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Education in China and the United States

A Comparative System Overview

CSET Issue Brief



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Executive Summary

Many in the national security community are concerned about China's rising dominance in artificial intelligence and AI talent. Leading in AI workforce competitiveness hinges on the education, development, and sustainment of the best and brightest AI talent. This includes top-tier computer scientists, software engineers, database architects, and other technical workers that can effectively create, modify, and operate AI-enabled machines and other products.

This issue brief provides an overview of the education systems in China and the United States. We provide this context for better understanding the accompanying main report, "AI Education in China and the United States: A Comparative Assessment."

The Chinese education system is mainly characterized by its Ministry of Education setting centralized goals in five- to 15-year education strategies. The MOE also certifies teachers and approves curricula and teaching materials, while funding responsibilities largely fall on local governments (see Appendix A). The MOE's role is greatest at the postsecondary level, where it directly manages 75 elite colleges and universities.

In contrast, the U.S. system is driven by an individual states-led approach where local governments and state authorities oversee curricula, student achievement standards, and teacher certifications. Additionally, administration and oversight of private education differs from public education, having more autonomy in its curriculum and educator standards. The U.S. Department of Education's primary role is to ensure equitable access to K-12 public education, compile education data, and distribute financial assistance for postsecondary education.

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Introduction

China's efforts to recruit foreign artificial intelligence talent capture headlines and are well-known. But China's ongoing strategies, initiatives, and other efforts to build their own AI workforce are more potent, well-funded, and the most insulated from U.S. sanctions.

This two-part analysis provides a new comparative perspective on the U.S.-China competition to grow and cultivate an AI workforce. This first brief provides an overview of each country's education system, with additional detail on system funding provided in Appendix A (China) and Appendix B (United States).

The second brief, titled "AI Education in China and the United States: A Comparative Assessment" discusses how each country is integrating AI education and training into each level of education. It also weighs potential national security implications for future U.S. science and technology education and workforce policy.

The research presented here is based on original primary source U.S. statistics, reports and assessments from education nonprofits, private-sector promotional material, and individual states' departments of education, along with Chinese education plans and policies, official statistics, and translations. The data is often defined and categorized differently, making uniform comparisons difficult. We attempt to clarify such differences when they occur.

Overview of China's Education System

China's education system is more centralized than its U.S. counterpart. Its education system includes 282 million students in 530,000 educational institutions from kindergarten to universities. China's Ministry of Education is the main authority overseeing China's education system, and is responsible for certifying teachers, setting national education goals, approving curricula and teaching materials, as well as providing limited funding assistance.¹

While the MOE supervises provincial education departments, it has granted more implementation responsibility to the provincial and municipal levels over recent decades.² Provincial and major city level bureaus follow national guidelines to develop provincial curricula based on an implementation plan that incorporates local contexts and MOE national curriculum guidance. But the MOE has final approval before implementation.³ Further local responsibilities include administering teaching materials, school programs, providing education subsidies, and setting additional standards for teacher training.⁴

The MOE establishes goals for its education system through five-, 10-, and 15-year education strategies. The goals for 2010–2020 included universalizing preschool education; improving nine-year compulsory education; raising the senior high school gross enrollment rate to 90 percent (which has already been exceeded); and increasing the higher education gross enrollment rate to 40 percent.⁵ Provinces then typically follow to create their own five- to 10-year plans for education.⁶ The MOE's Bureau of Education Inspections monitors implementation and provides feedback to local governments.⁷

Primary and Secondary Education (K-12)

Chinese students begin nine years of compulsory education at age six. These nine years are typically split between six years of elementary and three years of junior high school.⁸ In 2019, there

were 213,000 compulsory education schools nationwide teaching 154 million students. The 1986 Compulsory Education Law underpins this requirement, while additionally calling for achievement of the “two basics” (*liangji*): universal enrollment for students within the nine-year period, and full literacy.⁹

Moreover, 15-year-old students who continue into secondary education can pursue either an academic or vocational track.¹⁰ Regardless of track, all students take the cumulative *Zhongkao* examination, which is administered locally and not nationally standardized.¹¹ In 2019, MOE data indicated about 15.8 million students were enrolled in the vocational secondary track across more than ten thousand schools, while 24.1 million were spread across 14,000 academic high schools.¹² The vocational track entails one year of workplace training, after which students can directly seek employment and forgo further education.¹³

For students in academic high schools, their next step is either vocational colleges or universities.¹⁴ Both typically require preparing for the *Gaokao* college entrance examination; however, since 2014, students applying to vocational colleges can instead take an “academic plus skills test” organized by local governments or vocational colleges.¹⁵ The *Gaokao* is notoriously difficult and crucially determines whether students qualify for coveted spots at top academic universities such as the Ivy League-equivalent C9 League.¹⁶ In 2014, the MOE reduced the *Gaokao*’s difficulty by removing the test’s elective subject, and implemented a combined curriculum by removing the requirement that students choose between humanities and science streams for their last two years in high school.¹⁷

Postsecondary Education

Undergraduate Level

At the postsecondary level, China has 2,956 higher education institutions (HEIs), spanning public degree-granting universities and research institutes, junior colleges, vocational colleges and

universities, medical colleges, military institutions, private universities, and adult education institutions.¹⁸ 1,265 of the HEIs grant bachelor's degrees at the 本科 (*benke*) level, while 1,423 vocational colleges offer diplomas for specialized training at the 专科 (*zhuanke*) level, and the remaining 268 are for adult learning.¹⁹ Combined, there are 30.3 million undergraduate and junior college students nationwide as of 2019.²⁰ Chinese HEIs produce approximately eight million graduates annually—more than the United States and India combined—and this number is expected to triple by the year 2030.²¹

Chinese postsecondary institutions are broken into roughly four quality tiers, and unlike in the United States, China's elite universities are all public. The aforementioned C9 League sits at the pinnacle: most are located in Beijing, Shanghai, or major eastern Chinese cities.²² Eight of the C9 are among the 75 tier-one institutions directly supervised and funded by the MOE.²³ The ninth member of the C9, the Harbin Institute of Technology, is a member of the Seven Sons of National Defense, a group of universities directly supervised by the Ministry of Industry and Information Technology. The Seven Sons' core mission is to support the People's Republic of China's defense research and industrial base and military-civil fusion to merge civilian research into military applications.²⁴

Nearly all of the MOE's 75 institutions are also part of the "Double First Class University" (双一流大学) initiative, a 2017 program under Chinese President Xi Jinping that built upon previous reforms such as Project 211 and Project 985. These former projects identified and supported developing world-class universities.²⁵ "Double First Class" 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.²⁶ This initiative pared down the number of top universities China was focusing on.²⁷

China's second-tier universities are also typically public.²⁸ However, third-tier universities are usually private, are in some cases partnered with a public "mother university" to confer degrees, have lower admissions standards, and are operated without state funds.²⁹ Third-tier institutions typically charge at least 10,000 yuan (approximately \$1,400) for yearly tuition, or double that of the first and second tiers.³⁰ However, for individuals with insufficient *Gaokao* scores, third-tier institutions are increasingly popular for more applied careers, including computer science and business, despite the higher tuition.³¹

Fourth-tier institutions are usually vocational colleges.³² While they cannot grant bachelor's degrees, lower tuition than third-tier institutions is a frequent reason for enrolling.³³ Graduates of fourth-tier *zhuanke* institutions either directly enter the workforce as state-owned enterprise employees, factory managers, or enlist in the military.³⁴ However, they can also apply for 专升本 (*zhuanshengben*) "top-up" programs, which last two to three years and grant a bachelor's degree.³⁵

Academics argue that between the 1980s to 1990s, continual reforms increased provincial governments' responsibility over their own institutions, creating a joint governance approach between the central and provincial governments.³⁶ As a result, provincial governments are increasingly responsible for funding and management, as discussed in Appendix A.³⁷ However, we and other scholars believe true educational autonomy remains low, since party organizations are present within the organization structure, and Marxism and Chinese socialism courses are required.³⁸

Graduate Level

At the graduate level, China offers 828 graduate training institutions, which train 2.86 million students across 424,000 doctoral students and 2.44 million master's students.³⁹ It is unclear what degree of overlap exists between the 828 postgraduate institutions and the 1,265 HEIs offering bachelor's degrees. Non-

MOE supervised institutions—such as the Chinese Academy of Sciences, the Chinese Academy of Agricultural Sciences, and the Chinese Academy of Social Sciences—are first-tier public research universities that focus on graduate education.⁴⁰

CSET findings reflect increasing doctoral education quality. Around 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.⁴¹

College graduates take entrance examinations when applying for a master's and a doctorate.⁴² The MOE's Department of Degree Management and Postgraduate Education develops plans for graduate education, establishes graduate schools, and manages design of key national disciplines.⁴³

Overview of the United States' Education System

The U.S. education system is more decentralized than its Chinese counterpart, especially for primary and secondary education. Each individual state's own department of education is the authority that determines the laws that finance schools, hire educators, mandate student attendance, and implement curricula. In contrast to China's MOE, the U.S. federal government provides relatively minor education oversight through the compilation and reporting of education statistics, along with promoting equitable access to education and enforcing a prohibition on institutional discrimination.⁴⁴

The U.S. Department of Education, the United States' federal agency for education, proclaims that education is a "state and local responsibility," and the federal government's role in education is more of a "kind of emergency response system" to fill gaps when "critical national needs arise."⁴⁵ The most notable federal education initiatives, such as the Elementary and Secondary Education Act of 1965, the No Child Left Behind Act of 2002, and the Every Student Succeeds Act of 2015, reflect the U.S. government's efforts to promote childrens' equal access to quality public education.

At the postsecondary level, the federal government has slightly more authority through its administration of student financial aid. The Department of Education supports programs that provide grants, financial aid (loans), and work-study assistance. Roughly 66 percent of students apply for federal financial assistance.⁴⁶ The department's student loan programs have more than 43 million outstanding borrowers, with outstanding student debt over \$1.7 trillion.⁴⁷ (For more on U.S. education funding, see Appendix B.)

The jurisdiction of the U.S. Department of Education is rooted in the United States Constitution. As a result of the division in constitutional authority, states develop curriculum guidelines and performance standards, license private elementary and secondary schools to operate within their jurisdictions, certify teachers and

administrators, administer statewide student achievement tests, and distribute state and federal funding to school districts.⁴⁸ Additionally, education in the United States is segmented between public and private schools, including religious and nonsectarian institutions.

Primary and Secondary Education (K-12)

The U.S. primary and secondary education system (K-12) annually serves fifty million students, through around 98,000 public and 32,000 private elementary and secondary schools spread across roughly 18,200 school districts.⁴⁹ Of the estimated \$832 billion spent on K-12 education in the academic year 2018–19, states, local school districts, and private sources provided the majority. For K-12, the federal contribution is around 8 percent.⁵⁰ Federal funds do not solely come from the Department of Education, but also from other federal agencies such as the U.S. Department of Agriculture and the U.S. Department of Labor.

In the public sector, 13 years of formal schooling is available free of cost to all U.S. children and is overseen by state governments and local school districts. The compulsory starting age for children to attend school varies by state (ranging from five to eight years old), and individual states also determine the number of years of compulsory education. In most states it is until age 18, but a few are age 16 or 17.⁵¹

Both public and private options for 13 years of schooling are typically split among kindergarten, elementary, middle school or junior high school, and high school, but due to the system's decentralized nature, different models exist. Depending on the school district, middle school (typically years six through eight) may be included in either elementary or junior and senior high school.⁵²

As with most systems, prerequisite requirements and determined benchmarks set by state and local governments must be met at each stage in the education system to proceed to the next level.

Individual U.S. states employ a variety of tools and assessments to determine learners' eligibility based on their needs and achievements (for more on a recent attempt to adopt national standards, called Common Core, see Appendix C). These benchmarks will vary under the governance of state education departments. For example, high school students will have different requirements for exit exams and mandated credits in certain subject areas depending on the state in which they attend school.⁵³ After high school graduation, about two thirds of students attend a postsecondary institution the following fall season, with 44 percent attending a four-year institution.⁵⁴

Postsecondary Education

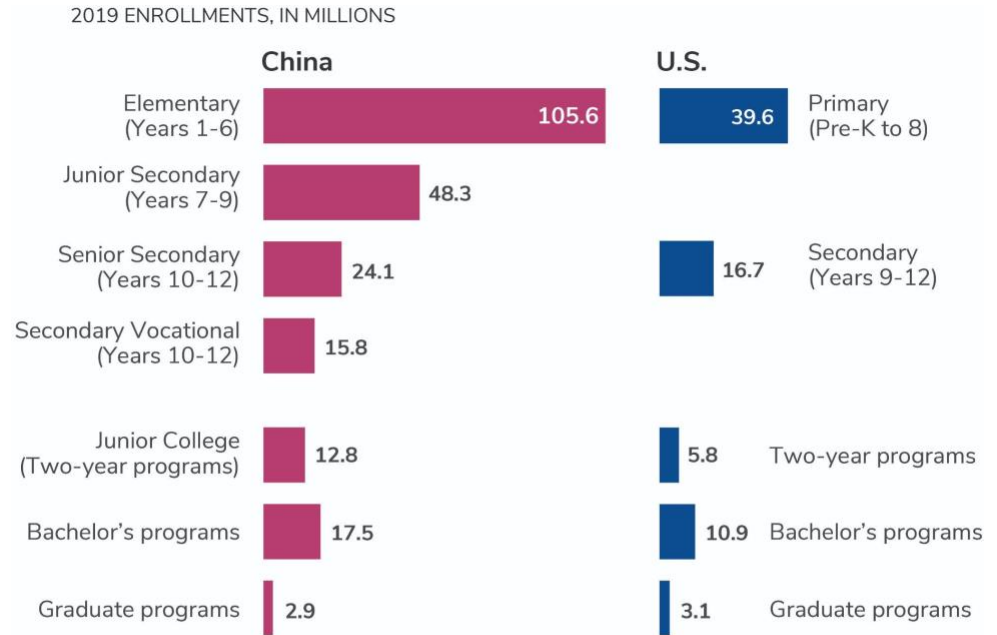
The United States is home to a competitive environment for degree-granting institutions, which include two- and four-year colleges and universities serving over twenty million postsecondary students. The National Center for Education Statistics tallies 3,982 degree-granting postsecondary institutions in the United States. Public institutions account for less than half of this total, at 1,625, although have a higher share of total enrollment than private institutions.⁵⁵ Private nonprofit institutions make up the largest count, with 1,660 institutions, while private for-profit institutions total 697. Degrees conferred by colleges and universities include five levels: associate's, bachelor's, master's, professional (e.g., JD, MD), and finally doctorates, split into research doctorates (e.g., PhD) and doctorates of practice (e.g., PsyD, DNP, EdD).⁵⁶

Community colleges are public postsecondary education options that often work with high schools to provide students with specialized education, technical and vocational training, and transition pathways to four-year colleges or universities. Additional nondegree postsecondary education options include stand-alone programs, distance or online learning, or specific course pathways that confer either certificates or licenses.⁵⁷

The rest of the U.S. postsecondary education system consists of four-year public and private colleges and universities. The Carnegie Commission on Higher Education classifies these institutions based on the types and numbers of degrees conferred and level of research activity. At the top of this classification are R1 and R2 institutions, which are the most research intensive universities in the United States, awarding at least 20 research or scholarship doctoral degrees and spending no less than \$5 million for research annually.⁵⁸ R1 universities, those with “very high research activity,” are often internationally recognized for their academic prestige, but comprise roughly 3 percent of U.S. postsecondary institutions.⁵⁹ However, these 131 R1 universities account for close to 18 percent of postsecondary enrollments.⁶⁰ There are a greater number of R2 institutions at a total of 135, but these account for fewer enrollments—8 percent of postsecondary students.⁶¹ Many other universities, including master’s colleges and universities, baccalaureate colleges, or special focus institutions such as business and management schools or faith-based institutions also offer graduate degrees, whereas some nonprofit private liberal arts institutions do not.

Figure 1 shows 2019 enrollment totals by level of education for China and the United States (2019 graduate totals by level of education are provided in the Appendix). China maintains a cumulative numerical advantage until the graduate level, after which the United States retains a slight lead. This lead disappears when not counting foreign-born students, who comprise about 14 percent of total graduate enrollment. However, as a share of total population in each country, the United States remains far ahead.

Figure 1. 2019 Total Educational Enrollment, United States and China



Notes: Some U.S. school districts split primary school into "elementary school" and "middle school" or "junior high school." Middle school and junior high school typically consists of grades 6-8 or 7-8. Chinese postsecondary figures do not include adult or web-based institutions

Source: 2020 Digest of Education Statistics; U.S. National Center for Education Statistics; 2020 Chinese Statistical Yearbook.

Conclusion

Access to AI education is a fundamental part of cultivating a globally competitive AI workforce. Assessing competitive strength in AI talent therefore includes understanding what each country is doing to provide AI education. However, given the inherent differences in each country's education system, it also includes understanding how both the Chinese and U.S. systems are structured and administered.

This brief provides an overview of the education systems in China and the United States. A companion brief, "AI Education in China and the United States: A Comparative Assessment," describes and compares each country's progress in providing AI education at all educational levels, along with associated implications for U.S. national security.

The Chinese education system is mainly characterized by its Ministry of Education setting centralized goals in five- to 15-year education strategies for its 282 million students across 530,000 educational institutions. The MOE also certifies teachers and approves curricula and teaching materials, while funding responsibilities largely fall on local governments (see Appendix A). The MOE's role is greatest at the postsecondary level, where it directly manages 75 elite colleges and universities.

In contrast, the U.S. education system is primarily managed and overseen by each individual state's own department of education, which sets curricula and achievement standards and certifies and hires educators. At the federal level, the U.S. Department of Education acknowledges states' primary educational responsibilities and instead maintains minor education oversight through the compilation and reporting of education statistics, promoting equitable access to education, and enforcing a prohibition on institutional discrimination. At the postsecondary level, the U.S. Department of Education has a more prominent role through the administration of funding, grants, and financial aid

(loans), but it is not the only federal entity that contributes postsecondary education funds.

Finally, there are clear similarities and differences in the challenges both countries face in providing equal access to quality education. Similarly, China and the United States share challenges that could hinder successful integration of new curricula or fundamental change in existing curricula—for example, to accommodate emerging technologies like AI. Both countries struggle with a persistent urban-rural divide, inability to access quality education, and uneven teacher quality.

However, the level of centralization in educational administration is notably different. While it is likely China can more easily push nationwide change with its top-down system and regimented five- to 15-year education plans, implementation can be uneven across provinces. The United States must rely on buy-in from and collaboration among its individual states for educational change to take place at a national level (see Appendix C for how this process can sometimes be complex).

Ultimately, each system has key advantages and disadvantages as it relates to growing and cultivating a globally competitive AI workforce. An exploration of this as it relates to AI education is in the companion report “AI Education in China and the United States: A Comparative Assessment.” Finally, an upcoming CSET report titled “U.S. AI Workforce: Policy Recommendations” will have policy recommendations that address these advantages and disadvantages for the United States.

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Appendix A. Funding China's Education System

Statistics from the MOE and the Chinese Statistical Yearbook do not disclose funding breakdowns at each level of education.⁶² What is known is funding includes government appropriations for education, funds invested by private school founders, donations and fundraising, and tuition fees.⁶³ The MOE's internal Department of Finance and Funds Supervision Affairs Center are responsible for fund management, and the Chinese government has stated that it will develop a more rigorous and standardized funding supervision system.⁶⁴

Government appropriations for education have traditionally hovered at 80 percent, forming the largest share of total funding.⁶⁵ However, within government appropriations and aggregated across all provinces and education levels, local governments bear 90 percent or more of the burden, which reached 3.7 trillion yuan (\$968 billion when adjusted for purchasing power parity [PPP]) in 2018.⁶⁶ China's Education Law requires increased government appropriations for all education levels proportional to national economic growth, which is determined by the State Council.⁶⁷

However, national funding does not always cover the requisite financial needs for provinces, some of which are unable to fill the remaining need. In other words, local-centric funding models have created inequities, since poorer areas have paltry resources to pay skilled teachers, purchase instruction materials, and maintain school facilities.⁶⁸ Other diversified funding sources—such as the aforementioned business donations and MOE-provided special funding for underdeveloped school systems and teacher education programs—may possibly provide a stopgap.⁶⁹

There is more clarity in the data when it comes to what the MOE itself spends most of its money on. In 2019, the MOE had a budget of 456.2 billion yuan, or \$120 billion PPP-adjusted.⁷⁰ This budget formed the largest share of China's 26 cabinet-level State Council departments with publicly disclosed figures.⁷¹ Despite the MOE's aforementioned responsibilities, it has a clear focus on spending

on higher education, particularly in science and technology.⁷² Its higher education spending surpasses \$80.6 billion PPP-adjusted each year, or over 85 percent of the ministry's budget, making it the State Council's largest publicly known line item.⁷³ This figure likely applies to the aforementioned 75 universities the MOE directly oversees.

Appendix B. Funding the United States' Education System

The funding mechanisms between the public and private education sectors are vastly different. Public education operates under a braided funding model, drawing from a number of different stakeholders such as state and local governments, whereas private for-profit educational institutions draw the vast majority of funds (typically over 90 percent for postsecondary institutions) from tuition and fees.⁷⁴ Private nonprofit educational institutions, on the other hand, draw less funds from tuition. For example, private nonprofit postsecondary institutions collect roughly one-third of funds from tuition and fees; the rest come from other stakeholders, including private gifts, grants, or contracts; federal, state, or local governments; and investment returns.⁷⁵

Public K-12 funding primarily draws from local sources. Individual states and local districts each differ in their approach to funding, however, a general framework exists across the United States. Typically, close to half of public K-12 school funding comes from state resources, such as income and sales tax.⁷⁶ The next largest contributor of funds comes from local sources, primarily through property taxes of homeowners in the area.⁷⁷ A final small percentage (around 8 percent) comes from federal sources, including grants for specific programs or services.⁷⁸ An Education Commission of the States report found that public school funding streams are sometimes “inconsistent and inefficient,” as they are impacted by shifts in policies or economic downturns.⁷⁹ Other factors, such as district demographics may impact local funding for schools. At times, great variances exist between states in public K-12 funding. For example, New York spends more than \$24,000 per student, while states such as Idaho and Utah spend significantly less, around \$8,000.⁸⁰ In sum, state, local, and federal governments spend about \$720 billion for K-12 public education, or \$14,840 on average per pupil.⁸¹

Public colleges and universities receive a share of their funding from their state. Aggregated nationally, states contribute over 78 percent of funds to public postsecondary education, and tax appropriations comprise a large share of this funding.⁸² The share of sources other than state tax appropriations, or local funding, average about 11 percent nationally.⁸³ However, the distribution of funding among stakeholders will vary, often widely, by state. Local appropriations for postsecondary education are as low as 0.1 percent (as in Alabama) or close to 50 percent (in Arizona, for example).⁸⁴ Additionally, figures from the State Higher Education Finance Report show that in more than half of U.S. states, tuition and fees have become the primary source of funding for public higher education as the share of state revenue dedicated to postsecondary funding has been declining nationwide.⁸⁵ From 2000 to 2015, state funding per student at higher education institutions, both public and private, fell by about 31 percent.⁸⁶

The rest of public college and university funding comes from direct tuition payments from students. Similarly, outside of university grants and other financial support including endowments, all funding at private sector institutions come from student tuition. Students can pay tuition through their own means, or through grants and scholarships, and increasingly, student loans.⁸⁷ Student loans are public or privately funded; the vast majority are administered federally through the U.S. Department of Education.

At the federal level, the Department of Education does not provide the majority of funds for education: in 2018, its share of federal education funding hit just below 45 percent.⁸⁸ Typically 13 cabinet-level entities, including the U.S. Departments of Agriculture, Defense, Energy, Justice, and Labor, and smaller federal departments and programs also contribute education funds.⁸⁹ Higher education also receives funds from over a dozen cabinet-level agencies for research, grant programs, and financial aid. The Department of Education directs higher education funds through discretionary grants (which are awarded through a competitive process), student loans (which are awarded for college

attendance), or formula grants (which use formulas determined by Congress).

We note this funding structure comes with the additional cost of budget fluctuations, which impacts not only long-term planning but the ability for school districts to add new curricula. For example, the COVID-19 pandemic greatly decreased state revenues and led to reduced funding for computer science education or its removal entirely from fiscal year 2021 budgets.⁹⁰

Appendix C. Recent Attempt to Standardize U.S. K-12 Education

Various U.S. administrations periodically attempt reforms to the public education system, particularly around establishing common public K-12 education standards. In 2009, state governors and education leaders spearheaded efforts to establish a new set of K-12 education standards to increase students' college preparedness and academic competitiveness.⁹¹ The federal government at the time promoted the effort, called the Common Core State Standards Initiative, and funded two testing consortia, the Partnership for Assessment of Readiness for College and Careers, and Smarter Balanced, to develop standardized tests that aligned with common K-12 education standards.⁹²

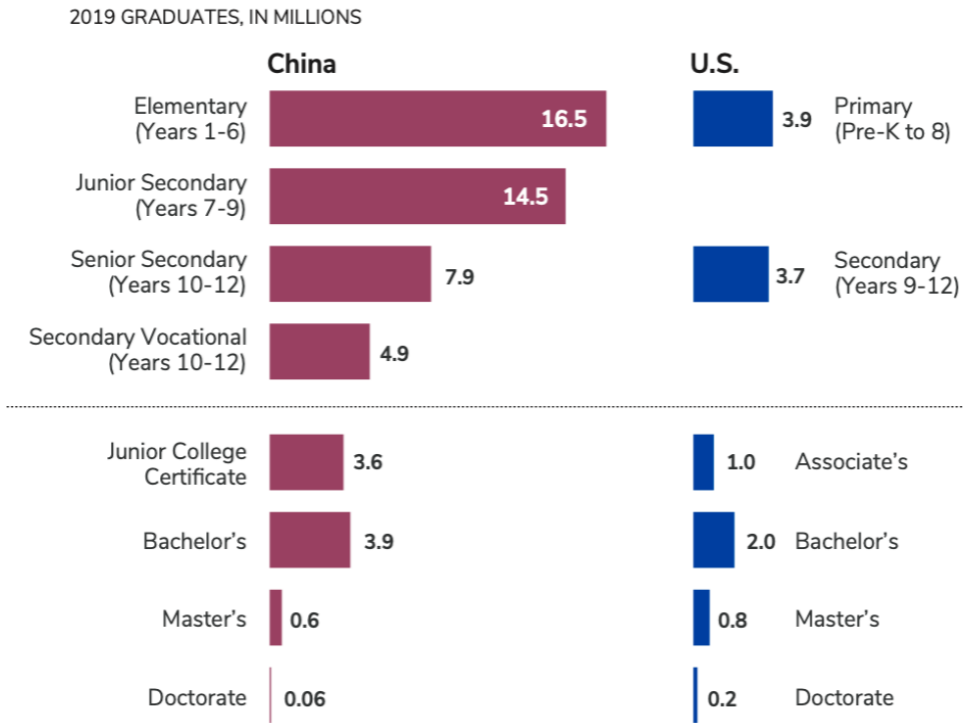
However, the Common Core was met with significant controversy, pushback, and rejection.⁹³ Although a majority of individual states adhered to the reformed Common Core standards, they have chosen their own standardized tests.⁹⁴

This demonstrates the difficulty of designing and implementing a U.S. education policy as a long-term strategic goal. Education preferences and priorities are not consistent and change with new administrations, as was seen after the Obama administration when federal policies shifted to “keep education local” (i.e., reduce the federal government's role in education governance) and challenge the Common Core.⁹⁵ In the long term, such fluctuations complicate strategic objectives that require planning beyond the four- to eight- year horizons of presidential terms.

Appendix D. Comparison of Graduates in the United States and China

Figure D presents the number of graduates in the United States and China by level of educational attainment. While China clearly educates and graduates more youth at lower levels of education, due to its larger population, the United States still confers more graduate degrees.

Figure D. Graduations in the United States and China by level of education, 2019



Notes: Eighth grade enrollment serves as a proxy for graduation given very low primary school drop-out rates in the U.S. Chinese postsecondary figures do not include adult or web-based institutions.

Source: 2020 Digest of Education Statistics, U.S. National Center for Education Statistics; 2020 Chinese Statistical Yearbook.

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