Educational Development in China: Progress, Challenges, and Outlook

Report prepared for the U.S.-China Economic and Security Review Commission

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Abstract

This report provides a desk review of recent educational policy priorities and developments in China. The report first provides a brief background on the development of the educational system today and introduces current administrative structures and national policy priorities for education. It next introduces important aspects of the context in which the educational system functions, with attention to challenges associated with emerging economic and demographic trends. The report then reviews recent policies and developments, organized by level of schooling. For each level of schooling, the report touches on current policies and policy goals and discusses available data and selected scholarly findings regarding progress in implementing policy goals, equity issues, and quality. The report also discusses available evidence regarding incorporation of EdTech and AI in education. The report closes with a summary of key elements of progress in China's educational development and a reflection on challenges ahead.

Keywords: Educational policy, educational systems, educational development, China

Contents

1 Introduction

1.1 Purpose of the report

This report provides an overview of recent educational policy priorities and developments in China. The report summarizes key policies and guidance documents, with respect to each stage of education, considers available evidence about progress and challenges in reaching policy goals, and considers the outlook, looking ahead.

1.2 Structure of the report

The structure of the report is as follows. It will first provide brief background on the development of the educational system today and then introduce current administrative and leadership structures and national policy priorities. It will next introduce important elements of the context in which the system functions, with attention to challenges associated with economic and demographic trends. The report will then turn to an overview of recent policies and developments, organized by level of schooling. For each level of schooling, the report will touch on current policies and policy goals and discuss available data and scholarly findings regarding progress in implementing policy goals, equity issues, and quality. The report will also discuss policies regarding EdTech and AI in education. The report will close with a summary of key elements of progress in China's educational development as well as challenges ahead.

2 Background

2.1 Development of the current educational system

Expanding access to basic education was a priority in the early ears of the People's Republic of China. Educational provision expanded rapidly in urban and rural areas (Hannum 1999). In the late 1950s and early 1960s, radical policies of the Great Leap Forward and an associated famine caused massive disruptions; in the mid-1960s to the mid-1970s, the Cultural Revolution brought a radical egalitarianism and an educational push into the countryside (Hannum 1999). At the end of the 1970s and into the 1980s, China embarked on market transition. A 1986 law decreed the roll-out of a 9-year period of compulsory schooling and offered guidelines on financing and other regulations (Pan, Vayssettes, and Fordham 2016). The law stipulated this right regardless of "gender, race, ethnicity, family socioeconomic status, or religious beliefs" (National People's Congress 1986), but children with disabilities were not explicitly assured of these rights in the 1986 law (An, Hu, and Horn 2018, 118).

In the early 2000s, policies continued to target cost barriers to basic education. The Compulsory Education Law was revised in 2006 (National People's Congress 2006), with guidelines prohibiting miscellaneous fees[1](Pan, Vayssettes, and Fordham 2016, 12). An, Hu, and Horn (2018) report that

1. The wording in the law itself does not specify the meaning of miscellaneous fees. It states, "No tuition or miscellaneous fees shall be charged for provision of compulsory education," suggesting that the strategy of charging what might be considered tuition by another name is not allowed (National People's Congress 2006)

the 2006 re-authorization of the compulsory education law (National People's Congress 2006),[2] and a Law on the Protection of Disabled Persons (National People's Congress 2008, article 21) stipulate the rights of persons with disabilities to education.

Paralleling developments in other parts of East Asia, curriculum reforms in the early 2000s sought to promote more holistic, student-centered learning (Hannum et al. 2019; Sargent et al. 2011; Sargent 2009). China began to address the demographic challenges of falling fertility and urbanization by a massive school consolidation push in the countryside starting in 2001 (Hannum, Liu, and Wang 2021; Hannum and Wang 2022). Finally, higher education was aggressively expanded in the early 2000s (Xiong, Yang, and Shen 2022). China also espoused a major policy initiative to universalize pre-primary education by 2020 (Pan, Vayssettes, and Fordham 2016, 11), has prioritized reforming vocational and technical education, including expanding corporate partnerships for apprenticeship training, and has set out plans for incorporation of smart technology and AI in education across levels (Australian Embassy in Beijing and Department of Education of Australia 2021).

Finally, as in all societies, social and economic inequalities shape educational opportunities and experiences. Children in poor households and communities, children in remote rural areas, children affected by migration, children with health problems or disabilities, and children from some of China's officially-recognized ethnic minority communities can face challenges in securing full access to high quality educational experiences, compared to others. These issues have continued to shape national policy agendas (National Working Committee on Women, National Bureau of Statistics, and UNICEF China 2018a, 108).

2.2 Administration and leadership of the educational system

This section relies in full on a thorough overview of national educational administration and leadership in China provided in Liu and An (2020). There are five leading entities in China's political

2. Article 6 states, "The State Council and the local people's governments at or above the county level shall rationally allocate educational resources, promote balanced development of compulsory education, help the schools started on weak foundations to improve the conditions for school running, and adopt measures to ensure that compulsory education is provided in rural areas and in areas inhabited by ethnic groups and that the school-age children and adolescents who are from families with financial difficulties or who are disabled receive compulsory education." Article 19 states, "People's governments at or above the county level shall, in light of need, establish schools (classes) to provide special education that is appropriate for school-age children and adolescents who are blind, deaf-mute or [developmentally delayed] to receive compulsory education. Such schools (classes) shall have places and facilities tailored to the special characteristics of the said children and adolescents for the benefit of their study, rehabilitation and daily life.

Regular schools shall admit to the classes corresponding to the levels of the disabled school-age children and adolescents who are capable of receiving regular education and provide them with aid in study and rehabilitation."

system: the Communist Party of China (CPC) Central Committee,[3] the State Council,[4] the National People's Congress (NPC),[5] the Chinese People's Political Consultative Conference (CPPCC) National Committee,[6] and the Central Military Commission[7] (Liu and An 2020). These entities "constitute the decision-making system ... at the national level and thus have a strong impact on the governance and management of educational institutions" (Liu and An 2020, 8–9). China's Constitution and a series of regulations issued by the Communist Party of China (CPC) Central Committee and the State Council provide the foundation within which the central government and local governments have set up structures of educational leadership and administration for education in China (Liu and An 2020, 8–9):

> ... [T]he Constitution of the PRC and The Educational Law of the PRC make legal provisions for the administrative system of education in China. The Constitution stipulates that the State Council guides and governs the work of education. Local governments at or above the county level within the restraints of authority regulated by law are in charge of the educational cause in their respective administrative areas. The Educational Law specifies that the State Council and local people's governments at various levels shall lead and govern the work of education in accordance with the principles of hierarchical management[8] and division of responsibility ... Primary and secondary education [are] administered by local people's governments under the leadership of the State Council. Higher education is managed by the State Council and the people's governments of provinces, autonomous regions, and municipalities directly under the central government.

3. The CPC Central Committee is the top leadership entity of the Communist Party. The fundamental policies of the CPC Central Committee "become national will through the NPC and its Standing Committee" and are implemented by the State Council (Liu and An 2020, 9). Liu and An (2020, 9) report that "[s]ome important educational reform and development policies are made in the name of the Central Committee of the Communist Party of China, while more educational reform and development policies are made according to the procedures and guiding ideology of the Central Committee."

4. The State Council is the top administrative entity and the top implementing entity for policies and decisions made by the National People's Congress; it guides and governs the work of education(Liu and An 2020, 8–9).

5. The National People's Congress is the top organ of state power, has national legislative power, and is responsible for enacting and amending the constitution and fundamental laws, among many other responsibilities. Education laws and important educational reform and development policies are usually passed by the National People's Congress (Liu and An 2020, 10).

6. The Chinese People's Political Consultative Conference (CPPCC) National Committee is an entity for political consultation with other parties and non-party people on national fundamental policies and other key issues (Liu and An 2020, 10).

7. The Central Military Commission is only responsible for military higher education (Liu and An 2020, 10).

8. The source explains, "[H]ierarchical management means that all levels of people's governments have different management responsibilities for education at all levels. Division of responsibility means the government departments at the same level — such as education, finance, national development and reform, personnel, audit, etc. — shoulder different responsibilities for the educational cause based on their duties" (Liu and An 2020, 8–9).

2.3 Current national priorities in education

A guiding document in current, national educational priorities is China's *Education Modernization 2035 Plan*, the broad goals of which include the below items (see Australian Embassy in Beijing and Department of Education of Australia (2021) and Zhu (2019, 357):

1. Establishing a modern education system
2. Achieving universal attendance in quality pre-school education
3. Providing high quality and balanced compulsory education
4. Achieving maximum attendance in senior high school
5. Significantly improving vocational education
6. Building a more competitive higher education system
7. Providing adequate education for disabled children/youth, and
8. Establishing a new education management system with participation from the whole society (i.e. not solely relying on government support).

A few months after the release of the 2035 Plan and Implementation Plan, one report indicates that the Ministry of Education issued a joint circular together with 10 other central government agencies to set the direction for online education development (Australian Embassy in Beijing and Department of Education of Australia 2021). The document offered guidance for improving China's online education infrastructure, with the Internet, big data and Artificial Intelligence (AI) set to be used more widely in education (Australian Embassy in Beijing and Department of Education of Australia 2021).

The goals of the 2035 Plan are very consistent with the educational priorities articulated in "Outline of the People's Republic of China 14th Five-Year Plan for National Economic and Social Development and Long-Range Objectives for 2035" (National People's Congress 2021), commonly referred to as China's 14th Five-Year Plan. The value attached to education in this national strategic planning document is indicated by the presence of an educational goal — increasing the education of the workforce from 10.8 years in 2020 to 11.3 years in 2025[9] — as a "binding" indicator among the main social and economic development goals set out in section 1 of the document (National People's Congress 2021, Table 1, 10).

In part 5 of the document, entitled "Accelerate digitalization-based development and construct a digital China," the document sets out a commitment to "smart education" in "Digitalized application scenarios:" "We will promote the integration of socialized (社　化, *she hui hua*), high-quality, and online course resources into the public teaching system, we will promote the online radiation of high-quality educational resources to weak schools in rural areas and remote areas, and develop

9. No information is provided in the source about the rationale for or significance of this specific educational benchmark.

scenario-based and experiential learning and intelligentized education management evaluation" (National People's Congress 2021, Table 9, 45).

Finally, part 13 of the document, "Improve the quality of citizens (民素 , *guo min su zhi*) and promote comprehensive human development," contains section XLIII, "Construct a high-quality educational system" (National People's Congress 2021, 104). In a table entitled, "Educational quality increase and capacity expansion projects," five commitments are made (National People's Congress 2021, Table 16, 107):

1. **Inclusive kindergartens:** Focusing on areas where the population is concentrated, rural areas, and the "Three Regions and Three Prefectures" (三 三州, *san qu san zhou*),[10] we will build, renovate, and expand 20,000 kindergartens and add over 4 million inclusive enrollment slots.

2. **Basic education:** Focusing on counties with weak educational foundations and population inflow areas, we will build, renovate, and expand 4,000 primary and secondary schools. We will construct 100 "national door schools" (校, *guo men xue xiao*) in border counties (and Xinjiang Production and Construction Corps farms (, *tuan chang*).

3. **Vocational and technical education:** We will support the construction of 200 high-level vocational schools and more than 600 high-level majors and support the construction of a number of excellent secondary vocational schools and high-quality majors.

4. **Higher education:** We will strengthen "double first-class"[11] construction of basic research and collaborative innovation capabilities of colleges and universities, improve the operating conditions of 100 undergraduate colleges and universities in the central and western regions, and lay out and build a number of high-level public health colleges and high-level normal colleges.

5. **Production and education integration platforms:** Focusing on key areas such as ICs, AI, industrial internet, and energy storage, we will lay out and build a batch of national innovation platforms for the integration of production and education and joint training bases for graduate students. We will build 100 high-level, professional, and open training bases for the integration of production and education."

The document also places emphasis on cultural preservation, patriotic education and party education, and moral education.

10. This term refers to highly impoverished areas – "the "three regions" are Tibet, the Tibetan ethnic areas of Sichuan, Yunnan, Gansu and Qinghai provinces, and the four prefectures in southern Xinjiang (Hotan, Aksu, Kashi and the Kizilsu Kirgiz Autonomous Prefecture). The "three prefectures" are Liangshan in Sichuan, Nujiang in Yunnan and Linxia in Gansu"(China.org 2021).

11. This English-language source uses the term "world class" in place of "first class." I have changed the translation in the main text to be "first class," with the intent to be consistent with other sources later in this report. A translator's note in the cited source explains that the PRC government launched its "world-class universities and world-class curricula" (世界一流大 和一流 科, *shi jie yi liu da xue he yi liu xue ke*) initiative, abbreviated "double world-class" (一流, *shuang yi liu*), in 2017 with the aim of increasing the number of Chinese universities that rank among the world's best. See discussion below, in the section entitled, Tertiary Education.

Xi Jinping's October, 2022 report to the 20th National Congress of the Communist Party of China reaffirmed these commitments (Xi 2022, 20). The report highlighted as a goal to "[b]ecome a leading country in education, science and technology, talent, culture, sports, and health; significantly enhance national soft power" (Xi 2022, 20). The document contained a section entitled, "Invigorating China through Science and Education and Developing a Strong Workforce for the Modernization Drive," which starts with the sentence, "Education, science and technology, and human resources are the foundational and strategic pillars for building a modern socialist country in all respects" (Xi 2022, 28). The document highlights the goal of "fostering virtue through education, and [nurturing] a new generation of capable young people with sound moral grounding, intellectual ability, physical vigor, aesthetic sensibility, and work skills who will fully develop socialism and carry forward the socialist cause" (Xi 2022, 28).

The document stresses "high-quality, balanced development and urban-rural integration in compulsory education," strengthening preschool education and special needs education, ensuring the diversified development of senior secondary schools, promoting collaboration and innovation in vocational education, and improving the financial aid system so it covers students at all stages of schooling. The document pledges support for the development of basic disciplines, emerging disciplines, and interdisciplinary subjects, and building up world-class universities and strong disciplines, with Chinese features. Promotion of standard spoken and written Chinese is a priority. Finally, the document supports development of new teaching materials, systems for school management and educational assessments, and mechanisms for school-family-society collaboration, endorses digitalization of education, and embraces the notion of lifelong learning for all (Xi 2022).

2.4 Adapting to new contexts

2.4.1 New economic realities

China transformed since the late 1970s from a relatively poor but highly egalitarian society to a much wealthier but highly unequal one. For much of the 21st century to date, China achieved rapid economic growth and paired that growth with highly ambitious poverty reduction activities that led to a reduction in extreme rural poverty by national estimates from half of the rural population in 2000 to 0 percent in 2020 (International Monetary Fund and National Bureau of Statistics of China 2023; National Bureau of Statistics of China 2023e). A detailed recent report on poverty alleviation in China published by The World Bank and Development Research Center of the State Council (2022, ix) opens with this assessment:

> Over the past 40 years, the number of people in China with incomes below 1.90 USD per day has fallen by close to 800 million, accounting for close to three-quarters of global poverty reduction since 1980 ... By any measure, the speed and scale of China's poverty reduction is historically unprecedented.

In the most recent period, China's growth has faltered (International Monetary Fund and National Bureau of Statistics of China 2023). Inequality has remained relatively high, though estimates from different sources differ on the absolute level and whether it is declining or increasing in recent

years. National estimates of China's GINI coefficient since 2004 show a range between about 46 to 49, with a value of 46.6 in 2021 (National Bureau of Statistics of China 2023d). Estimates based on the high-quality China Family Panel Surveys show higher levels than national estimates and an increasing trend, but estimates are not available for the most recent years (Mazzocco 2022).[12] For the sake of comparison, the Gini coefficient for the United States in 2020 was 41.95 (Statista and Bank 2021).

It is important to note that economic disparities in China have longstanding regional and urban-rural dimensions. For example, in terms of household per capita disposable income, the east coast region figure of ¥44,980.30 in 2021 (approximately $6,630)[13] is 1.47 times the corresponding figure for the northeast, China's rustbelt; 1.52 times the figure for central China; and 1.62 times the figure for the poorest western region (National Bureau of Statistics of China 2022). Nationally, the urban average on the same metric for the year 2022 was ¥49,283 (approximately $7,265), which was a full 2.45 times the rural figure in the same year (National Bureau of Statistics of China 2023c). For education planners, economic inequalities, including regional and urban-rural economic gaps, present important challenges to the equitable provision of education.

Also very relevant to educational planning is the concern about a poor job market for urban youth and for college graduates. Reports as recent as 2018 suggest that 91 percent of bachelor's graduates and 92 percent of vocational higher education graduates were employed (Textor 2023), but recent reports suggest that the monthly urban youth unemployment rate was nearly 20% in July 2022, while being slightly lower at about 17% in December 2022 (National Bureau of Statistics of China 2023b). The youth figures are much higher than corresponding figures for the general urban population. For example, the monthly urban unemployment rate for December 2022 was 5.5% (National Bureau of Statistics of China 2023a). The poor job prospects for urban youth are coinciding with unprecedented numbers of college graduates due to expansion in higher education. News reports indicate that a record 11.58 million college graduates are projected to join a very difficult labor market in 2023 (Reuters 2023).

2.4.2 New demographic realities

China's total fertility rate[14] has declined very dramatically since about 1970; it peaked *before* the implementation of the later-longer-fewer campaign in the 1970s and then the one-child policy (UN DESA 2022, 2023). The fertility rate fell to an all time low by the early 2000s and, despite loosening of fertility restrictions in recent years, was projected to be 1.19 in 2023 by the United Nations (Silver and Huang 2022; UN DESA 2023). Declining fertility, rising life expectancy and a progression of larger cohorts to older ages has brought rapid population aging in China (for a summary and statistics, see Textor (2022a).) China's working age population peaked around 2015 and has started to decline, while the elderly population share is rising, creating an increasing aged

12. A study spanning the years 1988 and 2013 indicated that national income inequality rose markedly to 2007 and thereafter fell slightly (Luo, Li, and Sicular 2020). The most recent World Bank estimate, for 2019, is lower, at 38.2 (World Bank 2023).

13. Dollar estimate uses an exchange rate for January 24, 2023 of 1 CNY = 0.147405 USD (XE.com 2023).

14. The total fertility rate is the point-in-time snapshot of the average number of children that women would have if they passed through reproductive years at prevailing age-specific fertility rates.

dependency ratio (Textor 2022a; UN DESA and Textor 2023). The child population is also declining (UN DESA and Textor 2023), and in rural areas, fertility decline and outmigration are leading to sparse school-age populations in many communities and many children being "left behind" by parents migrating to cities (Hannum, Liu, and Wang 2021; Hannum and Wang 2022; Shen, Hu, and Hannum 2021).

It is important to note that China achieved the difficult feat of broad-based educational expansion during a period of *growing* child cohorts, creating a "demographic dividend" in the form of a growing fraction of the population being both working age and educated. This circumstance is reversing as the working population and the school-age population decline and China faces demographic headwinds — sometimes referred to as a "demographic burden." Now facing ever *fewer* workers and *fewer* students, the national educational challenge is to reconfigure education to meet the needs of a rapidly-evolving economy with a declining workforce. In rural areas, where depopulation is also occurring due to outmigration, an additional challenge is to develop an educational delivery model that effectively and efficiently reaches rural communities with now-sparse school-age populations and many families in which the parent generation is gone.

3 Key policies and developments by level of schooling

3.1 Pre-primary education

A 2018 UNICEF report states that in the years 2011 and 2016, China "implemented two rounds of the Plan of Action for Pre-primary Education at the county level, and these efforts ... led to the continuous improvement of pre-primary education for children aged 3 - 6" (National Working Committee on Women, National Bureau of Statistics, and UNICEF China 2018a, 108). According to the same source, continuing concerns about access and quality led to initiation of "a third round of the Plan of Action for Pre-primary Education (2017 - 2020)" and efforts to set up a public service system for pre-primary education with broad coverage, and wide access and basic quality by 2020." (National Working Committee on Women, National Bureau of Statistics, and UNICEF China 2018a, 108). Making pre-primary education high quality and inclusive remains a policy priority, as discussed in the section, "Current national priorities."

As a crude indicator of progress on expansion, gross enrollment ratio data show a long-term upward trajectory in pre-primary enrollment, with very rapid increases around the time of these action plans, after a dip in the early 2000s (World Bank 2022).[15] As a crude indicator of quality, pupil-teacher ratios at the pre-primary stage have been dropping precipitously since 2010 (World Bank 2020). What were once large urban-rural and regional access gaps have narrowed in this recent period of policy focus. A UNICEF report shows that gaps in rates of use of pre-primary school before primary school entry have dwindled to a few percentage points, with rates from the mid- to high-90s (National Working Committee on Women, National Bureau of Statistics, and UNICEF China 2018b).

15. The reported gross enrollment ratio in China is now higher than the corresponding figure in the United States (World Bank 2022).

3.2 Primary and secondary education

3.2.1 Compulsory education

Compulsory education in China consists of primary and lower secondary education, and national policy has long prioritized a strategic goal of universal access to free compulsory education (see National Working Committee on Women, National Bureau of Statistics, and UNICEF China (2018a, 108); see also UNESCO (2021)).

Primary education access has been very high for decades, with net enrollment ratios[16] climbing from 97.8% in 1990 to above 99.96% in 2020 (Ministry of Education of China 2021b). Net enrollment ratios are not available for other levels of schooling, but gross enrollment ratios are available.[17] The lower secondary gross enrollment ratio grew from 66.7% in 1990 to 88.6% in 2000 to over 100% by 2020, where it has remained throughout the period of observation (Ministry of Education of China 2021a).[18] However, an OECD benchmarking report indicates that the gross graduation ratio[19] from lower secondary education declined from 97.98% in 2013 to 86.01% in 2018 (OECD 2020, 40).

Demographic shifts — declining fertility, rural-to-urban migration, and family separation due to parental outmigration — have created new challenges to rural educational systems. Consolidation of small schools and boarding at consolidated schools are common solutions to sparse rural cohorts of children and the left-behind children phenomenon (Hannum, Liu, and Wang 2021; Hannum and Wang 2022). A UNICEF report indicated that in 2017, 10.66 million primary school students and 20.74 million junior secondary school students were boarders —these figures represent 10.6 per cent of all students in primary schools and 46.7 per cent of those in junior secondary schools (National Working Committee on Women and National Bureau of Statistics of China and UNICEF China 2018). The same report highlighted significant extra exposure to boarding in rural areas and in central and western regions. Notably, in 2017, the proportion of students who were boarders in junior secondary education exceeded 80 per cent in rural areas of the Guangxi Zhuang Autonomous Region, the Tibet Autonomous Region, and Yunnan Province (National Working Committee on Women and National Bureau of Statistics of China and UNICEF China 2018).

3.2.2 Upper secondary education

After completing lower secondary education, students are required to take an upper secondary education entrance exam (中考, *zhongkao*) to participate in upper secondary education (OECD 2020, 36). Upper secondary can be general education or vocational education. Overall, educational access at this level has risen dramatically over time. China's long-term educational expansion at

16. The net enrollment ratio is calculated as the total number of students in the theoretical age group for a given level of education enrolled in that level, expressed as a percentage of the total population in that age group(OECD 2020, 37).

17. The gross enrollment ratio is the number of students enrolled in a given level of education, regardless of age, expressed as a percentage of the official school-age population corresponding to the same level of education (OECD 2020, 37).

18. Gross enrollment ratios can go over 100% when there is over-age or under-age enrollment at a given level.

19. The OECD defines the gross graduation ratio as "Number of graduates regardless of age in a given level or programme, expressed as a percentage of the population at the theoretical graduation age for that level or programme." The benchmarking report utilizes this measure as a proxy for student completion (OECD 2020, 37).

this level is reflected in the attainment of the adult population. The percentage of the Chinese population aged 25 and older that has reached a secondary level of education grew from 36% in 1990 to 52.3% in 2000 to 65.3% in 2010 to 79.2% in 2019 (UNDP 2021). A more timely indicator is the senior secondary gross enrollment ratio, which grew from 26% in 1990 to 42.8% in 2000 to 82.5% in 2010 (Ministry of Education of China 2022a). By the most recent available year of data, 2021, the ratio had reached 91.4%. UNESCO Institute for Statistics estimates of upper secondary gross enrollment ratios are slightly lower, at 76.8% in 2010 and 84.6% in 2021, with some ups and downs in between (UNESCO Institute for Statistics 2023).[20]

An important priority in education policy documents has been promotion and improvement of vocational and technical education. In 2021, about 26 million students were enrolled at at senior high schools in China (National Bureau of Statistics of China and Ministry of Education of China 2022b). Corresponding figures for secondary vocational schools were that around 13.12 million students were enrolled in 2021 (National Bureau of Statistics of China and Ministry of Education of China 2022d). However, this number reflects a declining number and share of students choosing vocational education. A challenge has been stigma attached to vocational schools and students and significant concerns about the quality of learning experiences in vocational education (Loyalka et al. 2016).

A major vocational education reform was set out in 2019 (State Council 2019). China's priorities in vocational education reform were discussed in a recent policy report by the Australian Embassy in Beijing (Australian Embassy in Beijing and Department of Education of Australia 2019). These included establishing national standards for vocational education, ensuring greater applied/technical learning and practical training, incorporating military-related vocational education into the national vocational education system, constructing a qualifications certification system and banking system for vocational education credits, promoting the integration of vocational schools with industry, establishing vocational education evaluation organizations, and improving funding mechanisms. Medium and large-sized private enterprises are set to run apprenticeships from a range of sectors that reportedly include agricultural, manufacturing, ICT, automotive and shipbuilding, aerospace, steel and metallurgy, energy and transportation, energy-saving and environmental protection, construction and assemblies, finance, and social services (Australian Embassy in Beijing and Department of Education of Australia 2021, 5).

Another document, *Opinions on Promoting High-quality Development of Modern Vocational Education*, was issued in October 2021 by the General Office of the CCPC Central Committee and the General Office of the State Council, (see Xinhua (2021a) for an announcement; see details and discussion in (Department of Education, Skills and Employment of Australia 2022)). The document reportedly prioritizes developing a modern vocational education system by 2025 and positioning China among the world's top countries for vocational education by 2035; reported strategies include "promoting greater international collaboration and exchange with 'quality partners', and

20. These discrepancies may emerge due to some combination of discrepancies in a) the age range used as the standard range eligible to be enrolled at this level, b) the estimate of the population in that age range, or c) the estimate of enrolled students.

giving more weight to vocational education in government-supported inbound and outbound studies" (Department of Education, Skills and Employment of Australia 2022).

3.2.3 Pandemic and recovery

China was the first country to implement nationwide school closures during the Covid crisis — the closure covered the entire education system at all levels, and is estimated to have affected 278 million students (OECD 2020, 144). When Covid broke out in early 2020 in Wuhan, students were out of school on winter vacation, and the Ministry of Education initially announced a delay in the school opening date of the spring semester on January 27, 2020 and then issued a notice "suspending classes without suspending learning" (停　不停　, *ting ke bu ting xue*) on February 12, 2020, which required primary and secondary school students to continue their studies at home (see source documents Ministry of Education of China (2020) and Ministry of Education of China and Ministry of Industry and Information Technology (2020), cited and described in Liao, Ma, and Xue (2022, 3)). The guidance was then implemented by provincial-level governments in a decentralized way: provincial governments made their own plans on how to conduct online education and when to reopen schools. China was also one of the earliest countries to develop school reopening plans (OECD 2020, 144).

At the outset of the pandemic, the OECD (2020, 145) reports that educational systems started coordinating online learning resources at national, regional and school levels, "with the intention of bringing together all existing learning resources, and making them public on one integrated, nationwide, online learning platform." The central education authority required local authorities to develop and provide new locally-relevant online learning classes. For areas with poor internet access, China's education system built "horizontal capacity" in the form of television broadcasts of learning resources, such as recorded lessons or live-streamed lessons (OECD 2020, 145).

How did students fare, under these preparations? As yet, there are not many well-designed, probability-sample-based studies of national causal impact of Covid lockdowns on educational outcomes. Existing studies in China suggest that China was perhaps relatively well-positioned to weather impacts on schooling of quarantines and remote schooling, but students experienced negative educational impacts that tended to be borne differently between privileged and disadvantaged children.

At the primary level, Li et al. (2023) collected and analyzed survey data from representative samples of households and teachers of 4,360 rural and urban primary school students from two prefectures in Henan Province who were forced to stay at home for much of the second semester of the academic year. Results showed that the vast majority of students — 87 percent of rural and 92 percent of urban school students — participated in distance education and most had interactions with teachers (Li et al. 2023, 62, 67). If representative of the larger experience in China, the authors write, results suggest that China "was able to provide a larger share of its K12 student population with the opportunity to learn than much of the rest of the world, even when compared to some high-income nations" (Li et al. 2023, 67).

At the same time, the study highlighted the challenges of children and families not served, as well as the kinds of learning inequalities documented elsewhere around the world (Li et al. 2023, 67):

> Approximately one out of eight rural students and one out of 20 urban students did not receive any distance education at all, and two out of 10 rural students and one out of 10 urban students had no interaction with their teachers. If we use these results to extrapolate opportunities to learn on a national scale ... this means that about 22 million rural and 10 million urban students (32 million total) did not receive distance education during the Covid crisis, while about 33 million rural and 8 million urban students (41 million total) had no interaction with their teachers. Although we cannot fully generalize our findings in these two prefectures of Henan to the rest of China, it would be surprising if other prefectures did not face major problems similar to those found here.

The study showed that the prevalence of smart phones across China was both boon and bane. Widespread availability meant that, perhaps more than in other countries, students depended on smartphones for digital learning in a way that promoted connection to teachers. At the same time, phones were likely to be less conducive to effective study than tablets or computers. Close to three-fourths of students in rural schools used smartphones for distance education, while only about one-fourth of students in urban schools did (Li et al. 2023, 63). Urban students were much more likely to have access to large devices such as computers and tablets. Affected cohorts learned significantly less than the previous cohort of corresponding-grade students (Li et al. 2023, 64). Finally, the estimated economic burden of income loss on parents was substantial: the authors estimate that it was equivalent to about 6 months of the average per capita income of rural residents and about 3.5 months of per capita income among urban parents (Li et al. 2023, 66).

Another study focused on middle schools in Shaanxi Province and used administrative data on a sample of 7,202 students' test scores before and after school shutdowns together with online survey data on students' family background (Liao, Ma, and Xue 2022). Findings showed that middle school students with more highly educated parents experienced an increase in relative test rankings after the shutdown period. This advantage accruing to children of more educated parents occurred via parents' engagement in their children's homeschooling, parents' mitigating the negative impacts of internet addiction on students, and parents' substituting for teachers who were unable to teach well online.

A third study analyzed academic examination scores for students at a high school in Eastern China between January and July 2020 (Ma, Zhang, and Hong 2022). Results showed that academic achievement of students declined during the closure and reopening of the school due to the Covid pandemic, and that the impact was disequalizing — the impact widened gaps between rural and urban students (Ma, Zhang, and Hong 2022, 15). In short, while China may have been relatively well-positioned to weather school closures compared to many places, a story of disproportionate impacts on marginalized children to those seen elsewhere emerged.

3.2.4 EdTech and AI

Experiences with Covid lockdowns underscored the urgency of an existing policy priority: developing digital infrastructure for schools (Australian Embassy in Beijing and Department of Education of Australia 2021).[21] In 2017, the State Council had released a development plan on the use of AI that promoted education in AI-related subjects in primary and middle schools, but also capitalizing on the potential of AI for "smart schools" or "smart education" (Australian Embassy in Beijing and Department of Education of Australia 2021; State Council 2017). The 2017 document promoted "smart education" — using intelligent technology to accelerate the reform of talent training models and teaching methods and build a new educational system that includes intelligent learning and interactive learning; to develop learner-centered educational environments, intelligent campuses, and online platforms; to promote the applications of artificial intelligence in teaching, evaluation, management; and to support opportunities for lifelong education (State Council 2017).

A report by the Center for Security and Emerging Technology indicates that China's government is " ... using its centralized authority to mandate AI education in its high school curricula and for AI companies to partner with schools ... to train students" (Peterson, Goode, and Gehlhaus 2021a, 1). The report describes the high school curriculum as follows (Peterson, Goode, and Gehlhaus 2021a, 11):

> At the high school level, the MOE in January 2018 revised its national education requirements to officially include AI, Internet of Things, and big data processing in its information technology curricula (Ministry of Education of China 2017). The revision requires high school students enrolled in the fall of 2018 and beyond to take AI coursework in a compulsory information technology course (AI Era (新智元) 2021). The coursework goals include data encoding techniques; collecting, analyzing, and visualizing data; and learning and using a programming language to design simple algorithms (AI Era (新智元) 2021).

The report notes that Chinese tech giants such as Baidu are also helping to introduce AI to vocational secondary schools (Peterson, Goode, and Gehlhaus 2021a, 12). More broadly, the significant investment being made in EdTech in China was underscored in a recent report by the International Trade Administration (2022, 6–7):

> In the past five years, China has enjoyed rapid growth in the use of education technology (EdTech) and online learning, both in the private and public sectors. The driving forces include favorable government policies, abundant venture capital, increased consumption, fast-growing mobile Internet penetration, and the fact that

21. A recent report by the International Trade Administration made this observation (International Trade Administration 2022):

> The long-term impact of Covid on education is expected to lead to an increase in spending on digital infrastructure and new digital models utilizing the new tools available in digital education.

the Chinese people attach great importance to education. Since 2015, China has been leading the global investment in EdTech. In 2020, China invested a record-high $10 billion in EdTech (Education Intelligence Unit 2021). From 2010 through the end of Q1 2021, China invested nearly twice the amount of the U.S., six times that of India, and ten times that of Europe, according to Holon IQ.

3.2.5 Evidence about quality

National quality monitoring. In 2015, the Ministry of Education initiated a national assessment plan designed to monitor basic education quality (OECD 2020, 139). In service of this task, a Basic Education Quality Monitoring Center was established at Beijing Normal University, under the supervision of the Ministry of Education (Yin 2021). As mandated by the Education Steering Committee under the State Council, the Center was tasked with monitoring "the performance of primary school students in academic, art and sports subjects, with a view to assessing the progress of compulsory education, particularly the implementation of curricula standards and policies across the country, and informing policy-making to improve the quality of education" (Ministry of Education of China 2018; Yin 2021). Indicators were based on national curriculum standards, with a focus on measuring specific "knowledge and skills acquisition, learning processes and methods, emotional attitudes and values, scientific reasoning and problem-solving abilities" (Ministry of Education of China 2018). The approach covered "student development, from moral, intellectual, physical, social, to aesthetic progress," along with key factors that have a potential impact on the quality of education, including "course teaching, teacher support, school management, and resource allocation" (Ministry of Education of China 2018). The monitoring project involved thousands of stakeholders "from frontline educational administrators, researchers, schoolmasters and teachers, to experts in the fields of curriculum design, teaching theory, educational measurement and evaluation, and education policy and management" (Ministry of Education of China 2018). Consistent with China's efforts to capitalize on the promise of technology, "IT and AI solutions were fully utilized to upgrade monitoring approaches" (Ministry of Education of China 2018).

The first China Compulsory Education Quality Oversight Report was released in 2018 (Ministry of Education of China 2018; Yin 2021). A press release highlighted select findings from the initial report, which covered the period of 2015-2017. The press release highlighted areas of strength in the system, but also highlighted as priority areas for improvement 1) overemphasis on academic achievement, 2) a lack of emphasis on art education and sports, 3) a lack of opportunities for students to develop practical and hands-on skills, including opportunities to carry out experiments and develop critical thinking skills in science classes, and 4) heavy homework loads.

International benchmarking. The OECD conducts an assessment known as the Programme for International Student Assessment (PISA) every three years, in 79 countries among with 600,000 students (Amstrong 2019). The assessment tests the skills and knowledge of 15 year-old students in science, reading and mathematics, along with collaborative problem solving and financial literacy (Amstrong 2019). China's scores for the most recent round are based on students in Beijing,

Shanghai, Jiangsu, and Zhejiang.[22] These places are among the wealthiest provinces of China — they rank 1, 2, 3 and 6, respectively, in provincial per capita GDP (Statistics of China 2022). At the same time, the level of income of these regions is well below the OECD average (Amstrong 2019), and, though estimates are hard to come by, one study suggests that that these areas are characterized by extremely high levels of income inequality (Bhattacharya, Palacio-Torralba, and Li 2018). Much discussion has emerged around the fact that the regions selected for inclusion in PISA are among China's wealthier and more developed areas, and that this and other issues might exert an upward influence on test scores compared to what would be observed in a national sample (Loveless 2013, 2014, 2019; Xu and Wu 2022).

With these points of context in mind, students in these four province-level jurisdictions outperformed peers in other high-performing countries in mathematics, science and reading by what the OECD characterizes as "a large margin" (OECD 2020, 15). Additionally, the OECD reports that educational systems in these jurisdictions have a lower share of low-performing students and a higher share of high-performing students when compared to other high-performing education systems (OECD 2020, 15).[23]

National benchmarking is not possible due to lack of available data. The strong performance on PISA tests just described must be weighed against evidence of a less sanguine nature about educational performance in rural areas put forward by economist Scott Rozelle and his colleagues, perhaps most notably in the recent book *Invisible China* (Rozelle and Hell 2020). A significant concern is that poverty-related stressors on families and associated early health and nutrition problems may impede children's capacity to fully engage in education, particularly in China's competitive educational system.[24]

Relevant to the question of international benchmarking, Gao et al. (2021) collected data from a sample of 23,143 rural primary school students across three provinces in different regions of China —– northwest, southwest, and southeast — and compared this data to student reading achievement data in different countries and regions from the Progress in International Reading Literacy Study (PIRLS) tests in 2011. Results showed that sample students China ranked last in reading skills among a sample of students from the other 44 countries/regions (Gao et al. 2021). While PISA and PIRLS are not the same test, the very poor performance in early reading in these rural areas may appear difficult to reconcile with the very positive PISA outcomes in more developed areas of China. However, this disconnect is less surprising in light of research that has shown that structural factors such as location play a large role in determining educational performance in China (Lyu, Li, and Xie 2019).

In short, absent national data for global benchmarking, it is difficult to characterize overall quality of performance. On one hand, evidence shows that student performance in *some provinces and jurisdictions* on international tests is among the strongest in the world. At the same time, research

22. Jiangsu and Zhejiang are neighboring provinces to Shanghai

23. For example, the percentage of low performers in all subjects (1.1 %, rank 76/76 in 2018) and the percentage of low performers in at least one subject (6 %, rank 76/76 in 2018) were among the lowest among PISA countries (OECD 2023).

24. Highlights are summarized in a recent Center for Strategic and International Studies report (Mazzocco 2022).

also indicates that more marginalized groups of children in China face significant headwinds to reaching those levels of performance.

3.3 Tertiary education

3.3.1 Recent developments

The turn of the 21st century in China saw dramatic expansions in higher education, and with policies that, in targeting elite institutions to compete at the international level, significantly increased horizontal stratification within the higher educational system.[25] In 1999, the central government resolved to substantially increase higher education spaces. The rationales for this shift included a number of educational goals, but reportedly, the most immediate catalyst was economic: increasing tuition-paying students would stimulate consumption after the Asian financial crisis of 1997 (Wang and Liu 2011).[26] The goal was achieved in dramatic fashion. As Li, Whalley, and Xing (2014, 568) report, 1999 was a historic year in the development of China's higher education, with the number of new college students experiencing its greatest increase since 1978, and tuition fees ramping up significantly (regarding tuition, see Yang (2006), as cited in Li, Whalley, and Xing (2014, 568); tuition jumped from increased from 800 RMB per person per year to 5000 RMB per person per year on average.)

Reflecting aggressive higher education expansion policies, the number of students enrolled in degree programs at all kinds of public institutions of tertiary education in China[27] tripled from 3.82 million students in 1990 to 12.29 million in 2000; grew to 33.25 million students by 2010, and reached 44.3 million by 2021 (Ministry of Education of China 2022b). These numbers represent substantial increases in overall access. As a crude indicator of overall access, the gross enrollment ratio grew from 3.4% in 1990 to 12.5% in 2000 to 26.5% in 2010 to 57.8% in 2021 (Ministry of Education of China 2022c).

In 2021, public colleges and universities in China numbered 2,756, including 1,238 bachelor's degree granting universities and 1,518 higher vocational colleges (National Bureau of Statistics of China and Ministry of Education of China 2022e, 2022f; Textor 2022b). There were 764 non-governmental colleges and universities, 256 adult higher education institutes, and 21 other institutions (National Bureau of Statistics of China and Ministry of Education of China 2022e). The majority of enrollments were in public universities, but the private sector is not trivial. In 2021, about 8.5 million undergraduates were enrolled at private colleges and universities, compared to about 35 million enrollees in undergraduate programs in public colleges and universities (National Bureau of Statistics of China and Ministry of Education of China 2022c, 2022g). Among the 35 million students in public colleges and universities, 19.1 million were studying in bachelor's degree programs while the

25. For a review of higher education reforms, see (Xiong, Yang, and Shen 2022) and for a brief review of the academic literature on these tensions, see Shen and Hannum (2023).

26. The discussions of expansionary policies and policies to promote quality draw heavily on Shen and Hannum (2023).

27. Tertiary education in China includes universities, providing four-year bachelor, master and doctorate programs, and higher vocational colleges, providing more practically oriented three-year, short-cycle degree programs; it is also possible to obtain degrees at public institutes for adult education and from online and self-learning courses provided by public institutions (Textor 2022d).

other 15.9 million were enrolled in more practically oriented short-cycle degree programs (National Bureau of Statistics of China and Ministry of Education of China 2022g; Textor 2022d). From vocational institutions, students can enter the job market, join the military, or apply for "top up" programs to earn a bachelor's degree (Peterson, Goode, and Gehlhaus 2021b, 8). A State Council press release indicated that China had added nearly 100 vocational colleges between 2015 and 2019 (Xinhua 2021b). Graduate enrollments, while much smaller, have also been increasing steadily, such that by 2021, around 3.33 million students were enrolled in master's and doctoral degree programs at colleges and universities in China (National Bureau of Statistics of China and Ministry of Education of China 2022a; Textor 2022c).

One side of the agenda was expanding access, but the other was to promote quality — to cultivate Chinese universities to become world-class institutions of higher education. Key initiatives included Project 211 (in 1995), Project 985 (in 1998), and the Double First Class (一流, *shuang yi liu)* project (in 2015) (Bodenhorn, Burns, and Palmer 2020; Postiglione 2020). Project 211 provided extra resources to those universities that could show promise in attaining a higher standard in academic and scientific disciplines and develop the human resources needed to support the national strategy for economic and social development (Postiglione 2020). Project 985 focused resources on a smaller number of elite institutions (Yang and Leibold 2020). Zha (2020) observed that the most elite universities were protected from over-expansion, in order to focus on achieving global excellence, while expansions were taking place in the lower tiers of the higher education system. Local institutions—those under provincial and municipal jurisdictions, including newly emerging higher vocational colleges and higher-cost private institutions—absorbed most of the additional enrollments (Zha 2020); see Postiglione (2020) and Zhou (2020) on private institutions in the wake of expansion). Thus, higher education systems during massification became more differentiated and stratified, with institutions in the top, middle, and lower tiers "differing in orientation toward teaching, research (basic, applied, developmental) and service to the communities they serve" (Postiglione, 2020, p. 922).

The later Double First Class Project (一流, *shuang yi liu*) similarly sought to develop a group of elite Chinese universities, but also to offer support for individual university departments to reach world-class standards (Bodenhorn, Burns, and Palmer 2020). In this way, unlike the earlier projects, the Double First Class project supported not only "the already established universities" but also universities "with urgent needs, distinctive features, and new disciplines" (Yang and Leibold 2020, 1142)). Peterson, Goode, and Gehlhaus (2021b, 6) report that the initiative "split universities into two tracks: 42 universities were selected as world-class universities, and split respectively into 36 "Class A" (already close to being world class) and 6 "Class B" (potential to be world-class) universities."[28] Yang and Leibold (2020) report that institutions outside of the traditional elite group have been able to identify areas of excellence to compete for "double first class"status, though a case study of a relatively poorly resourced university in Tibet illustrates some of the distortions, as well as the possibilities, introduced by the need to compete mainly in fields of comparative advantage. In addition, under this plan, 465 disciplines from 140 universities (including the group

28. See lists of universities by class and listed disciplines available at Education and Research Section of the Australian Embassy in Beijing and Department of Education of Australia (2017).

of 42) are also identified as having the potential to become world class (Education and Research Section of the Australian Embassy in Beijing and Department of Education of Australia 2017). Reportedly, the list of 42 universities includes all 39 of the former "985" project universities, along with three additional universities from the former "211" project: Zhengzhou University (Henan), Yunnan University (Yunnan) and Xinjiang University (Xinjiang) (Education and Research Section of the Australian Embassy in Beijing and Department of Education of Australia 2017). In addition, the discipline development list consists primarily of former "985" and "211" project universities, with an additional 25 non "211" project universities that have strengths in particular fields (Education and Research Section of the Australian Embassy in Beijing and Department of Education of Australia 2017).

The Double First-Class initiative has a broader geographical reach than the former "985" and "211" projects, which aligns with the national education development goal of having more balanced and equitable education for all, but the majority of disciplines to be developed are still clustered in major cosmopolitan areas in the eastern region of China (Education and Research Section of the Australian Embassy in Beijing and Department of Education of Australia 2017).[29] Doctoral training is heavily represented among more elite schools. Peterson, Goode, and Gehlhaus (2021b, 9) reports that about 45 percent of Chinese doctoral students graduate from the elite Double First Class (A) universities, while about 80 percent of graduates come from generally elite universities administered by the central government. Institutions including the Chinese Academy of Sciences, the Chinese Academy of Agricultural Sciences, and the Chinese Academy of Social Sciences are first-tier public research universities not supervised by the Ministry of Education that focus on graduate education (Peterson, Goode, and Gehlhaus 2021b, 9). China reportedly added seven new universities to the the list in February of 2022 and introduced a multi-dimensional evaluation mechanism to identify universities with "distinctive characteristics and comprehensive advantages" (Mao 2022; Zou 2022).

Today, the "C9 League" of public institutions represent the most elite tier (Chinadaily.com.cn 2013; Peterson, Goode, and Gehlhaus 2021b; Times Higher Education (THE) 2011). The C9 League, an association established in 2009, consists of Fudan University, Harbin Institute of Technology, Nanjing University, Peking University, Shanghai Jiao Tong University, Tsinghua University, University of Science and Technology of China, Xi'an Jiaotong University, and Zhejiang University (Chinadaily.com.cn 2013; Times Higher Education (THE) 2011). Peterson, Goode, and Gehlhaus (2021b, 6) report that Eight of the C9 are among the 75 tier-one institutions directly supervised and funded by the Ministry of Education, while the ninth—the Harbin Institute of Technology—is a member of a group of universities directly supervised by the Ministry of Industry and Information Technology.

29. Beijing topped the chart with 162 disciplines, followed by Shanghai with 57 and Jiangsu with 43. These three provinces together have more than half of the total disciplines to be developed (Education and Research Section of the Australian Embassy in Beijing and Department of Education of Australia 2017).

3.3.2 Evidence about quality

This section will elide important questions about quality of experience of students, due to lack of empirical evidence, and focus on a narrow definition of quality as reflected in global ranking systems and research capacity, with particular attention to technical research capacity. Two members of the C9 League–Tsinghua University and Peking University, sometimes referred to respectively as the "MIT of China" and the "Harvard of China" — now regularly reach the highest positions in global university rankings. They are ranked 16 and 17, respectively, in the most recent Elsevier/ *Times Higher Education* Rankings; 26 and 34 in the most recent Academic Ranking of World Universities (ARWU); and 23 and 39 in the most recent *US News and World Report Global Rankings*)(Elsevier and Times Higher Education 2022; Shanghairanking.com 2022; Textor 2022d; US News and World Report 2022). A news report observed that in the *US News and World Report* global rankings, for the first time, time China outnumbered the U.S. among the 2,000 schools from more than 90 countries that were ranked: 338 Chinese universities made the list, compared to 280 American universities (Han 2022). Han (2022) observed further that while China "surpassed the U.S. by 58 spots, the majority of U.S. universities appear in the top half of the rankings, including 8 of the top 10."

In a 2022 report for the Center for Security and Emerging Technology at Georgetown, Corrigan and Rodriguez (2022, 1) compared performance over time of Chinese and United States universities on the Academic Ranking of World Universities (ARWU, also known as the Shanghai rankings) and the World University Rankings (QS).[30] Between 2010 and 2020, the number of U.S. universities that appeared in the top 500 on at least one global ranking dropped from 160 to 137, while the number that appeared on both rankings fell from 102 to 82 (Corrigan and Rodriguez 2022, 1). In contrast, Corrigan and Rodriguez (2022, 1) report,

> Chinese universities have made significant gains in the global rankings. Between 2010 and 2020, the number of Chinese universities in the top 500 on at least one global ranking more than tripled (from 23 to 71), while the number that appeared on both rankings rose from 9 to 26. Chinese universities have also steadily moved up the rankings over time.

Corrigan and Rodriguez (2022, 1) observe that improvements in Chinese university rankings seem to be driven largely by increases in research productivity, which in turn coincide with a series of state-sponsored higher education initiatives that have sought to improve the quantity and quality of academic research in China. These improvements have made it possible for universities in China to significantly improve research productivity metrics relative to the United States.

30. Corrigan and Rodriguez (2022, 3) provide this background on the sources of the two ranking systems:

> The Academic Ranking of World Universities, also known as the Shanghai Ranking, is published by the Shanghai Ranking Consultancy, a Chinese analysis group that is not publicly affiliated with any government or university. Prior to 2009, the ARWU was published by Shanghai Jiao Tong University. The QS World University Rankings is published by Quacquarelli Symonds, [which is] a higher education analysis group based in the United Kingdom.

Corrigan and Rodriguez (2022, 4) make two points about trends in higher education quality in China, based on analyses of these two ranking systems — that the Chinese university system is improving overall, and the country's best universities are getting even better:

> In 2010, only two Chinese universities — Peking and Tsinghua — appeared in the QS top 100, and none appeared in the ARWU top 100. By 2020, six Chinese universities — Fudan, Peking, Shanghai Jiao Tong, Tsinghua, Zhejiang, and the University of Science and Technology of China — appeared in the top 100 on both rankings ... All but one of the 23 ranked Chinese universities in 2010 had improved their ranking by 2020.

3.3.3 AI in tertiary education

One emerging subject area that is identified by China as a strategic priority is artificial intelligence. A report by the Center for Security and Emerging Technology states that since 2018, 345 universities in China have been approved to offer an AI major, which is now the country's most popular new major, and at least 34 universities have launched their own AI institutes (Peterson, Goode, and Gehlhaus 2021a, 1). Further, China's AI companies are asked to partner with universities — partnerships focus both on training teachers and students (Peterson, Goode, and Gehlhaus 2021a, 20).

In this new strategic priority area, China is excelling in global rankings. Among the top 10 schools ranked by *US News and World Report*, five are in China, with Tsinghua ranked at the top (Han 2022).[31] A *Harvard Business Review* piece reports on research showing that China's global share of research papers in the field of artificial intelligence "vaulted from 4.26% (1,086) in 1997 to 27.68% in 2017 (37,343), surpassing any other country in the world, including the U.S." (Li, Tong, and Xiao 2021, 2). The authors cite China's "decades-long effort in promoting technology and engineering" in providing "a rich supply of high-quality computer scientists and engineers" (Li, Tong, and Xiao 2021, 5). In a data brief prepared for the Center for Security and Emerging Technology, Acharya and Dunn (2022) analyzed a corpus of more than 200 million publications from six academic data sets. The authors draw a similar conclusion on research strength in this area in China. Among other indicators of growing strength, Acharya and Dunn (2022, 1) report,

> Chinese researchers' output of highly cited AI publications is increasingly competitive with the work of their U.S. counterparts. Over the past decade, Chinese researchers have published a growing share of the world's top-5-percent AI publications, rising from half of U.S. output in 2010 to parity in 2019.

Finally, Acharya and Dunn (2022, 1) underscore that collaborative research between scientists in the United States and China has moved this field forward:

31. The best ranked US institution is Carnegie Mellon, at 12 (Han 2022).

> A notable share of both U.S. and Chinese researchers' high-impact AI publications were U.S.-Chinese collaborations. For example, such collaborations accounted for *24 percent of both countries' highly cited AI publications in 2019* (emphasis added).

4 Outlook

Educational reform and improvement loom large in China's national strategic planning efforts. Past decades have seen tremendous improvements in access to schooling, with expansions in pre-primary and tertiary schooling being notable successes in the 21st century. Improving access and retention at the secondary level is a current priority area. Vocational education is an area of intense policy interest, with a focus on growing numbers and improving quality at both the secondary and tertiary levels. At primary and secondary levels, national evidence about quality of schooling that is comparable to other countries is not available, but available evidence for benchmarking suggests a) that children in some of China's regions are doing extremely well in terms of performance; and b) that children in poorer rural regions face significant barriers to achieving that level of performance. At the tertiary level, available evidence suggests that China's educational institutions are on a strong upward trajectory, and that this is particularly the case in some emerging fields of strategic interest.

Some of the challenges facing China's educational policy makers lie outside of the purview of the educational system. The combination of economic faltering in recent years with high levels of economic inequality is likely to translate to family resource inequalities that pose significant equity challenges even to an educational system based on the premise of allocating places based on fair exams. Many of China's students had access to technology and family circumstances to weather Covid lockdowns, but the challenges of lockdowns, as elsewhere, appear to have been borne disproportionately by economically disadvantaged children and families. Fostering equitable access across economic, geographic, and other divides is an important continuing challenge, looking forward. Demographic scarcity in some rural areas continues to pose a challenge to educational provision in such areas. More broadly, population aging and demographic decline intensify pressures on the policy community to correctly identify promising forms of education that will enable economic flourishing for a future, smaller work force operating in a rapidly transforming economy. Finally, the pandemic and lockdowns likely exacerbated mental health distress experienced by students already facing a high degree of competition and pressure in the school system.

Other challenges will include balancing competing priorities identified for the educational system. In particular, cultivating world class institutions and generally positioning students for internationalization and global competition may sit in tension with other stated national priorities — linguistic and cultural preservation and promotion and fostering national unity, Party loyalty, and patriotism. Recent debates about the appropriate role of the English language in China's educational system are one example of these tension between the goal of supporting global competitiveness and the goal of linguistic preservation (see news reports in Chen (2022) and *The Economist* (2022)).[32] Concerns about preserving national identity, curbing Western influences in classrooms, and reinforcing

32. Part of the concern about weight given to English language in exams may relate to an equity issue within China: that poorer rural students have very little chance to compete in this domain with wealthier urban counterparts.

the primacy of the Party are evident, for example, in recent guidelines on permissible textbooks; yet, these guidelines sit alongside significant investments in international student exchange and engagement in the form of China Scholarship Council Fellowships.[33] Finally, looking ahead, geopolitical uncertainties and tensions appear likely to continue to exert a significant dampening effect on academic exchange and collaboration.[34]

33. See guidance on textbooks in Ministry of Education of China (2019); Cheung (2020) offers a summary. For an overview of activities of the China Scholarship Council Programming, see Fedasiuk (2020).

34. See a recent *Nature* commentary on of the perils of geopolitical tensions for scientific innovation in Lau (2022).

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