively. UArctic members are engaged in research, education, and development activities with each other. UArctic activities are coordinated with Arctic research and are also relevant to Arctic Council working groups, indigenous people organizations, and Arctic science and development organizations. Therefore, UArctic members of China and the U.S. could take advantage of UArctic activities such as GoNorth (assisting members to promote their institutions as northern destinations of study to those outside the region), Rectors' Forum (annually brings together university leaders around specific themes), Student Forums (accompany Rectors' Forums, giving students from across UArctic membership a direct voice), Student Ambassadors (the creation of UArctic Student Ambassadors is to promote UArctic and its activities, and engage UArctic Member students to create a "UArctic student" community), etc., to carry out broader and deeper education cooperation.

Early and mid-career young scholars network building will be crucial for the future China-U.S. Arctic education cooperation. Young people have empathy for the citizens of another country and are willing to work together with them. The China-U.S. Youth Scholars Forum jointly organized by Global Times and Carter Center in the U.S. as well as Chinese institutions has set a great example on China-U.S. education cooperation. The forum aims to provide a platform for young people from both countries to exchange and understand each other. In September 2014, the first China-U.S. Youth Scholars Forum was held in Xi'an, China. Since then, it has been gathered for dialogue and education exchange for eight times under different themes. In recent years, the criticism and disputes in China-U.S. relations have made it increasingly difficult for the two countries to collaborate for common interests, early and mid-career young scholars network building helps find ways for the people and governments of China and the U.S. on Arctic education cooperation (Fu, 2020).

Table 4 Current UArctic membership of China and the U.S.

Country	Member of universities	Member of research institutes/other organizations
China	1. Arctic Studies Center, Liaocheng University 2. Dalian Maritime University 3. Fudan University 4. Harbin Engineering University 5. Jilin University 6. Ocean University of China 7. Department of Ocean Science and Engineering, Southern University of Science and Technology 8. Wuhan University	1. Chinese Academy of Meteorological Sciences 2. Chinese Research Academy of Environmental Sciences 3. First Institute of Oceanography, Ministry of Natural Resources 4. Harbin Institute of Technology 5. National Marine Environmental Forecasting Center 6. Polar Research Institute of China 7. Second Institute of Oceanography, Ministry of Natural Resources
U.S.	1. Alaska Pacific University 2. Arctic Initiative, Belfer Center, Harvard Kennedy School 3. Climate Change Institute - University of Maine 4. Dartmouth College 5. Fletcher School of Law and Diplomacy, Tufts University 6. Ilisagvik College 7. University of Alaska Anchorage 8. University of Alaska Fairbanks 9. University of Alaska Southeast 10. University of Colorado 11. University of Maine at Fort Kent 12. University of New England 13. University of New Hampshire 14. University of North Dakota 15. University of Southern Maine 16. University of Washington	1. Battelle Memorial Institute 2. Cold Climate Housing Research Center 3. Institute of the North 4. Science Diplomacy Center 5. Wilson Center, Polar Institute 6. Aleut International Association 7. Anchorage Museum 8. Arctic Research Consortium of the United States 9. Scandinavian Seminar Group 10. The Yellow Tulip Project

6 Conclusion

The unique climate, geography and ecosystem of the Arctic require international cooperation in Arctic research and education. Many education and research projects are presently being carried out in collaboration with China and Arctic states including the U.S. Arctic education cooperation is one of the few issue areas where China and the U.S. could develop mutual trust and improve bilateral relations, under the present stagnation of international cooperation in the Arctic affected by the Russia-Ukraine conflict and the intensifying strategic competition between China and the U.S. The discussion of the Arctic education as a opportunity for cooperation adds another dimension to China-U.S. relations.

The dilemma of "power cooperation theory" is the most significant in China-U.S. Arctic education cooperation. The ongoing deterioration of China-U.S. relations is the biggest challenge hindering the Arctic education cooperation between the two countries. Despite a series of recent high-level meetings that aim to manage the relations, Biden's intentions towards China have been rather clear since he took office. Additionally, the U.S.' priority partners in Arctic cooperation, including education cooperation, are Arctic states, not non-Arctic states; moreover, fearing a new

distribution of power as China rises, the U.S. is skeptical of China's intentions to expand its investment, presence and influence in the Arctic, and is therefore wary of cooperating with China. All of these factors pose challenges to China-U.S. Arctic education cooperation.

Arctic scientific research, without doubt, is the main activity of both China and the U.S. in Arctic as science is the currency for influence and decision-making power in Arctic affairs. In this regard, China and the U.S. share considerable converging interests in the Arctic such as marine scientific research, climate change, conservation of living resources and protection of environment and ecosystem. These issue areas are opportunities for further cooperation between China and the U.S. in the field of Arctic education. Meanwhile, Arctic social sciences, human sciences and art account for a small proportion of the current China-U.S. cooperation in Arctic education. These disciplines and related issue areas should also be attached importance in future China-U.S. Arctic education cooperation.

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