Feng Zhuolin
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Liu Niancai *Editors*

# Education in China and the World

## National Development and Global Benchmarking

上海交通大學出版社
Shanghai Jiao Tong University Press



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# Preface

Education is considered a fundamental strategy for China's socioeconomic development. Since the opening-up four decades ago, education in China has undergone tremendous expansion and has continuously improved its visibility and global influence. However, language barriers and the complex nature of education transformation have led to a dearth of accessible and reliable information on Chinese educational systems and trends for research outside the country. This poses substantial challenges to comparative studies and information exchange in the field. It is increasingly important to provide to provide a comprehensive, holistic, and updated analysis of education in China to the world.

In response to this need, the School of Education (SOE) at Shanghai Jiao Tong University initiated the ambitious "Education in China and the World" project in 2021. This endeavor aims to provide conceptual support for the development of "a modern education system with Chinese characteristics and global standards", to promote understanding, inspire critical discussion on education development in both China and internationally, and provide implications for further enhancing quality education across all sectors.

In 2023, the inaugural publication of this project, titled *Education in China and the World: Achievements and Contemporary Issues*, was published by Springer and Shanghai Jiao Tong University Press. To ensure a timely and insightful analysis of education development in China, SOE aims to publish this book series biennially, with two volumes that will be updated alternately every other year. One volume focuses on the latest developments in Chinese education and its various sectors, while the other explores key educational priorities and critical issues in China.

In addition to the above-mentioned aims, the 2024 edition of the publication series is set in the context of President Xi's report on the 20th National Congress. This report stresses the vital role of science, education, and human resources for China's sustained development and global competitiveness and has profound implications for future development. Covering different educational sectors from basic education to post-secondary education, the 2024 edition seeks to offer an in-depth analysis reflecting the latest developments within China and updated comparisons between China and other global counterparts.

This publication consists of eight chapters. It starts with a general introduction to the Chinese education system and structure in Chap. 1, serving as a snapshot of the evolution of Chinese education over the past four decades. The next seven chapters (Chaps. 2–8) discuss Chinese education in seven educational segments including: elementary education, middle school education, senior high school education, undergraduate education, graduate education, professional education, and vocational education. Chapters 2–8 follow the same organization, covering six sections: highlighting data, excellence index, best practices, inspiring stories, latest research, and national policies.

The analysis throughout the publication integrates official data from China and reliable resources at home and abroad to conduct systematic statistical analysis. These resources include major global organizations, governmental statistical reports, and databases at local and institutional levels. The featured analysis incorporates a global comparison of key indicators to explore the strengths and gaps of Chinese education with its counterparts in the world and to seek implications for enhancing quality and performance. Each chapter also collects influential case studies and real-life stories of inspiring educators and undergoes a comprehensive literature search on current research and national policy, to provide insights into educational practices and trends in the Chinese context.

The analysis in this current edition highlights China's achievements in education development, showcasing significant growth in key indicators, particularly in terms of educational attainment and research output. Such progress can be attributed to substantial and continued financial support from the government. However, a global comparison reveals disparities in quality performance compared to international standards, which is evident in areas such as educational resources per capita. Further efforts need to be prioritized in promoting academic excellence and allocating adequate educational resources to address public needs comprehensively.

This publication will serve as a valuable resource for students, scholars, and policy makers in the field of education studies, as well as for the public who are interested in Chinese education. Looking ahead, in the 2025 edition of the book series, SOE aims to delve deeper into key educational priorities and critical topics in China, including education systems, STEAM education, international education, excellence initiatives for building world-class universities, mental health education, and values education.

Shanghai, China

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The original version of the book has been revised: Author's Affiliations has been updated. A correction to this book can be found at https://doi.org/10.1007/978-981-97-7415-9_9

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# Abbreviations

| | |
|---|---|
| AI | Artificial Intelligence |
| ARWU | Academic Ranking of World-Class Universities |
| CAE | Chinese Academy of Engineering |
| CAHE | Chinese Association of Higher Education |
| CAS | Chinese Academy of Sciences |
| CAST | China Association for Science and Technology |
| CEDEFOP | European Center for the Development of Vocational Training |
| CFPS | China Family Panel Studies |
| CNKI | China National Knowledge Infrastructure |
| CPC | Communist Part of China |
| CPI | Consumer Price Index |
| CSCSE | Chinese Service Center for Scholarly Exchange |
| CSSCI | China Social Science Citation Index |
| CSU | China South University |
| DSTI | Department of Science, Technology and Informatization |
| EAfA | European Alliance for Apprenticeships |
| EEE | Emerging Engineering Education |
| ESCS | Economic, Social, and Cultural Status |
| EU | European Union |
| FDU | Fudan University |
| GDP | Gross Domestic Product |
| GER | Gross Enrollment Ratio |
| HEI | Higher Education Institution |
| HIT | Harbin Institute of Technology |
| HUST | Huazhong University of Science and Technology |
| HZMB | Hong Kong-Zhuhai-Macau Bridge |
| IAGtVET | Interagency Group on Technical and Vocational Education and Training |
| IC | Imperial College London |
| ISCED | International Standard Classification of Education |
| LFS | Labor Force Survey |

| | |
|---|---|
| LSE | London School of Economics and Political Science |
| MBA | Master of Business Administration |
| MEXT | Ministry of Education, Culture, Sports, Science and Technology (Japan) |
| MIIT | Ministry of Industry and Information Technology |
| MIT | Massachusetts Institute of Technology |
| MOE | Ministry of Education |
| MOF | Ministry of Finance |
| MOOCs | Massive Open Online Courses |
| MOST | Ministry of Science and Technology |
| MPA | Master of Public Administration |
| NBS | National Bureau of Statistics |
| NCES | National Center for Education Statistics |
| NDRC | National Development and Reform Commission |
| NEAC | National Educational Attainment Categories |
| NIES | National Institute of Education Sciences |
| NJU | Nanjing University |
| OECD | Organization for Economic Co-operation and Development |
| P.E. | Physical Education |
| PBL | Project-Based Learning |
| PETOE | Plan for Educating and Training Outstanding Engineers |
| PISA | Program for International Student Assessment |
| PKU | Peking University |
| PPP | Purchasing Power Parity |
| QS | Quacquarelli Symonds |
| R&D | Research and Development |
| RMB | Renminbi (Chinese yuan) |
| S&T | Science and Technology |
| SCI | Science Citation Index |
| SCIE | Science Citation Index Expanded |
| SISU | Shanghai International Studies University |
| SJTU | Shanghai Jiao Tong University |
| SMHC | Shanghai Mental Health Center |
| SMU | Shanghai Maritime University |
| SSCI | Social Sciences Citation Index |
| SYSU | Sun Yat-Sen University |
| TALIS | Teaching and Learning International Survey |
| THE | Times Higher Education World University Rankings |
| THU | Tsinghua University |
| TJU | Tongji University |
| UCB | University of California, Berkeley |
| UCL | University College London |
| UCLA | University of California, Los Angeles |
| UCSD | University of California, San Diego |
| UIS | UNESCO Institutes for Statistics |

| | |
|---|---|
| UNESCO | The United Nations Educational, Scientific and Cultural Organization |
| USTC | University of Science and Technology of China |
| VET | Vocational Education and Training |
| VR | Virtual Reality |
| WOS | Web of Science |
| XJTU | Xi'an Jiaotong University |
| ZJU | Zhejiang University |

# Chapter 1
# Education in China: An Introduction

**Jia Xintong and Feng Zhuolin**

**Abstract** Chinese education has undergone tremendous transformation complementing the wide-scale socioeconomic reform over the past four decades. Education continues to change along with an increasingly complex and diversified world. This book provides a comprehensive overview and profound insights into the landscape of education in China. It aims to encourage further discussions on the issues and challenges confronting Chinese education and the world and to promote international understanding. The first chapter presents a comprehensive overview of the evolution of Chinese education over the past four decades. It provides essential context and analysis, setting the stage for the following chapters. It reviews educational goals based on China's Five-Year Plans and introduces the Chinese education system and structure. The first chapter also explores the development of education and research in China, and reflects developmental trends based on statistics.

**Keywords** Educational development · Education policy · Education system · Educational scale · Education resources · Scientific research

## 1.1 An Overview of the Chinese Education System

Education in China has undergone tremendous transformation along with its socioeconomic reform in the past four decades. This chapter provides a general introduction to education development and systems in China. The analysis in this section focuses on educational goals in the twenty-first century since the beginning of the 2000s, as well as educational development and progress since the reform and opening-up in 1978.

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## *1.1.1 Evolving Educational Goals in the Past Two Decades*

The analysis of educational goals is based on the policy documents of the *Five-Year Plans for Economic and Social Development of the People's Republic of China* (hereafter the Five-Year Plans) endorsed by the National People's Congress. The Five-Year Plans are formulated every 5 years and establish the central policy directions for further reform and development in the next 5 years. This series of plans set development goals for education, which reflect the educational conditions in China over time. By analyzing the goals from the past two decades, the progress and advancement of education can be easily seen and summarized.

### 1.1.1.1 *The 10th Five-Year Plan (2001–2005)*: Speeding up Education Development

*The 10th Five-Year Plan* was endorsed by the ninth National People's Congress in 2001 (National People's Congress, 2001). It set China's development goals from 2001 to 2005 and proposed to rapidly advance development.

*To Develop All Types of Education at All Levels.* The Plan promoted well-rounded education (*suzhi* education)[1] and the holistic development of students in moral, intellectual, physical, and aesthetic aspects. It prioritized the enhancement of basic education, consolidating gains in regions where 9-year compulsory education had achieved widespread coverage. Special attention was given to expanding compulsory education in economically disadvantaged areas of western China and areas with concentrations of ethnic minorities The Plan pointed out the need to expand upper secondary education. It also proposed to implement Project 211 and increase the number of leading universities and disciplines in higher education. Additionally, it promoted the development of vocational education and training, early childhood education, and distance learning in the Chinese context (ibid).

*To Further Reform the Education System.* The Plan expedited the reform of schooling systems, fostering the standardization of non-state actors' involvement in diverse educational formats. It established a framework for developing both public and private education sectors simultaneously under government oversight. The Plan aimed to deepen the reform of the education management system, guarantee decision-making powers of higher education institutions (hereafter HEIs) in accordance with the law, and construct an educational system that bridges vocational and traditional education. Moreover, the Plan also encouraged increased education investment, strengthened funding to the compulsory education sector, and enhanced personnel and employment systems for university graduates (ibid).

[1] Well-rounded education (*suzhi* education) is close to but different from the well-rounded education in the U.S., which refers to education covering multiple subject areas. This notion is close to the notion of liberal arts education in the west, and it emphasizes on a holistic approach of student development, including the development in moral, intellectual, physical, and aesthetic aspects.

#### 1.1.1.2 *The 11th Five-Year Plan (2006–2010)*: Prioritizing Education Development

*The 11th Five-Year Plan* was endorsed by the 10th National People's Congress in 2006 (National People's Congress, 2006). It set China's development goals from 2006 to 2010 and proposed to prioritize education development.

*To Reinforce and Make Compulsory Education for All*. The Plan sought to reinforce the importance of compulsory education in rural areas, reduce the dropout rate of rural students, and promote the balanced development of compulsory education in urban and rural areas (ibid).

*To Develop Vocational Education and Training*. The Plan proposed to further develop secondary vocational education, promote various vocational skills training projects, and reform the teaching methods of vocational education (ibid).

*To Strengthen Higher Education Quality*. The Plan encouraged improving the quality of higher education, optimizing the structure, and enhancing the popularization of higher education. It proposed to strengthen the development of leading universities and key disciplines. Adult education was also emphasized (ibid).

*To Increase Educational Investment*. The Plan specified a goal of gradually raising the percentage of government expenditure on education represented in GDP (Gross Domestic Product) to 4%. It aimed to promote educational equality and it proposed the allocation of additional resources to rural areas, the central and western regions, poor areas, and minority-inhabited areas. It also identified the need to further develop the student loans system, improve the subsidy system for students at all levels of schools, and the student aid system for economically disadvantaged students (ibid).

*To Further Reform the Education System*. The Plan emphasized the need for clarity in the roles and responsibilities of government at all levels to provide public education, form a diversified system of educational investment, and establish a strict publicity system for educational charges. It put forth efforts and sought a teaching system that adapted the requirements of a well-rounded education, reformed the examination and enrollment systems, and promoted the reform of teaching, curriculum, and evaluation. It also proposed to reform the education management system and establish clear regulations of responsibilities and guaranteed decision-making powers of schools (ibid).

#### 1.1.1.3 *The 12th Five-Year Plan (2011–2015)*: Further Accelerating Education Reform

*The 12th Five-Year Plan* was endorsed by the 11th National People's Congress in 2011 (National People's Congress, 2011). It set China's development goals from 2011 to 2015 and proposed to further accelerate education reform.

*To Develop All Types of Education at All Levels*. The Plan set the goal of actively developing preschool education and raising total enrollment for children receiving 1-year preschool education to 85%. It emphasized reinforcing the achievement of the popularization of compulsory education. It also sought to popularize upper secondary education during the 5-year period, vigorously develop vocational education and emphasize rural education. Furthermore, the Plan highlighted the importance of accelerating the establishment of world-class universities, national top-tier universities, and key disciplines. It was also important to support education for minority nationalities and speed up the development of special education and continuing education (ibid).

*To Enhance Education Equality.* The Plan advocated for the equitable distribution of educational resources to address regional disparities and promote balanced development across all areas. It stressed the importance of promoting a balanced development of compulsory education, and focusing on education in rural, remote, economically disadvantaged, and minority-inhabited areas (ibid).

*To Promote Well-Rounded Education*. In order to promote well-rounded education, the Plan put forward to reform the content, teaching methods, and assessment system of education, and reinforce the holistic development of students on moral, intellectual, physical, and aesthetic aspects. It sought to widely administer the Academic Proficiency Test and Comprehensive Student Assessment in upper secondary education. In higher education, the Plan focused on carrying out projects related to the improvement of teaching quality, instructional reform, and the creation of an effective evaluation system (ibid).

*To Further Reform the Education System.* The Plan set the goal of reforming the examination system and enrollment method, and gradually forming an effective system including classified exams, comprehensive quality assessment, and diversified admission standards. The decision-making powers of schools were guaranteed and expanded, and non-state actors were encouraged to run schools. The Plan also claimed to follow globalization trends, strengthen international cooperation, and underscore high-quality educational resources (ibid).

#### 1.1.1.4 *The 13th Five-Year Plan (2016–2020)*: Promoting the Modernization of Education

*The 13th Five-Year Plan* was endorsed by the 12th National People's Congress in 2016 (National People's Congress, 2016). It set China's development goals from 2016 to 2020 and proposed to promote the modernization of education.

*To Promote the Balanced Development of Basic Public Education.* The Plan proposed to establish a unified urban and rural funding mechanism for compulsory education, take appropriate measures to ensure that state-run schools that provide compulsory education comply with educational standards, and work to raise the completion rate of compulsory education to 95%. It was important to improve the quality of teachers with a focus on those teachers in rural areas and improve the teaching environment in rural schools. The Plan envisioned a more accessible preschool education system by proposing the targets of opening kindergartens for all children and raising the gross enrollment for children receiving 3-year preschool education to 85%. It specified the goal of raising the gross enrollment of upper secondary education to over 90%. The Plan also encouraged increased availability of special needs education for groups with disabilities and promoted the development of education for ethnic minority students (ibid).

*To Integrate Vocational Education and Industry*. The Plan aimed to improve the modern vocational education system and give momentum to training models for applied expertise and technical skills, which allow for the involvement of industry and vocational education as well as increased cooperation between schools and enterprises. It also emphasized the mutual recognition and vertical mobility between vocational education and regular education (ibid).

*To Train Innovators in University*. The Plan prioritized the quality enhancement of higher education, emphasizing a classification-based management approach and advocating for comprehensive reforms within institutions of higher learning. It aimed to implement an educational framework that caters to the diverse needs of students by integrating general knowledge with specialized expertise, thus fostering the development of both academic talents and applied talents. Additionally, the Plan aimed to revitalize higher education in the central and western regions of China. It underscored the importance of fostering innovation across all universities and promoting a coordinated effort towards developing world-class universities and disciplines (ibid).

*To Build a Learning Society*. The Plan emphasized developing continuing education and it envisioned a system for lifelong learning and training that was available to all members of society. The open sharing of learning resources and the development of senior citizen education were also encouraged (ibid).

*To Enhance the Vitality of the Reform of Education*. The Plan emphasized furthering reform examination and enrollment systems as well as instructional methods. It also put forth efforts to reform the professional job title system for elementary and secondary school teachers nationwide and promote close integration of modern information technology with education and teaching. The decision-making powers of schools were expanded, and non-state actors and investors were encouraged to provide a diverse range of educational services (ibid).

#### 1.1.1.5 *The 14th Five-Year Plan (2021–2025) and Vision 2035*: Reinforcing a High-Quality Education System

*The 14th Five-Year Plan and Vision 2035* was endorsed by the 13th National People's Congress in 2021 (National People's Congress, 2021). It sets China's development goals from 2021 to 2025 and puts forward China's long-term development plan towards 2035. In the education sector, it proposes to reinforce a high-quality education system.

*To Promote the Equality of Basic Public Education*. The most current Plan aims to further consolidate the balanced development of compulsory education, promote the further development of balanced compulsory education, and close the urban–rural divide. It seeks to strengthen the ranks of teachers and improve the quality of teaching staff in rural schools. In upper secondary education, it specifies the target of raising the gross enrollment ratio to more than 92%. The Plan also sets the goals of guaranteeing preschool education to be more inclusive and requiring special education and specialized education to be more accessible. It requires the gross enrollment of preschool education to be raised to more than 90% (ibid).

*To Enhance the Adaptability of Vocational Education*. The Plan highlights the characteristics of vocational education and trains substantial talents with technical and professional skills. The Plan seeks to reform the schooling mode of vocational education and give impetus to the involvement of industry and vocational education as well as cooperation between schools and enterprises. It also emphasizes the link between vocational education and regular education (ibid).

*To Improve the Quality of Higher Education*. The Plan puts forward managing higher education based on classifications, carrying out comprehensive reform of institutions of higher learning, and enhancing the gross enrollment ratio to 60%. It encourages the adoption of a classified approach to developing world-class universities and disciplines, and it supports the development of leading research universities. It also calls for the reform of the talent training system for basic disciplines and encourages to expand the scale of graduates with professional degrees (ibid).

*To Improve the Quality of Teaching Staff*. The Plan intends to establish a modern system of high-performing instructional staff and places emphasis on constructing normal education bases, developing public-funded education for normal university students, and deepening the comprehensive reform of the management of teachers in elementary schools, secondary schools, and kindergartens (ibid).

*To Further Reform Education.* The Plan aims to improve educational assessment and develop a well-rounded education. It requires education to be covered in public welfare, and it points out to raise the spending on education and increase the efficiency of the use of educational spending. The Plan encourages to expand the decision-making powers of schools and reinforces the comprehensive reform of examination and enrollment systems. It also recommends supporting and regulating the development of non-state education and promoting cooperation with leading schools in other countries. Moreover, the Plan intends to harness the advantages of online education, improve the system of lifelong learning, and build a learning society (ibid).

#### 1.1.1.6 Developmental Trends of Educational Goals

Since 2001, China has undergone a period of rapid development, marked by five consecutive Five-Year Plans. These plans have proposed educational goals based on China's specific conditions at the time and have played a pivotal role in leading China's education. They have guided efforts to enhance educational quality and promote equity in education. Over the past two decades, educational goals have become increasingly detailed, with specific goals set for various sectors and levels of education. Making education for all and promoting educational reform have emerged as key priorities. Above all, there has been a steadfast emphasis on the quality of education, with the overarching goal of fostering individuals' all-round development and meeting societal needs (The State Council, 2010). The Five-Year Plans put forward specific reform measures for all types of education at all levels to guarantee the development of well-rounded education and promote the holistic development of students in moral, intellectual, physical, and aesthetic aspects (Table 1.1). Concurrently, enrollment ratios across all levels of schooling have steadily increased. The emphasis on quality underscores a shift in China's educational focus from scale expansion to comprehensive development. In pursuit of a comprehensive strategy for economic and social development, China has heavily relied on science and education, prioritizing talent development and innovation-driven growth. Therefore, the development of well-rounded education and continuous improvement in educational quality have been and will be the long-term development goals.

## *1.1.2 The Education System*

China's education system covers preschool education, compulsory education, upper secondary education, and higher education (Fig. 1.1). Compulsory education includes elementary education and lower secondary education; higher education includes undergraduate education and graduate education.

### 1.1.2.1 Preschool Education

In China, children usually enroll in preschool at the age of two or three and leave preschool at the age of 6. Although preschool education is not compulsory, the government actively promotes its accessibility. Both public and private preschools play significant roles in China's early childhood education landscape. As of 2022, 45.96% of preschool students were enrolled in private preschools (Ministry of Education [MOE], 2023a).

### 1.1.2.2 Compulsory Education

China follows a system of 9-year compulsory education, which shall be received by all school-age children and adolescents. This typically comprises 6 years of elementary education followed by 3 years of lower secondary education. However, there is some variation between regions with a small number of them using a "5 + 4" structure. Compulsory education in public schools is publicly funded and uniformly implemented by the State. No tuition or miscellaneous fees are charged, and the State shall establish a guaranteed mechanism for operating funds for compulsory education. Private schools also provide elementary and lower secondary education, but they are not tuition-free. As of 2021, 10.60% of compulsory education students were enrolled in private schools (MOE, 2022). The curricula and standards for compulsory education are set by the MOE and implemented nationwide by provincial and municipal governments. Article III of the *Compulsory Education Law of the People's Republic*

**Table 1.1** Educational goals in China's Five-Year Plans

| | The 10th Five-Year Plan (2001–2005) | The 11th Five-Year Plan (2006–2010) | The 12th Five-Year Plan (2011–2015) | The 13th Five-Year Plan (2016–2020) | The 14th Five-Year Plan and Vision 2035 (2021–2025) |
|---|---|---|---|---|---|
| Education for all | To develop all types of education at all levels | To reinforce and make compulsory education for all | To develop all types of education at all levels<br>To enhance education equality<br>To promote well-rounded education | To promote the balanced development of basic public education<br>To build a learning society | To promote the equality of basic public education<br>To improve the quality of teaching staff |
| Educational reform | To further reform the education system | To further reform the education system | To further reform the education system | To enhance the vitality of the reform of education | To further reform education |
| Education resources | | To increase educational investment | | | |
| Higher education | | To strengthen higher education quality | | To train innovators in university | To improve the quality of higher education |
| Vocational education | | To develop vocational education and training | | To integrate vocational education and industry | To enhance the adaptability of vocational education |

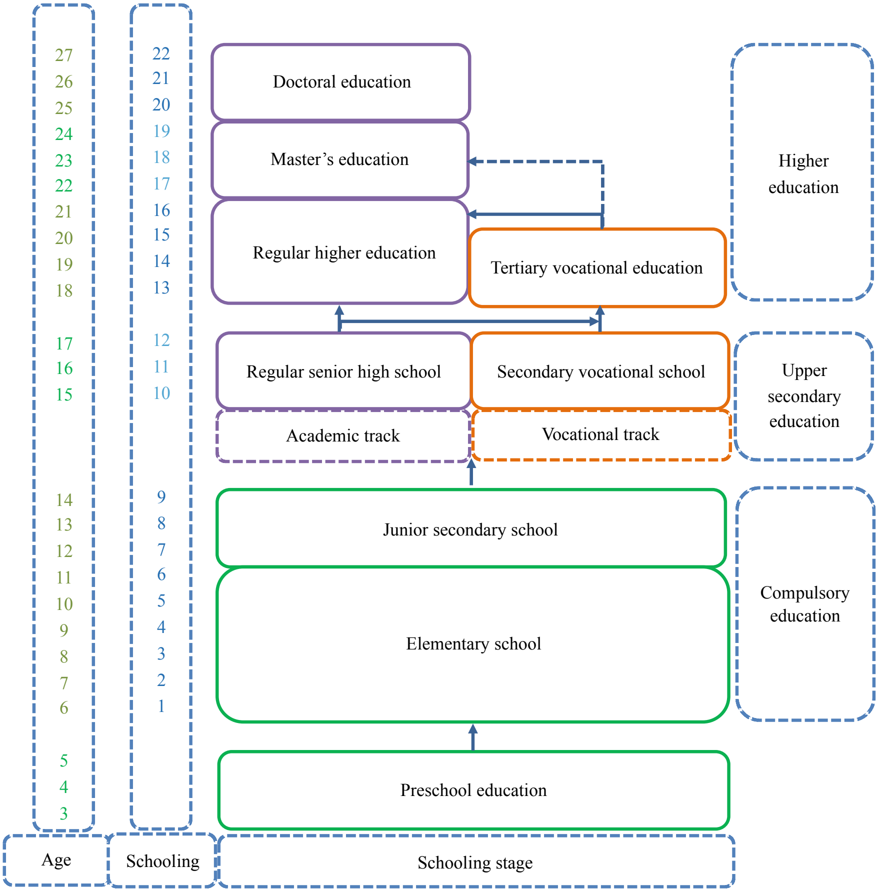


**Fig. 1.1** The education system of China. *Source* Adapted from OECD (2016).

*of China* stipulates that well-rounded education shall be carried out to improve the quality of education and enable children and adolescents to achieve all-round devel-opmentmorally, intellectually, and physicallyto lay the foundation for cultivating well-educated and self-disciplined workforce with high ideals and moral integrity (National People's Congress, 2018a).

#### 1.1.2.3 Upper Secondary Education

Following compulsory education, students have the option to pursue upper secondary education, which typically lasts for 3 years. This stage of education comprises two types of schools: regular senior high school and secondary vocational school. Regular senior high school represents academic track, while secondary vocational school represents vocational track.[2] Before entering upper secondary schools, students must complete a senior high school entrance examination (*zhongkao*). Based on their examination results, students are assigned to different types of upper secondary schools. In China, upper secondary education is primarily publicly funded. However, in 2022, approximately 18.34% of regular senior high school students and 20.63% of secondary vocational school students were enrolled in private schools (MOE, 2023a).

#### 1.1.2.4 Higher Education

According to Article II of the *Higher Education Law of the People's Republic of China,* higher education in China is defined as "education that is carried out after the completion of upper secondary education" (National People's Congress, 2018b). It encompasses postsecondary education provided by academies, universities, colleges, vocational institutions, institutes of technology, and other collegiate-level institutions, including vocational schools, trade schools, and career colleges that confer academic degrees or professional certifications (Yu et al., 2012). In China, the bachelor's, master's, and doctoral degrees are the three officially recognized higher education degrees. Higher education in China comprises undergraduate education and graduate education. Within the undergraduate education system, regular higher education is the more academic route and tertiary vocational education is the more vocational route; through examination, students of tertiary vocational education can transfer to regular higher education. Students of both routes have opportunities to obtain bachelor's degrees. The graduate education system includes master's education and doctoral education. Admissions to undergraduate education are based on students' scores in the college entrance examination (*gaokao*), and admissions to graduate education also depend on students' results in entrance examinations. In China, higher education is primarily publicly funded. In 2022, 25.27% of undergraduate students were enrolled in private HEIs (MOE, 2023a).

### *1.1.3 The Educational Development Since the Reform and Opening-Up in 1978*

#### 1.1.3.1 Focusing on Developing Education

Concentrating educational resources on selected schools, key fields, and in-demand skills and occupations has consistently been a prominent characteristic of "holding a large scale of education in a resource-constrained setting". To expedite reform

[2] Secondary vocational school includes regular specialized high schools (*putong zhongzhuan*), vocational high schools (*zhiye gaozhong*), adult specialized high schools (*chengren zhongzhuan*), and technical schools (*jishu xuexiao*).

within a limited timeframe, China has adopted a strategy of directing its educational resources strategically.

*Key Elementary and Secondary Schools.* In January 1978, MOE established objectives, tasks, plans, enrollment methods, and leadership guidelines for key elementary and secondary schools. In October 1980, MOE embarked on a mission to develop approximately 700 secondary schools into first-class, high-quality schools with a focus on cultivating exemplary study habits. Furthermore, in July 1995, the National Education Commission (the predecessor of MOE) conducted evaluations and released a list of around 1000 model regular senior high schools.

*Projects 211 and 985 to Develop Higher Education Excellence.* In 1993, the State proposed that the central government and local authorities should focus on enhancing about 100 key universities and several core disciplines. In November 1995, Project 211 was officially launched. In 1998, President Jiang Zemin proposed the establishment of a number of world-class universities in China. In 1999, Project 985 was officially launched. These initiatives aimed to develop a cohort of excellent universities and enhance the overall strength of higher education in the country.

*Key Vocational Schools.* To enhance the quality of vocational education, the State Council proposed the evaluation and accreditation of national key secondary vocational schools in January 1995. As a result, 296 vocational schools were selected nationwide for this initiative (Zhang, 2018).

#### 1.1.3.2 Governing Education Development Through Laws and Regulations

Governing education development through legislation reflects the advancement of modernization in the field of education.

In 1985, the Chinese government put forth the implementation of nine-year compulsory education, followed by the enactment of the *Compulsory Education Law of the People's Republic of China* in 1986. It took 25 years for China to develop compulsory education from the all-round "universal" stage to the quality improvement stage. As a developing nation with a large population, China successfully achieved the objective of ensuring 9-year compulsory education for all.

China established its higher education degree system in 1980. *Higher Education Law of the People's Republic of China*, promulgated in 1998, formalized a degree system including bachelor's, master's, and doctoral degrees. This legislation has become one of the pivotal laws driving the advancement of higher education in China.

In the domains of preschool education, special education, and vocational education, significant regulatory milestones were achieved. The State Council sanctioned the inaugural administrative regulation on preschool education in 1989, and then the first special regulation on education for individuals with disabilities in 1994. Subsequently, the *Vocational Education Law of the People's Republic of China* was implemented in 1996, marking a crucial step in the regulation of vocational education (ibid).

#### 1.1.3.3 Taking Efficiency and Equity into Consideration

As education in China has evolved and achieved a fundamental level of equitable access, the emphasis on educational reform and development has shifted from ensuring entry equity to ensuring equity throughout the educational process. Additional efforts have been made to improve the insufficient and imbalanced development of education.

*Resuming College Entrance Examinations and Relaxing Restrictions on the Identity of Candidates.* In 1977, the college entrance examinations were resumed. Groups including workers, peasants, and fresh high school graduates could sit for the exam as long as they met the requirements, and this change helped improve the equity of talent selection.

*Eliminating the Drop-Out of Girls and Promoting Equal Education Opportunities for Men and Women.* The Chinese government has actively taken action to eliminate the dropping-out of girls and worked to effectively guarantee school-age girls' rights to education.

*Ensuring School-Age Children's Right to Receive Compulsory Education.* The Chinese government has been actively providing increased policy support and implementing measures to safeguard the right of school-age children to receive 9-year compulsory education.

*Effectively Narrowing the Gap between Regions, Urban and Rural Areas, Schools, and Groups.* To bridge the educational disparity among the eastern, central, and western regions of China, increased financial investment was allocated to the central and western regions, coupled with the implementation of revitalization plans for education in these areas. Addressing the urban–rural educational gap involved implementing reforms targeting underperforming rural schools and offering additional support to rural teachers. Efforts to mitigate disparities between schools included providing advantages in educational funding, capital construction, acquisition of teaching equipment, and adjustments in teaching personnel for low-performing schools. Furthermore, to address disparities among different groups, the Chinese government actively encouraged and supported disadvantaged groups in accessing education (ibid).

#### 1.1.3.4 Encouraging and Supporting Education Diversification

Education is a common cause that unites society. Encouraging non-state actors to engage in and support educational development is crucial. Schools managed by non-state actors not only alleviate funding shortages but also enhance the dynamism of education, cater to diverse educational needs, and foster the health and scientific development of education.

A series of policies have been implemented to support and encourage non-state actors in managing schools. Article XIX of the *Constitution of the People's Republic of China*, promulgated in 1982, stipulated that "the State encourages collective economic organizations, state enterprises and institutions, and other non-state actors to organize education in accordance with the law" (National People's Congress, 1982). In 1985, the Chinese central government emphasized the need to boost the enthusiasm of governments at all levels, teachers, students, employees, and social actors through reform initiatives. In July 1997, the State Council endorsed regulations to support and regulate non-state actors in operating schools. The culmination of these efforts came in September 2003 with the implementation of the *Private Education Promotion Law of the People's Republic of China*, marking a new phase of legalization for China's non-public educational sector. More recently, in 2016, the Standing Committee of the National People's Congress and the State Council issued regulations to actively guide non-state actors in establishing and managing non-profit private schools.

Non-state actors were encouraged to participate in the development of education at all levels. Along with making 9-year compulsory education for all, initiatives such as Project Hope (*Xiwang Gongcheng*) and Spring Bud Project (*Chunlei Jihua*) were launched. Project Hope, launched by the China Youth Development Foundation in 1989, aimed to establish Hope Elementary Schools (*Xiwang Xiaoxue*) and provide financial assistance to students from impoverished backgrounds. Similarly, the Spring Bud Project, initiated by the China Children and Teenagers' Foundation in 1989, focused on enhancing educational opportunities for girls from economically disadvantaged families (ibid).

### *1.1.4 President Xi's Report on the 20th National Congress of the Communist Party of China*

In October 16, 2022, President Xi Jinping made a report on the 20th National Congress of the Communist Party of China. This important report puts forward to invigorate the country through science and education and to develop a strong workforce for the modernization drive.

The report emphasizes education, science and technology, and human resources as the foundational and strategic pillars for building a modern country in all respects. It highlights the importance of recognizing science and technology as the primary productive force, talent as the primary resource, and innovation as the primary driver of growth. The proposed strategies include invigorating China through science and education, workforce development, and innovation-driven development. Additionally, the report advocates for new developmental areas, nurturing emerging growth drivers, and fostering new strengths to sustain steady development (Xi, 2022).

The report seeks to prioritize education, enhance self-reliance and strengthen science and technology, and rely on talent for pioneering development. Emphasis is placed on accelerating the establishment of a robust education system, strengthening scientific and technological capabilities, and developing a quality workforce. The report advocates ongoing efforts for talent cultivation and comprehensive enhancements in talent development at home. All these measures aim at producing top-tier innovators and attracting the brightest minds globally (ibid).

#### 1.1.4.1 To Develop Education that Meets the People's Expectations

Education is of critical importance to the future of the country. The fundamental issues that education must address include what kind of people China should cultivate, how, and for whom. The report stresses the central goal of fostering virtue through education, with the goal of nurturing a new generation characterized by sound moral reasoning, intellectual ability, physical vigor, aesthetic sensibility, and in-demand skills. Emphasizing a people-centered approach, the report advocates swiftly constructing a high-quality education system, advancing students' well-rounded development, and ensuring educational equity (ibid).

#### 1.1.4.2 To Improve Systems for Scientific and Technological Innovation

Innovation will remain at the heart of China's modernization efforts. The report aims to enhance the national resource mobilization system for key technological breakthroughs, strengthen China's strategic position in science and technology, optimize innovation resource allocation, and delineate the roles of national research institutes, advanced-level research universities, and leading high-tech enterprises to improve their layout. It also seeks to establish a system of national laboratories, coordinate the development of international and regional centers for scientific and technological innovation, enhance basic scientific and technological capacity, and ensure better strategic input from the science and technology sector, to boost the overall performance of China's innovation system.

The report proposes to deepen structural scientific and technological reform and reform of the evaluation systems for scientific and technological advances. It also strives to increase investment in science and technology through diverse channels and strengthen legal protection of intellectual property rights, to establish a foundation for comprehensive innovation. The report encourages to nurture a culture of innovation and dedication to science, cultivate fine academic conduct, and foster a supportive environment for innovation.

The report emphasizes expanding international science and technology exchanges and cooperation, cultivate a global research environment, and create an open and globally-competitive innovation ecosystem (ibid).

#### 1.1.4.3 To Accelerate Innovation-Driven Development

Setting the sights on the global frontiers of science and technology, national economic development, and critical social needs, the report advocates for an accelerated focus on greater self-reliance and strength in science and technology.

In alignment with China's strategic needs, the report proposes concentrating resources on original and pioneering scientific and technological research to promote breakthroughs in core technologies within key disciplines. To enhance China's innovation capacity, the report suggests expediting the launch of major national projects of strategic and long-term importance. It is also significant to strengthen basic research, prioritize original innovation, and encourage researchers to engage in free exploration.

To inspire greater creativity, the report proposes more effective investment in science and technology and advocates for reforms in the allocation and utilization of government research funds. It encourages close collaboration between industries, universities, and research institutes, stays goal-oriented, and promotes the industrial application of scientific and technological advances. The report reinforces the central role of enterprises in innovation, gives full play to the guiding and supporting role of key high-tech enterprises, encourages the growth of micro, small, and medium technological enterprises, and promotes deeper integration of the innovation, industrial, capital, and talent chains (ibid).

#### 1.1.4.4 To Implement the Workforce Development Strategy

Cultivating a large workforce of high-quality talent who have both integrity and professional competence is of critical importance to the long-term development of China. The report highlights the importance of respecting work, knowledge, talent, and creativity. Proactive and open talent policies are encouraged to inspire dedication to the nation and its cause. The report advocates for a more strategic distribution of human resources and makes concerted efforts to cultivate talented people in all fields, to create a large, well-structured, and high-quality workforce.

The report proposes expedited efforts to build global hubs for talent and innovation, promote better distribution and balanced development of talent across regions, and strive to build up China's comparative strengths in global competition for talent. It seeks to nurture a contingent of personnel with expertise of strategic importance and cultivate greater numbers of master scholars, science strategists, first-class scientists and innovation teams, young scientists, outstanding engineers, master craftsmen, and highly-skilled workers.

The report also emphasizes increasing international personnel exchanges and leveraging potential, to reform talent development systems to attract, nurture, and utilize diverse talents. The report underscores the necessity of bringing together the best and brightest across fields for national progress (ibid).

## 1.2 Educational Scale in China

Based on *the Overview of Educational Achievements in China* and *the Statistical Bulletin on National Education Development* published by MOE, this section depicts the scale of China's education from the following four aspects: literacy level, number of schools, number of students, and number of full-time teachers.

### *1.2.1 Literacy Level*

Literacy level is analyzed through the following four metrics: the number of students in elementary, junior secondary schools, and upper secondary education for every 100,000 people; the enrollment ratio in elementary, junior secondary schools, upper secondary education, and higher education; the proportion of elementary and junior secondary school graduates continue on to the next education level; the ratio of enrollment to graduation at compulsory education level (Table 1.2). The net enrollment ratio in elementary school and the gross enrollment ratio in junior secondary school in 2020 were maintained at a high level. Notably, the gross enrollment ratio in higher education reached 59.60% in 2022, marking a historic high.

### *1.2.2 Number of Schools by Educational Sector and Level*

Table 1.3 shows the number of schools by educational sector and level in 2022. The number of preschools reached 289,200, marking the highest figure among all educational sectors and levels. Compulsory education was served by a total of 201,600 schools, with elementary schools comprising three-fourths of this total and junior secondary schools representing the remaining one-fourth. In upper secondary education, the number of regular senior high schools doubled that of secondary vocational schools. Regarding higher education, there were 3,013 HEIs, including ten world-class universities.

### *1.2.3 Number of Students by Educational Sector and Level*

Table 1.4 shows the number of students by educational sector and level in 2022. The number of students enrolled in compulsory education reached 158 million, marking a historic high. Similarly, the number of higher education students reached 46.55 million, also reaching a record high. Within upper secondary education, the number of students attending regular senior high school doubled that of those enrolled in secondary vocational school.

**Table 1.2** The literacy level of Chinese students

| | |
|---|---|
| The number of students in elementary schools for every 100,000 people | 7661 |
| The number of students in junior secondary schools for every 100,000 people | 3510 |
| The number of students in upper secondary education for every 100,000 people | 2948 |
| The net enrollment ratio in elementary school | 99.96% |
| The gross enrollment ratio in junior secondary school | 102.50% |
| The gross enrollment ratio in upper secondary education (2022) | 91.60% |
| The gross enrollment ratio in higher education (2022) | 59.60% |
| The proportion of elementary school graduates continue onto junior secondary school | 99.50% |
| The proportion of junior secondary school graduates continue onto upper secondary education | 94.60% |
| The ratio of enrollment to graduation at the compulsory education level (2022) | 95.50% |

*Source*MOE (2021, 2022, 2023a)

*Notes* 1. Net enrollment ratio: the percentage of the total number of students (age groups are specified) in a given education level represents the population of the age group specified by that given education level

2. Gross enrollment ratio: the percentage of the total number of students (age groups are not specified) in a given education level represents in the population of the age group specified by that given education level, as informal age groups (low-age and over-age) are included, the figure can be over 100%
3. Upper secondary education includes regular senior high schools, secondary vocational schools, and senior high schools for adults
4. The latest data of 2022 are listed wherever is available, while the other data are of 2020

### *1.2.4 Number of Full-Time Teachers by Educational Sector and Level*

Table 1.5 shows the number of full-time teachers by educational sector and level in 2022. Among all categories, the number of full-time teachers in compulsory education was the largest. Additionally, in 2022, the number of every category was the largest ever.

## 1.3 Educational Resources in China

Based on *the 2022 Statistical Bulletin on Education Spending* co-released by MOE, National Bureau of Statistics (NBS), and Ministry of Finance (MOF) (2023), and The 2022 Education Statistics published by MOE (2023b), this section depicts educational resources in China from the following four aspects: the overall spending on education, the general public expenditure on education, the general public operating expenditure on education per student, and school infrastructure.

**Table 1.3** Number of schools by educational sector and level (2022)

| Educational sectors and levels | Number of schools |
|---|---|
| **Compulsory education** | 201,600 |
| Elementary school | 149,100 |
| Junior secondary school | 52,500 |
| **Upper secondary education** | 22,201 |
| Regular senior high school | 15,000 |
| Secondary vocational school | 7201 |
| **Higher education** | 3013 |
| World-class university | 10 |
| Non-world-class university | 3003 |
| **Preschool** | 289,200 |
| **Special school** | 2314 |
| **Private school** | 178,300 |

*Source* MOE (2023a), Shanghai Ranking (2023), Quacquarelli Symonds (QS) (2023), Times Higher Education (THE) (2023)

*Notes* 1. Upper secondary education includes regular senior high schools, secondary vocational schools, and senior high schools for adults. The 2021 and 2022 data on upper secondary education did not include the data for senior high schools for adults

2. Secondary vocational school includes regular specialized high schools, vocational high schools, adult specialized high schools, and technical schools. The 2021 and 2022 data of secondary vocational school did not include the data of technical schools

3. World-class university refers to the universities in Mainland China that have entered the top 100 of any of the Academic Ranking of World Universities (ARWU), QS World University Rankings (QS), and Times Higher Education World University Rankings (THE) (2023). World-class universities include Tsinghua University, Peking University, Zhejiang University, Shanghai Jiao Tong University, University of Science and Technology of China, Fudan University, Sun Yat-Sen University, Central South University, Huazhong University of Science and Technology, and Nanjing University

4. Private school refers to all levels of schools that are not state-run, which include preschools, elementary schools, junior secondary schools, regular senior high schools, secondary vocational schools, and regular HEIs

### *1.3.1 Overall Spending on Education*

Table 1.6 shows China's overall spending on education in 2022. The overall spending on education nationwide reached USD1,524.84 billion adjusted for purchasing power parity (PPP), and the spending on education from the national budget reached USD1,205.19 billion adjusted for PPP. Moreover, the spending on education from the national budget represented 4.01% of China's GDP in 2022.

**Table 1.4** Number of students by educational sector and level (2022)

| Educational sectors and levels | Number of students (in thousand) |
|---|---|
| **Compulsory education** | 158,206 |
| Elementary school | 107,000 |
| Junior secondary school | 51,206 |
| **Upper secondary education** | 40,532 |
| Regular senior high school | 27,139 |
| Secondary vocational school | 13,393 |
| **Higher education** | 46,550 |
| World-class university | 540 |
| Non-world-class university | 46,010 |
| **Preschool** | 46,276 |
| **Special school** | 919 |
| **Private school** | 52,827 |

*Source* MOE (2023a), Shanghai Ranking (2023), QS (2023), THE (2023), Tsinghua University (THU) (2022), Peking University (PKU) (2022), Zhejiang University (ZJU) (2022), Shanghai Jiao Tong University (SJTU) (2023), University of Science and Technology of China (USTC) (2022), Fudan University (FDU) (2022), Sun Yat-Sen University (SYSU) (2023), China South University (CSU) (2023), Huazhong University of Science and Technology (HUST) (2022), Nanjing University (NJU) (2022)

*Notes* 1. Upper secondary education includes regular senior high schools, secondary vocational schools, and senior high schools for adults. The 2021 and 2022 data of upper secondary education did not include the data of senior high schools for adults

2. Secondary vocational school includes regular specialized high schools, vocational high schools, adult specialized high schools, and technical schools. The 2021 and 2022 data of secondary vocational school did not include the data of technical schools

3. World-class university refers to the universities in Mainland China that have entered the top 100 of any world university ranking of ARWU, QS, and THE in 2023. World-class universities include Tsinghua University, Peking University, Zhejiang University, Shanghai Jiao Tong University, University of Science and Technology of China, Fudan University, Sun Yat-Sen University, Central South University, Huazhong University of Science and Technology, and Nanjing University

4. Private school refers to all levels of schools that are not state-run, which include preschools, elementary schools, junior secondary schools, regular senior high schools, secondary vocational schools, and regular HEIs

### *1.3.2 General Public Expenditure on Education*

Table 1.7 shows China's general public expenditure on education in 2022. The general public expenditure on education reached USD976.06 billion adjusted for PPP and it represented 15.07% of the national public budget in 2022.

Table 1.8 shows the general public expenditure on education per student in schools by educational sector and level in 2022. Among the various educational sectors and levels, the figure for higher education was the highest, whereas preschool was the lowest

**Table 1.5** Numbers of full-time teachers by educational sector and level (2022)

| Educational sectors and levels | Number of full-time teachers (in thousands) |
|---|---|
| **Compulsory education** | 10,654 |
| Elementary school | 6629 |
| Junior secondary school | 4025 |
| **Upper secondary education** | 2851 |
| Regular senior high school | 2133 |
| Secondary vocational school | 718 |
| **Higher education** | 1978 |
| World-class university | 40 |
| Non-world-class university | 1938 |
| **Preschool** | 3244 |
| **Special school** | 73 |

*Source* MOE (2023a), Shanghai Ranking (2023), QS (2023), THE (2023), THU (2022), PKU (2022), ZJU (2022), SJTU (2023), USTC (2022), FDU (2022), SYSU (2023), CSU (2023), HUST (2022), NJU (2022)

*Notes* 1. Upper secondary education includes regular senior high schools, secondary vocational schools, and senior high schools for adults. The 2021 and 2022 data of upper secondary education did not include the data of senior high schools for adults

2. Secondary vocational school includes regular specialized high schools, vocational high schools, adult specialized high schools, and technical schools. The 2021 and 2022 data of secondary vocational school did not include the data of technical schools

3. World-class university refers to the universities in Mainland China that have entered the top 100 of any world university ranking of ARWU, QS, and THE in 2023. World-class universities include Tsinghua University, Peking University, Zhejiang University, Shanghai Jiao Tong University, University of Science and Technology of China, Fudan University, Sun Yat-Sen University, Central South University, Huazhong University of Science and Technology, and Nanjing University

4. Private school refers to all levels of schools that are not state-run, which include preschool, elementary school, junior secondary school, regular senior high school, secondary vocational school, and regular HEIs

**Table 1.6** China's overall spending on education (2022)

| *China's overall spending on education* | |
|---|---|
| Overall spending on education nationwide | RMB6.13 trillion (USD1524.84 billion adjusted for PPP) |
| Spending on education from the national budget | RMB4.85 trillion (USD1205.19 billion adjusted for PPP) |
| Spending on education from the national budget as a percentage of GDP | 4.01% |

*Source* MOE, NBS, & MOF (2023)

*Notes* 1. Spending on education from the national budget mainly comes from government finances, government-managed funds, businesses running schools in partnership with the government, school-run businesses, and not-for-profit organizations

2. China's GDP in 2022 is RMB121.02 trillion (USD30.09 trillion adjusted for PPP)

3. The PPP conversion rate is sourced from OECD (2023), reflecting the PPP conversion rate of the year 2022

**Table 1.7** China's general public expenditure on education (2022)

| *China's general public expenditure on education* | |
|---|---|
| General public expenditure on education | RMB3.93 trillion<br>(USD976.06 billion adjusted for PPP) |
| General public expenditure on education as a percentage of the national public budget | 15.07% |

*Source* MOE, NBS, & MOF (2023)
*Notes* 1. General public expenditure on education includes operating expenditure, investments in infrastructure, and education surcharge
2. China's national public budget in 2022 is RMB26.06 trillion (USD6.48 trillion adjusted for PPP)
3. The PPP conversion rate is sourced from OECD (2023), reflecting the PPP conversion rate of the year 2022

**Table 1.8** General public expenditure on education per student (2022)

| Educational sectors and levels | General public expenditure on education per student (USD adjusted for PPP) |
|---|---|
| Preschool | 2535.65 |
| Elementary school | 3180.42 |
| Junior secondary school | 4513.17 |
| Regular senior high school | 4753.34 |
| Secondary vocational school | 4341.51 |
| Higher education | 5520.99 |

*Source* MOE, NBS, & MOF (2023)
*Notes* The PPP conversion rate is sourced from OECD (2023), reflecting the PPP conversion rate for the year 2022

### *1.3.3 General Public Operating Expenditure on Education Per Student*

Table 1.9 shows the general public operating expenditure on education per student in schools by educational sector and level in 2022. The expenditure on higher education was the highest, whereas preschool was the lowest.

### *1.3.4 School Infrastructure*

#### 1.3.4.1 Condition of Fixed Assets and Teaching Resources

Table 1.10 illustrates the condition of fixed assets and teaching resources by educational sector and level in 2022.

**Table 1.9** General public operating expenditure on education per student (2022)

| Educational sectors and levels | General public operating expenditure on education per student (USD adjusted for PPP) |
|---|---|
| Preschool | 2420.81 |
| Elementary school | 3048.12 |
| Junior secondary school | 4282.85 |
| Regular senior high school | 4424.80 |
| Secondary vocational school | 4041.44 |
| Higher education | 5203.02 |

*Source* MOE, NBS, & MOF (2023)
*Notes* The PPP conversion rate is sourced from OECD (2023), reflecting the PPP conversion rate for the year 2022

The statistics cover the total areas occupied by different levels and types of schools, as well as the green areas and sports areas occupied by them respectively. The total number of campus soccer field includes the numbers of 11-a-side soccer field, 7-a-side soccer field, and 5-a-side soccer field.

The total volumes of library books and magazines in different schools are shown. The digital resources in secondary vocational school and regular HEIs are displayed, which include the number of e-books, electronic journals, degree thesis, and the length of audio and video. Secondary vocational school's statistics also include vocational education virtual simulation training resources, covering the numbers of simulation experiment, training, and practice software.

The statistics cover the total number of digital terminals in different schools, as well as the number of teachers' terminals and student terminals. The total number of classrooms is shown, and the number of network multimedia classrooms is shown separately. The total value of fixed assets in different schools is shown and converted based on the PPP conversation rate, as well as the total value of equipment and instruments.

#### 1.3.4.2 Condition of School Buildings

Figure 1.2 and Tables 1.11, 1.12, 1.13 and 1.14 illustrate the condition of school buildings by educational sector and level in 2022. The school buildings include five categories: buildings for instruction and ancillary uses, administrative buildings, residential and welfare buildings, rooms for other purposes, and residential quarters for teachers and workers. It can be seen from Fig. 1.2 that the areas of buildings for instruction and ancillary uses and residential and welfare buildings are much larger than other categories.

**Table 1.10** Condition of fixed assets and teaching resources by educational sector and level (2022)

| | | Elementary school | Junior secondary school | Regular senior high school | Secondary vocational school | **Regular HEIs** | **Special school** |
|---|---|---|---|---|---|---|---|
| Areas occupied ($m^2$) | Total | 2,343,965,707.06 | 1,768,857,411.18 | 1,208,089,981.65 | 530,706,366.90 | 1,528,959,171.24 | 25,391,372.83 |
| | Of which: green areas | 437,133,086.79 | 380,166,154.07 | 321,255,923.37 | 128,705,894.96 | 541,765,162.54 | 5,590,632.27 |
| | of which: Sports areas | 771,565,725.63 | 535,846,406.93 | 296,905,336.13 | 82,621,326.31 | 97,007,383.55 | 6,285,928.03 |
| Campus football | Total | 79,684 | 40,774 | 16,363 | 16,676 | 4026 | 668 |
| Books and magazines in libraries (volume) | Total | 2,699,645,426 | 1,954,559,041 | 1,123,784,627 | 342,804,855 | 2,164,681,782 | 12,640,509 |
| Number of digital terminals (set) | Total | 16,506,208 | 11,118,035 | 7,363,792 | 3,752,417 | 10,556,621 | 154,095 |
| | Number of teachers' terminals | 5,547,067 | 4,051,930 | 2,904,563 | 834,419 | 3,162,534 | 88,867 |
| | Number of student terminals | 10,525,559 | 6,761,631 | 4,238,616 | 2,814,970 | 6,261,372 | 57,619 |
| Classroom (room) | Total | 3,865,337 | 2,104,875 | 1,337,074 | 471,605 | 513,767 | 44,395 |
| | Number of Network multimedia classroom | 2,852,109 | 1,593,524 | 997,394 | 300,028 | 303,428 | 24,100 |

(continued)

**Table 1.10** (continued)

| | | Elementary school | Junior secondary school | Regular senior high school | Secondary vocational school | **Regular HEIs** | **Special school** |
|---|---|---|---|---|---|---|---|
| Total value of fixed asset (USD adjusted for PPP) | Total | 389,145,796,519.15 | 352,349,201,118.85 | 342,136,207,657.88 | 13,403,680.46 | 635,452,953,505.72 | 7,438,621,904.53 |
| | Of which: Total value of equipment and instrument | 55,310,335,256.09 | 40,216,719,965.19 | 34,457,952,933.86 | 2,831,863.24 | 155,045,015,663.85 | 1,177,266,210.84 |
| Digital resources | E-books (book) | | | | 258,062,350.00 | 2,100,898,928.00 | |
| | Electronic journals (book) | | | | 21,811,767.00 | 1,307,209,644.00 | |
| | Degree thesis (book) | | | | 132,295,477.00 | 7,160,006,132.00 | |
| | Audio and video (h) | | | | 4,579,463.69 | 154,221,373.09 | |
| Vocational education virtual simulation training resources | Total | | | | 196,084 | | |
| | Simulation experiment software | | | | 47,963 | | |

(continued)

**Table 1.10** (continued)

| | | Elementary school | Junior secondary school | Regular senior high school | Secondary vocational school | **Regular HEIs** | **Special school** |
|---|---|---|---|---|---|---|---|
| | Simulation training software | | | | 134,756 | | |
| | Simulation practice software | | | | 13,365 | | |

*Source* MOE (2023b)

*Notes* 1. The PPP conversion rate is sourced from OECD (2023), reflecting the PPP conversion rate of the year 2022

2. All the data of secondary vocational school and regular HEIs include the fixed assets and teaching resources owned by the schools (institutions) and those not owned but actually used by the schools (institutions)

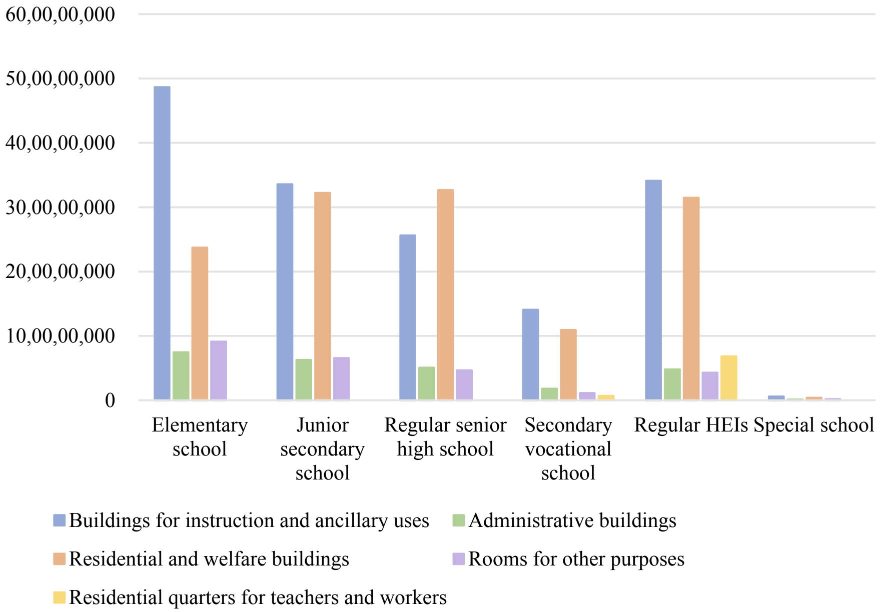


**Fig. 1.2** Condition of school buildings by educational sector and level (2022) (m$^2$). *Source* MOE (2023b). *Notes* 1. The specific items and statistics of school building conditions are illustrated in Tables 1.11, 1.12, 1.13 and 1.14. 2. The statistics of residential quarters for teachers and workers in elementary school, junior secondary school, regular senior high school, and special school are not available

#### 1.3.4.3 Other School Running Conditions

Table 1.15 illustrates other school running conditions in elementary school, junior secondary school, and regular senior high school in 2022.

## 1.4 Scientific Research in China

### *1.4.1 Scientific Research Development at China's HEIs*

Over the past four decades since the reform and opening-up, China has progressively built a national innovation system. During this transformative period, HEIs have assumed an increasingly pivotal role in fostering scientific and technological innovation. This section provides an overview of technological policies across five important stages since 1978.

**Table 1.11** Condition of school buildings in elementary school, junior secondary school, and regular senior high school (2022) ($m^2$)

| | | Elementary school | Junior secondary school | Regular senior high school |
|---|---|---|---|---|
| Buildings for instruction and ancillary uses | Total | 486,639,810.79 | 335,728,599.45 | 256,156,277.92 |
| | Classroom | 325,606,574.28 | 188,865,414.67 | 130,604,586.47 |
| | Professional classroom | 68,662,563.68 | 73,515,722.93 | 55,744,903.89 |
| | Physical and chemical biology laboratory | NA | 39,539,544.70 | 34,204,292.56 |
| | Other buildings for instruction | NA | 33,976,178.23 | 21,540,611.33 |
| | Public teaching space | 92,370,672.83 | 73,347,461.85 | 69,806,787.56 |
| | Library | 24,949,682.62 | 19,337,421.33 | 20,112,335.92 |
| | Gymnasium | 20,978,120.79 | 21,078,897.32 | 25,876,527.03 |
| | Psychological counseling room | 4,943,274.98 | 3,074,627.54 | 1,958,424.48 |
| | Other buildings for ancillary uses | 41,499,594.44 | 29,856,515.66 | 21,859,500.13 |
| Administrative buildings | Total | 74,616,452.22 | 62,703,103.69 | 50,789,621.02 |
| | For teachers | 49,187,822.87 | 38,696,979.46 | 30,526,136.00 |
| | Others | 25,428,629.35 | 24,006,124.23 | 20,263,485.02 |
| Residential and welfare buildings | Total | 237,226,423.81 | 322,332,740.74 | 326,683,399.49 |
| | Dormitories for faculty | 22,039,538.50 | 25,565,243.44 | 21,806,208.22 |
| | Accommodation for circulation of teachers | 32,841,599.15 | 32,501,988.82 | 23,824,322.20 |
| | Students' dormitories | 46,904,395.91 | 137,191,282.70 | 175,042,557.76 |
| | Students' dining halls | 48,180,615.19 | 60,496,312.15 | 55,688,082.74 |
| | Toilets | 38,524,530.32 | 26,659,541.55 | 20,282,497.79 |
| | Others | 48,735,744.74 | 39,918,372.08 | 30,039,730.78 |
| Rooms for other purposes | | 91,135,284.72 | 65,719,076.89 | 46,719,750.10 |

*Source* MOE (2023b)

**Table 1.12** Condition of school buildings in secondary vocational school (2022) ($m^2$)

| | | Secondary vocational school |
|---|---|---|
| Buildings for instruction and ancillary uses | Total | 140,793,636.66 |
| | Classroom | 54,893,447.56 |
| | Co-class classroom | 3,155,989.18 |
| | Basic course lab | 6,250,632.89 |
| | Training room | 56,214,939.82 |
| | Reading room | 7,291,874.05 |
| | Psychological consultation room | 562,111.93 |
| | Outdoor playground | 12,424,641.23 |
| Administrative buildings | Total | 18,108,119.43 |
| | Office | 15,065,281.87 |
| | Teaching and research office | 3,042,837.56 |
| Residential buildings | Total | 109,341,151.31 |
| | Students' dormitories | 76,004,832.59 |
| | Dining halls | 18,870,041.34 |
| | Apartments for single | 6,340,580.45 |
| | Other auxiliary buildings | 8,125,696.93 |
| Residential quarters for teachers and workers | | 6,757,106.61 |
| Rooms for other purposes | | 11,160,068.97 |

*Source* MOE (2023b)
*Notes* All the data of secondary vocational school include the school buildings owned by the schools, those not owned but actually used by the schools, and those under construction

#### 1.4.1.1 Stage One: Restoring the Scientific Research Function of HEIs (1978–1984)

In 1978, the Chinese central government formulated a national plan to guide the development of science and technology during the period from 1978 to 1985. Deng Xiaoping, the leader of China during that period, promoted strategies such as "science and technology are elementary productive forces" and "the key to the four modernizations is the modernization of science and technology", aiming to rejuvenate and advance the science and technology systems. During this period, the role of scientific research within HEIs gradually regained prominence. Deng Xiaoping's endorsement of increased research activity in 1977, stating that "key higher education institutions are significant in scientific research and should undertake more scientific research tasks", underscored the importance of HEIs in scientific endeavors. Consequently, HEIs began receiving budget allocations for scientific research from national funds, signifying an official shift and the restoration of HEIs' involvement in scientific research. In 1978, the National Education Commission, the National

**Table 1.13** Condition of school buildings in regular HEIs (2022) ($m^2$)

| | | Regular HEIs |
|---|---|---|
| Buildings for instruction and ancillary uses | Total | 341,013,255.57 |
| | Classroom | 102,132,338.31 |
| | Of which: art school professional classroom | 3,984,468.42 |
| | Experimental practice room | 122,109,889.04 |
| | Office and research space for full-time scientific research institutions | 36,266,704.21 |
| | Library | 39,454,587.97 |
| | Gymnasium | 22,881,560.82 |
| | Multi-functional activity room | 8,920,478.74 |
| | Hall | 7,056,721.88 |
| | Continuing education room | 2,190,974.60 |
| Administrative buildings | Total | 48,071,306.06 |
| | School administrative | 20,884,281.19 |
| | Faculty and faculty offices | 27,187,024.87 |
| Residential buildings | Total | 314,823,105.86 |
| | Students' dormitories | 234,368,233.95 |
| | Dining halls | 29,783,032.12 |
| | Single teacher dormitory | 26,224,827.57 |
| | Logistics and auxiliary rooms | 24,447,012.22 |
| Residential quarters for teachers and workers | | 68,222,596.97 |
| Rooms for other purposes | | 43,009,361.64 |

*Source* MOE (2023b)
*Notes* All the data of regular HEIs include the school buildings owned by the schools, those not owned but actually used by the schools, and those under construction

Science Commission (the predecessor of the Ministry of Science and Technology [MOST]), and MOF jointly decided to allocate RMB30 million from "the three types of expenses of science and technology" (encompassing the expense of new product experiments, the expense of semi-plant testing, and key scientific research subsidies) to HEIs, aiming to foster significant scientific research and experimentation. Scientific research has been integrated into the operational expenditure of higher education since 1979, with an appropriation of RMB14.15 million for scientific research that year. By 1985, the scientific research fund for HEIs had surged to nearly RMB600 million (Yin & Shen, 2005).

**Table 1.14** Condition of school buildings in special school (2022) ($m^2$)

| | | Special school |
|---|---|---|
| Buildings for instruction and ancillary uses | Total | 5,990,045.82 |
| | Classroom | 2,615,505.55 |
| | Professional classroom | 1,923,214.88 |
| | Public activity and rehabilitation room | 1,451,325.39 |
| | Reading room | 219,196.63 |
| | Physical rehabilitation training room | 355,350.76 |
| | Psychological consultation room | 87,276.05 |
| | Others | 789,501.95 |
| Administrative buildings | Total | 1,239,122.69 |
| | For teachers | 670,268.71 |
| | Others | 568,853.98 |
| Residential and welfare buildings | Total | 3,969,340.40 |
| | Students' dormitories | 1,836,039.59 |
| | Students' dining halls | 728,336.99 |
| | Students' toilets | 465,245.70 |
| | Others | 939,718.12 |
| Rooms for other purposes | | 1,697,104.52 |

*Source* MOE (2023b)

#### 1.4.1.2 Stage Two: Establishing Research Universities (1985–1994)

In 1985, the Chinese government emphasized the significant roles of HEIs and the Chinese Academy of Sciences in both basic and applied research. It stressed the importance of aligning basic and applied research with workforce needs. HEIs meeting specific criteria were encouraged to establish distinctive and efficient research institutes. Furthermore, in September 1991, the State Council underscored the importance of scientific research within HEIs, considering it a fundamental task. HEIs with a large number of key disciplines, substantial responsibilities in graduate student training, and strong foundations in teaching and research were designated to become hubs for education and scientific research (Yin, 2005). These institutions were expected to undertake major scientific and technological tasks, nurture high-level talent, and spearhead efforts to enhance China's scientific and technological capabilities and the quality of higher education (ibid). To bolster HEIs' scientific research capabilities in the early 1990s, the Chinese government devised policy-level plans to allocate special funds for the establishment of research universities. In December 1991, the National Planning Commission (the predecessor of the National Development and Reform Commission [NDRC]), National Education Commission, and MOF jointly proposed to the State Council that they all "agree to the country's decision of establishing key universities and key disciplines that are

**Table 1.15** Other school running conditions by educational sector and level (2022)

| | Elementary school | Junior secondary school | Regular senior high school |
|---|---|---|---|
| Schools number: Sports areas reached standard | 139,456 | 50,214 | 14,193 |
| Schools number: Sports equipment reached standard | 144,755 | 51,475 | 14,500 |
| Schools number: Musical instrument reached standard | 144,365 | 51,369 | 14,402 |
| Schools number: Fine arts instrument reached standard | 144,337 | 51,365 | 14,432 |
| Schools number: Equipment of natural science reached standard | 144,078 | 51,299 | 14,452 |
| Chief information officer | 55,987 | 24,450 | 7,877 |
| Full Wi-Fi coverage | 115,185 | 41,265 | 11,800 |
| Campus hospital | 83,177 | 36,416 | 12,806 |
| Number of full-time medical schools | 21,217 | 15,980 | 10,105 |
| Number of schools with allied health staff | 21,436 | 12,524 | 6,268 |

*Source* MOE (2023b)

*Notes* 1. The standards for sports areas and sports equipment refer to those regulated by MOE (2008), see: http://www.moe.gov.cn/srcsite/A17/moe_938/s3273/200806/t20080612_88635.html

2. The standards for musical instrument, fine arts instrument, and equipment of natural science refer to the standards regulated by the governments of China's provinces, autonomous regions, and municipalities

required for national economic and social development". In 1993, *the Outline of China's Education Reform and Development* proposed the collaborative establishment of 100 strategic universities by the central government and local authorities. These policies laid the groundwork for the higher education initiative known as Project 211 (MOE, 2008).

#### 1.4.1.3 Stage Three: Implementing National Initiatives to Further Develop Research Universities (1995–2004)

To enhance the competitiveness of Chinese higher education internationally, the Chinese government introduced a series of initiatives aimed at supporting the creation of research universities. In November 1995, the blueprint for Project 211 was unveiled. This initiative empowered both the central government and local authorities to collaboratively establish approximately 100 key universities along with a number of key disciplines striving to reach world-class level (ibid).

In December 1998, MOE put forward a goal of elevating several key universities and disciplines to world-class level within the subsequent 10–20 years. In January 1999, the State Council officially ratified Project 985 for higher education.

During the *10th Five-Year Plan* period (2001–2005), China allocated significant funding towards the construction of Project 211 and Project 985. In 2001, at the Education Work Conference, it was proposed to intensify the development of leading universities and key disciplines, emphasizing the pivotal role of key disciplines as the nucleus for accelerated progress (ibid). Subsequently, in 2004, the second phase of Project 985 was launched, which expanded the university list, and a total of 39 universities were included. Additionally, five key goals were delineated for the development of world-class universities, focusing on mechanism innovation, talent training, platform establishment, supportive conditions, and international communication and cooperation (Yuan & Guo, 2012).

After nearly a decade of development, a number of Chinese HEIs have embraced the goal of developing world-class universities and significantly enhanced their level of scientific research. An investigation of the scale and impact of scientific research conducted by China's research universities from 1997 to 2006 reveals a notable trend. The volume of scientific research achievements produced by China's research universities surged nearly fivefold over the decade, accompanied by a continuous enhancement in the influence of these scientific research achievements. Remarkably, the inflection point of scientific research output aligns closely with the inception of Project 985, highlighting its pivotal role in catalyzing advancements in scientific research (Zhu & Liu, 2009).

#### 1.4.1.4 Stage Four: Serving National Innovation System (2005–2014)

In 2005, the State Council released an outline of the national plan for science and technology development for the period of 2006–2020 and proposed the general goal of "establishing national innovation system" (MOST, 2006).

In the process of establishing a national innovation system, universities, especially research universities, were required to realize new targets. The State Council emphasized that universities serve as crucial hubs for training high-level innovative talent and are primary drivers of basic research and high-tech innovation. In line with the imperative of establishing a national innovation system, Chinese universities were tasked not only with enhancing their scientific research capabilities but also with fostering collaborative innovation systems involving enterprises and government (ibid). In 2008, NDRC, MOE, and MOF initiated the third phase of Project 211. This phase aimed to propel China towards becoming an innovative country by reinforcing the development of key disciplines, innovative talent and personnel, and the public service system of higher education (ibid). Additionally, in 2012, MOE and other relevant ministries proposed the 2011 Plan. Originating from the "urgent demand of the country and the requirement of reaching world-class level", the 2011 Plan was anchored on the trinity of enhancing the innovative capacity of talent, disciplines, and scientific research. Its overarching objective was to enhance the quality of higher education and contribute to the advancement of the economy and society (MOE, 2014).

#### 1.4.1.5 Stage Five: Further Developing World-Class Universities and Disciplines (2015–Present)

In October 2015, the State Council issued *the Overall Plan for Promoting the Construction of World-Class Universities and World-Class Disciplines*, outlining a vision to "promote a number of leading universities and disciplines to get into the first class or the front class in the world" (The State Council, 2015). It put forward the following goals: to develop a number of world-class universities and first-class academic disciplines by 2020; to have more universities and disciplines among the world's best and to enhance the country's overall higher education capacity by 2030; and to lead the number, quality, and capacity of world-class universities and disciplines among the world's best, becoming a higher education powerhouse by 2050 (*ibid*).

In September 2017, MOE, MOF, and NDRC published the list of the Double World-Class Project, which selected 42 universities aiming for world-class status and 140 universities that were designated to develop world-class disciplines (MOE, MOF, & NDRC, 2022). In February 2022, the list of the second round of the Double World-Class Project was unveiled, which selected more than 400 disciplines from 147 universities (MOE, 2022). The Double World-Class Project aligns with the national strategy of innovation-driven development, aiming to elevate the level of educational development, bolster the core competitiveness of the country, and realize the great development of China from a large country in higher education to a powerful country in higher education.

### *1.4.2 Research Performance of China's HEIs*

#### 1.4.2.1 Science and Technology (S&T) Research Output

Scientific and technological achievements refer to the output of scientific and technological research. The scientific and technological achievements at China's HEIs mainly include four categories: scientific and technological books, academic papers, international projects completed and approved, and intellectual property rights and patents.

In 2022, China's HEIs published 15,148 scientific and technological books and 1,203,369 academic papers, of which 655,413 were published in foreign academic journals. A total of 3,271 international projects were completed and approved (2021 data). In 2022, China's HEIs applied for 368,170 patents, of which 308,548 were authorized and 16,015 were sold. The number of other intellectual property rights that China's HEIs acquired in 2022 was 42,440 and they include software registration, integrated circuit design registration, new animal and plant varieties registration, and national new drug registration, etc. (Department of Science, Technology and Informatization [DSTI], 2023).

#### 1.4.2.2 Innovative Talent Development in S&T

Scientific and technological talent includes individuals who are directly engaged in scientific and technological activities within relevant institutions or departments and receive remuneration for their work; this includes scientists, engineers, technicians, and auxiliary personnel who contribute to various aspects of scientific and technological endeavors (UNESCO, 2014). In statistics, the scientific and technological workforce at China's HEIs can be divided into three categories: teaching and scientific research personnel, R&D personnel, and scientific and technological services personnel.

In 2022, the total number of scientific and technological workforce of China's HEIs was approximately 1.98 million. The number of teaching and scientific research personnel was 1,345,872, accounting for around 68%; the number of R&D personnel was 557,291, accounting for around 28%; and around 4% of the total workforce was personnel of scientific and technological services, with the number of 74,632 (DSTI, 2023).

#### 1.4.2.3 S&T Innovation Platforms

The scientific and technological innovation platforms within China's HEIs mainly include national key laboratories, national engineering technology research centers, key laboratories of MOE, key laboratories on provincial and ministerial levels, engineering technology research centers on provincial and ministerial levels, and research institutes built by schools (Wu & Tang, 2006).

#### 1.4.2.4 S&T Projects at China's HEIs

Scientific and technological projects refer to the research and experiment and development works that aim at solving complex and comprehensive scientific and technological problems. Scientific and technological projects at China's HEIs mainly include three categories: basic research project, applied basic research project, and experiment and development project.

In 2022, the total number of scientific and technological projects of China's HEIs was 795,998. The number of basic research projects was 357,643, accounting for around 45% of the total; the number of applied basic research projects was 363,647 accounting for around 46%; the number of experiment and development projects was 74,708, accounting for around 9% (DSTI, 2023).

## 1.5 Trends in Chinese Education

### *1.5.1 Trends in Educational Scale*

Based on *the Overview of Educational Achievements in China* and *the Statistical Bulletin on National Education Development* published by MOE from 2012 to 2023, this section analyses changes in education scale in Mainland China from the following four aspects: gross enrollment ratios in schools by educational sector and level, number of schools, number of students, and number of full-time teachers.

#### 1.5.1.1 Gross Enrollment Ratio

Figure 1.3 illustrates the enrollment ratios across educational sectors and levels spanning from 2011 to 2022. Elementary and junior secondary school enrollments remained consistently high, whereas preschool and higher education enrollments saw a steady increase throughout the period.

#### 1.5.1.2 Number of Schools

Figure 1.4 illustrates the total number of all types of schools at all levels in China during the period from 2011 to 2022. There was a slight decrease from 2011 to 2015, followed by a notable increase post-2016. However, there was a slight decline observed in both 2021 and 2022.

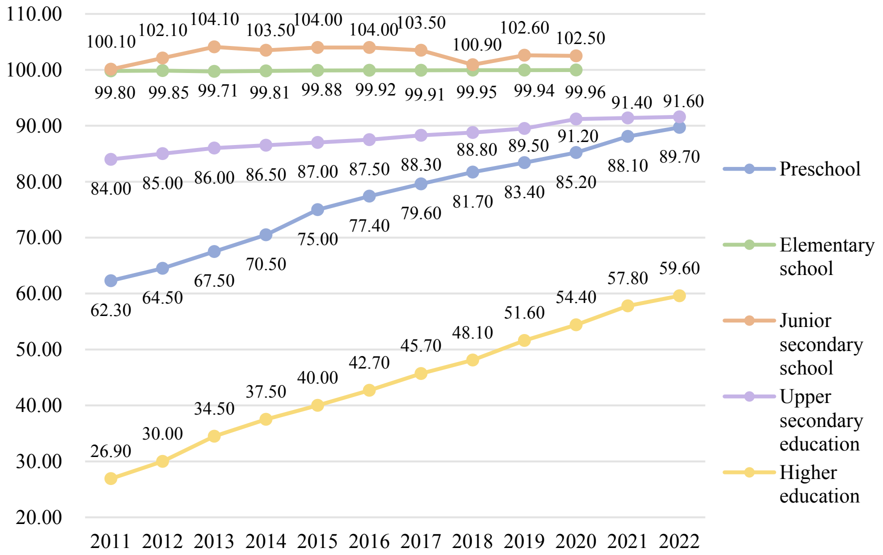


**Fig. 1.3** Gross enrollment ratio (2011–2022) (%). *Source* MOE (2012–2023a). *Notes* 1. The enrollment ratio of elementary school is the net enrollment ratio. 2. Gross enrollment ratio: the percentage of the total number of students (age groups are not specified) in a given education level represents in the population of the age group specified by that given education level, as informal age groups (low-age and over-age) are included, the figure can be over 100%. 3. Net enrollment ratio: the percentage of the total number of students (age groups are specified) in a given education level represents the population of the age group specified by that given education level. 4. The official 2021 and 2022 data for elementary school and junior secondary school are not published yet

#### 1.5.1.3 Number of Schools by Educational Sector and Level

Figure 1.5 shows the number of schools by educational sector and level in China during the period from 2011 to 2022. Elementary school numbers consistently declined over the period, contrasting with a significant increase in preschools, albeit experiencing a slight dip in 2022. Additionally, junior secondary schools, upper secondary education, higher education, and special education constituted the lowest four categories, generally maintaining stability throughout the timeframe.

#### 1.5.1.4 Number of Students

Figure 1.6 illustrates the total number of students in all types of schools at all levels in China during the period from 2011 to 2022. The figure exhibited fluctuations in the period spanning from 2011 to 2016, followed by a notable and rapid increase after 2016.

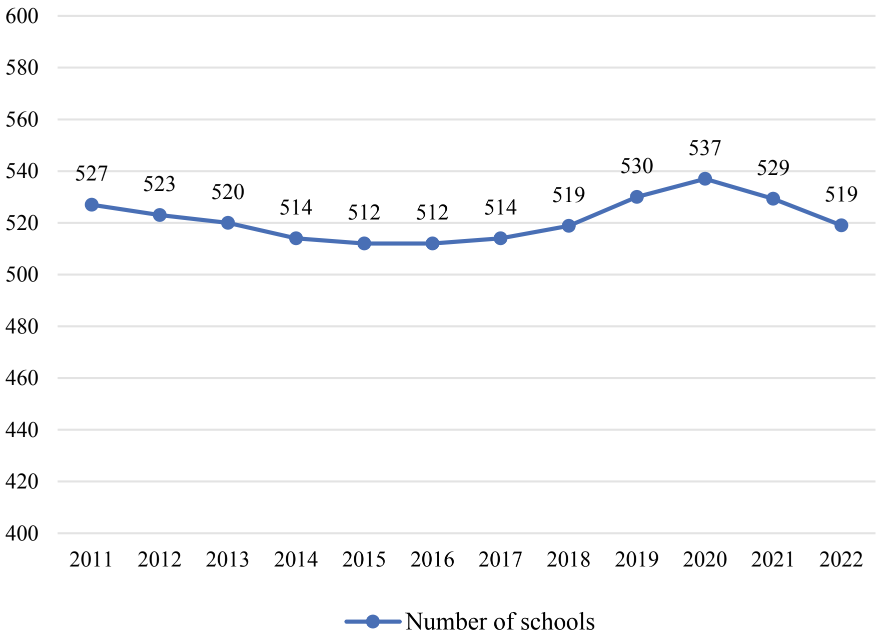


**Fig. 1.4** Number of schools (2011–2022) (in thousand). *Source* MOE (2012–2023a)

#### 1.5.1.5 Number of Students by Educational Sector and Level

Figure 1.7 shows the number of students in schools by educational sector and level in China during the period from 2011 to 2022. Elementary school remained consistently high throughout the period, maintaining its position as the highest. In contrast, upper secondary education witnessed a decline, while higher education experienced a continuous increase, surpassing upper secondary education in 2019.

#### 1.5.1.6 Number of Full-Time Teachers

Figure 1.8 shows the total number of full-time teachers in all types of schools at all levels in China during the period from 2011 to 2022. The figure steadily increased throughout the period.

#### 1.5.1.7 Number of Full-Time Teachers by Educational Sector and Level

Figure 1.9 shows the number of full-time teachers in schools by educational sector and level in China during the period from 2011 to 2022. The figures for all categories generally experienced an upward trend throughout the period. Moreover, the figure

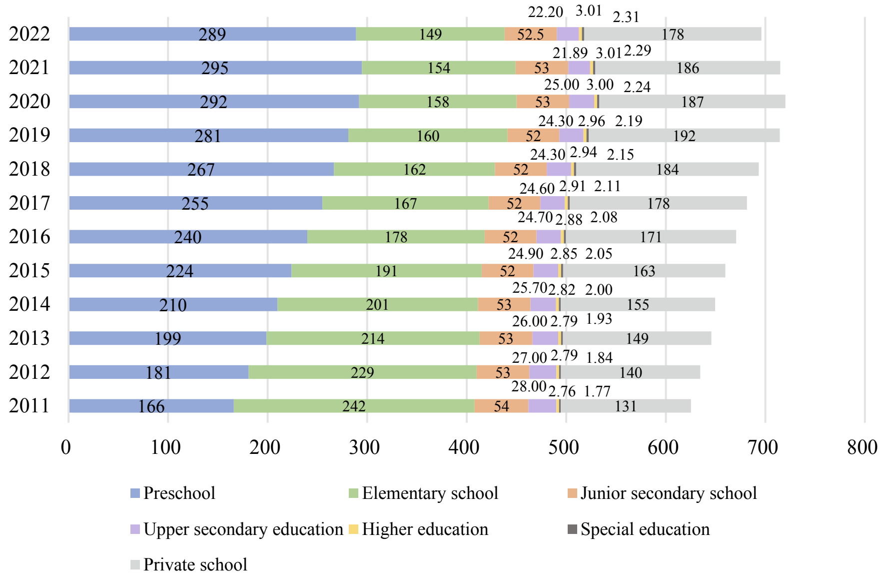


**Fig. 1.5 Number of schools by educational sector and level (2011–2022) (in thousand)**. *Source* MOE (2012–2023a). *Notes* 1. Upper secondary education includes regular senior high schools, secondary vocational schools, and senior high schools for adults. In 2021 and 2022, the data of upper secondary education did not include the data of senior high schools for adults, and the data of secondary vocational schools did not include the data of technical schools. 2. Private school refers to all levels of schools that are not state-run, which includes preschool, elementary school, junior secondary school, regular senior high school, secondary vocational school, and regular HEIs

for elementary school remained stable at the highest, and the figure for preschool saw a rapid increase during the period.

### *1.5.2 Trends in Education Resources*

Based on *the Statistical Bulletin on Education Spending* co-released by MOE, NBS, and MOF from 2012 to 2023, this section shows the trends in education resources in China during the 12 years from the following four aspects: the overall spending on education nationwide, the general public expenditure on education, the general public expenditure on education per student, and the general public operating expenditure on education per student.

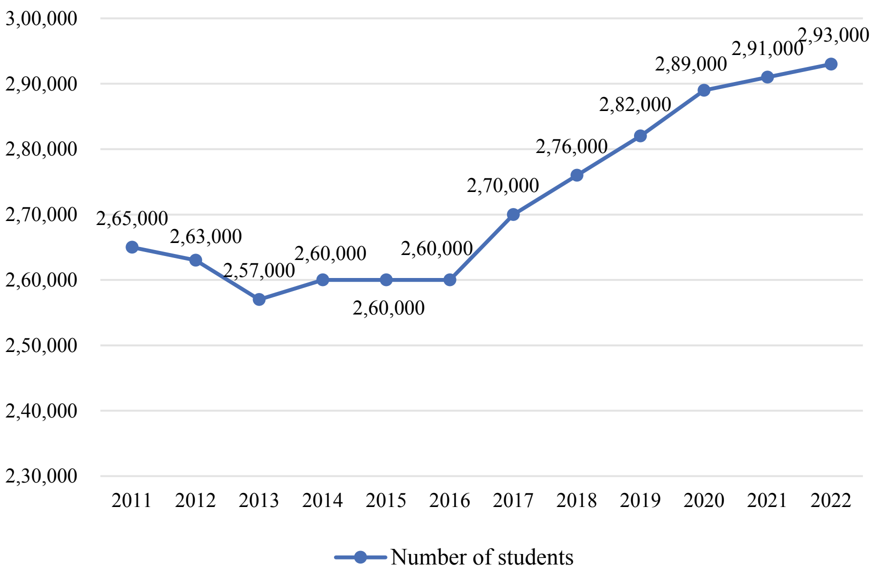


**Fig. 1.6** Number of students (2011–2022) (in thousand). *Source* MOE (2012–2023a)

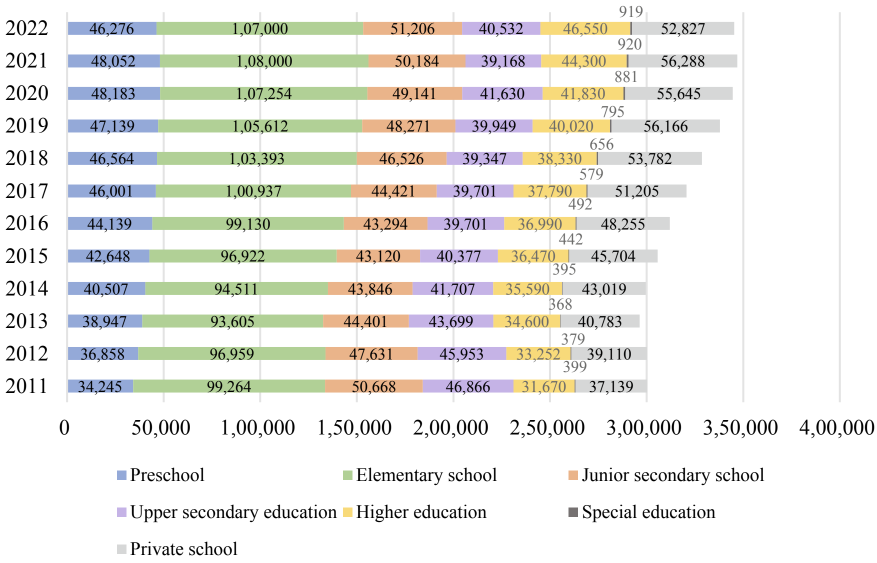


**Fig. 1.7** Number of students by educational sector and level (2011–2022) (in thousand). *Source* MOE ( 2012–2023a). *Notes* 1. Upper secondary education includes regular senior high schools, secondary vocational schools, and senior high schools for adults. In 2021 and 2022, the data of upper secondary education did not include the data of senior high schools for adults, and the data of secondary vocational school did not include the data of technical schools. 2. Private school refers to all levels of schools that are not state-run, which includes preschool, elementary school, junior secondary school, regular senior high school, secondary vocational school, and regular HEIs

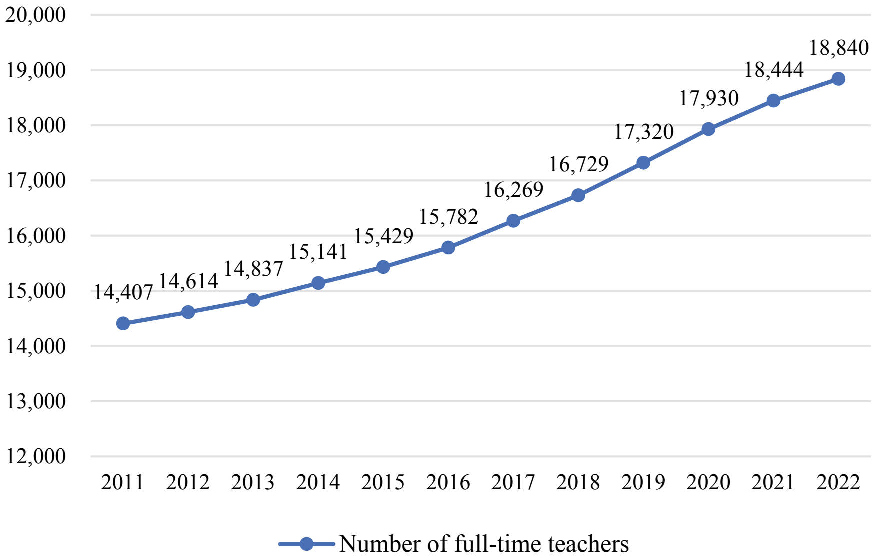


**Fig. 1.8** Number of full-time teachers (2011–2022) (in thousand). *Source* MOE (2012–2023a)

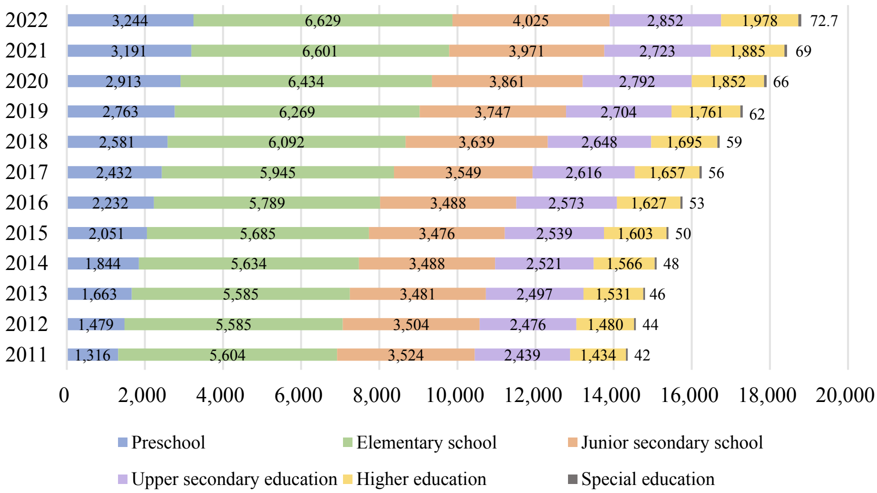


**Fig. 1.9** Number of full-time teachers by educational sector and level (2011–2022) (in thousand). *Source* MOE (2012–2023a). *Notes* (Upper secondary education includes regular senior high schools, secondary vocational schools, and senior high schools for adults. In 2021 and 2022, the data of upper secondary education did not include the data of senior high schools for adults, and the data of secondary vocational schools did not include the data of technical schools

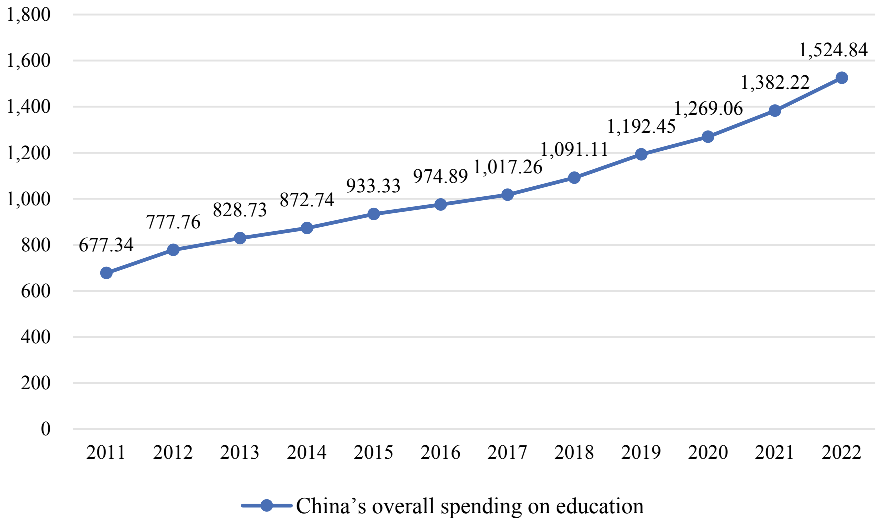


**Fig. 1.10** China's overall spending on education (2011–2022) (USD billion adjusted for PPP). *Source* MOE, NBS, & MOF (2012–2023a). *Notes* The PPP conversion rate data are sourced from OECDreflecting the PPP conversion rate of the data year

#### 1.5.2.1 Overall Spending on Education

Figure 1.10 shows the trends of China's overall spending on education nationwide during the period from 2011 to 2022. Over the 12 years, the figure increased steadily, with the figure for 2022 doubling that for 2011.

#### 1.5.2.2 General Public Expenditure on Education

Figure 1.11 shows the trend of China's general public expenditure on education during the period from 2011 to 2022. The figure increased consistently over the 12-year period, and the figure for 2022 doubled that for 2011.

#### 1.5.2.3 General Public Expenditure on Education Per Student

Figure 1.12 shows the trend of China's general public expenditure on education per student in six levels of schools from 2017 to 2022. During the period, the figure for higher education experienced a slight decline in 2020 before resuming an upward trend, remaining the highest throughout. Conversely, the figure for preschool consistently remained the lowest.

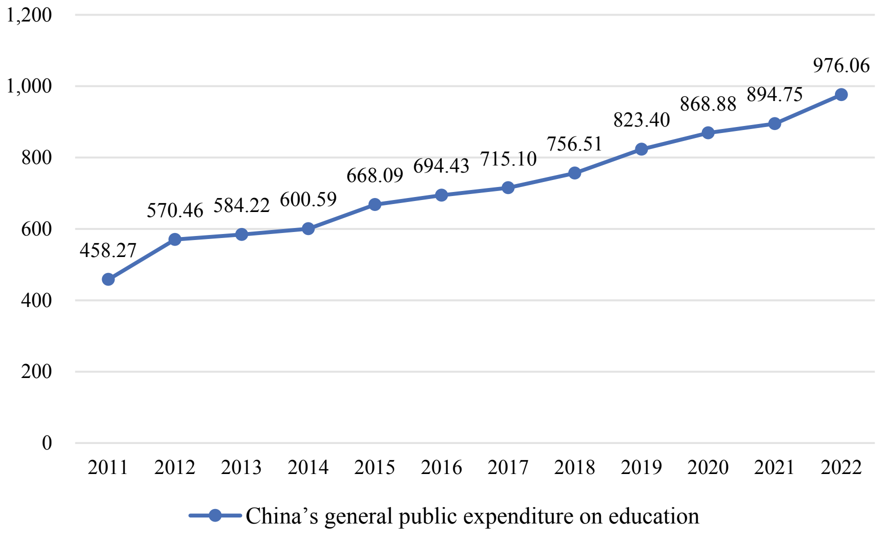


**Fig. 1.11** China's general public expenditure on *education (2011–2022) (Billions of USD billion adjusted for PPP). Source* MOE, NBS, & MOF (2012–2023). *Notes* 1. General public expenditure on education includes operating expenditure, investments in infrastructure, and education surcharge. 2. The PPP conversion rate is sourced from OECD (2023). The PPP conversion rate of the data year is used

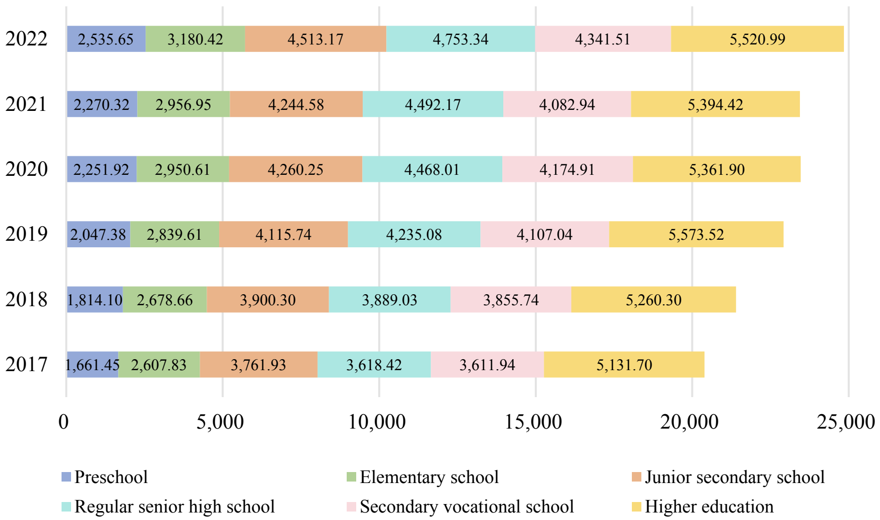


**Fig. 1.12** General public expenditure on education per student (2017–2022) (USD adjusted for PPP). *Source* MOE, NBS, & MOF (2018–2023). *Notes* The PPP conversion rate is sourced from OECD (2023). The PPP conversion rate of the data year is used

#### 1.5.2.4 General Public Operating Expenditure on Education Per Student

Figure 1.13 shows the trend of China's public operating expenditure on education per student in six levels of schools during the period from 2011 to 2022. Throughout the period, the figures for all categories generally exhibited an upward trend. Notably, the figure for higher education consistently remained considerably higher than that for other categories, maintaining its position as the highest. Conversely, the figure for elementary school consistently ranked as the lowest, although the figure for preschool became the lowest after its inclusion in 2017.

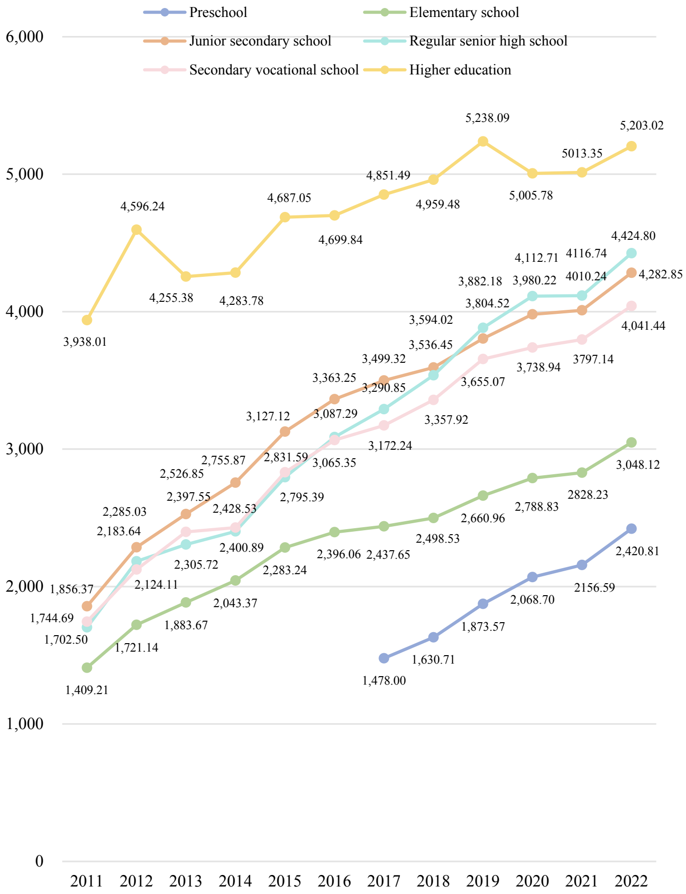


**Fig. 1.13** General public operating expenditure on education per student (2011–2022) (USD adjusted for PPP). *Source* MOE, NBS, & MOF (2012–2023). *Notes* 1. The data of preschool only covers the period of 2017–2022. 2. The PPP conversion rate is sourced from OECD (2023). The PPP conversion rate of the data year is used

### *1.5.3 Trends in HEIs' Scientific Research*

#### 1.5.3.1 The S&T Achievements of China's HEIs

The achievements mainly include four categories: scientific and technological books, academic papers, international projects completed and approved, and intellectual property rights and patents.

Table 1.16 and Figs. 1.14, 1.15, 1.16 and 1.17 illustrate the scientific and technological achievements of China's HEIs from 2016 to 2022. The publication of scientific and technological books by China's HEIs exhibited fluctuations over the period. In contrast, the figures for academic papers and intellectual property rights and patents experienced increases generally. The number of completed and approved international projects consistently declined from 2016 to 2020 but saw an increase in 2021.

#### 1.5.3.2 The S&T Talents of China's HEIs

The talents mainly include three categories: teaching and scientific research personnel, R&D personnel, and personnel of scientific and technological services.

Table 1.17 and Fig. 1.18 show the scientific and technological talents of China's HEIs from 2016 to 2022. The total number of talents steadily increased from 2016 to 2020, experienced a slight decrease in 2021, and then rose to its highest point in

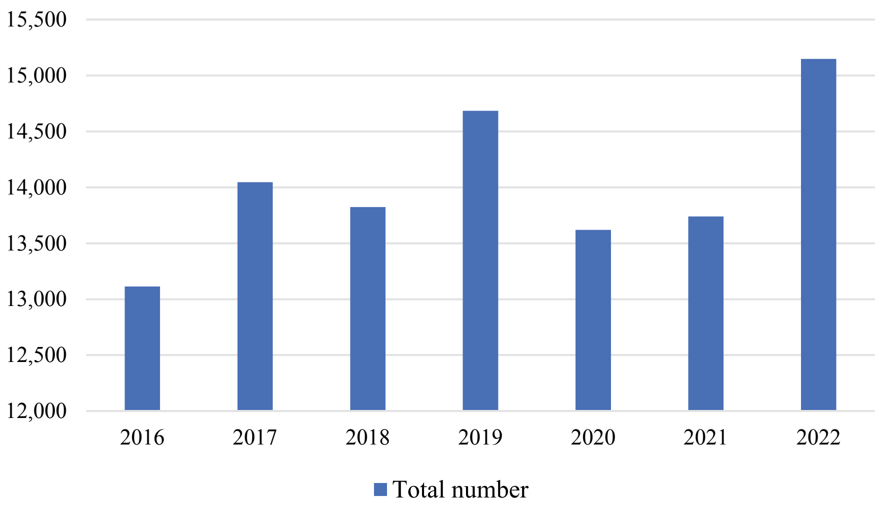


**Fig. 1.14** Number of scientific and technological books (2016–2022). *Source* DSTI (2017, 2018, 2020a, 2020b, 2021, 2022, 2023). *Notes* The data of 2018 and 2019 were both published in 2020

**Table 1.16** Number of scientific and technological achievements (2016–2022)

| | | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|---|---|
| Scientific and technological books | Total number | 13,113 | 14,046 | 13,824 | 14,685 | 13,619 | 13,740 | 15,148 |
| Academic papers | Total number | 870,529 | 918,161 | 957,332 | 1,026,200 | 1,083,321 | 1,129,917 | 1,203,369 |
| | Published on foreign academic journals | 302,414 | 343,999 | 376,836 | 444,735 | 523,834 | 571,696 | 655,413 |
| International projects completed and approved | Total number | 4,884 | 4,628 | 3,359 | 3,214 | 2,743 | 3,271 | NA |
| Intellectual property rights and patents | Applied | 184,423 | 229,458 | 266,418 | 310,276 | 330,375 | 328,896 | 368,170 |
| | Authorized | 121,981 | 144,375 | 163,157 | 184,934 | 206,036 | 268,450 | 308,548 |
| | Sold | 2,695 | 4,803 | 5,899 | 6,115 | 9,229 | 15,169 | 16,015 |
| | Other intellectual property rights and patents | 11,943 | 16,300 | 18,773 | 25,079 | 32,093 | 34,915 | 42,440 |

*Source* DSTI (2017, 2018, 2020a, 2020b, 2021, 2022, 2023)
*Notes* The data of 2018 and 2019 were both published in 2020

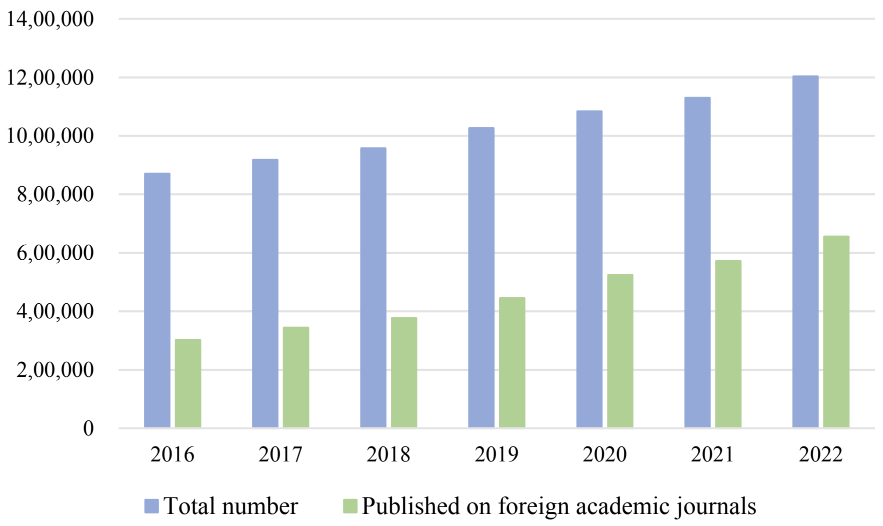


**Fig. 1.15** Number of academic papers (2016–2022). *Source* DSTI (2017, 2018, 2020a, 2020b, 2021, 2022, 2023)

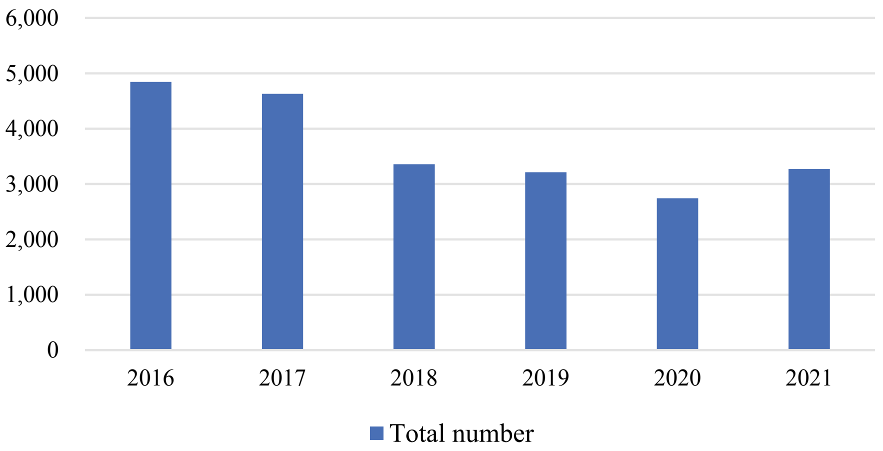


**Fig. 1.16** Number of international projects completed and approved (2016–2021). *Source* DSTI (2017, 2018, 2020a, 2020b, 2021, 2022, 2023). *Notes* The data of 2018 and 2019 were both published in 2020

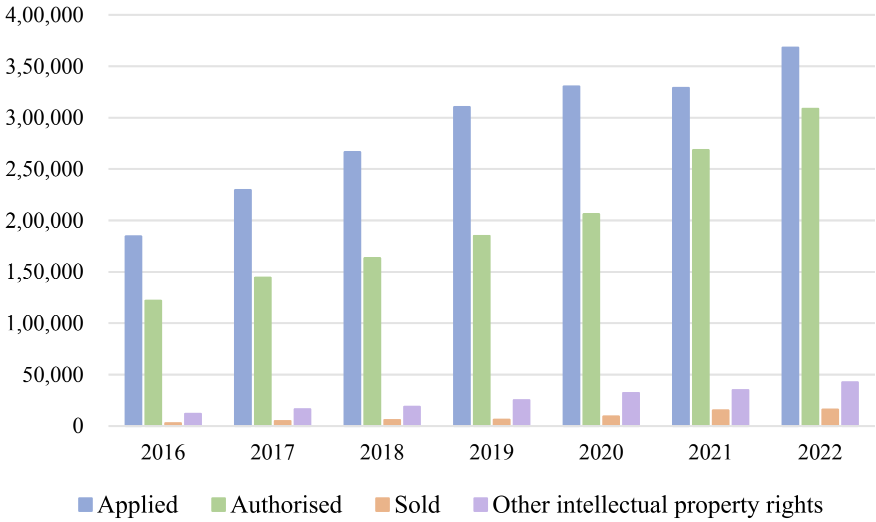


**Fig. 1.17** Number of intellectual property rights and patents (2016–2022). *Source* DSTI (2017, 2018, 2020a, 2020b, 2021, 2022, 2023). *Notes* 1. "Other intellectual property rights and patents" mainly include software registration, integrated circuit design registration, new animal and plant varieties registration, and national new drug registration, etc. 2. The data of 2018 and 2019 were both published in 2020

2022. Throughout this period, the figure for teaching and scientific research personnel consistently remained the highest among the three categories.

#### 1.5.3.3 The S&T Projects of China's HEIs

The projects mainly include three categories: basic research projects, applied basic research projects, and experiment and development projects.

Table 1.18 and Fig. 1.19 show the scientific and technological projects of China's HEIs from 2016 to 2022. The figures for the three types of projects gradually increased over time, with the figure for applied basic research projects consistently maintaining the highest.

This section provides a summary of the developmental trends of education in China spanning from 2011 to 2022. An analysis of trends in educational scale, funding resources, and scientific research at HEIs indicates a rapid transformation in the education landscape, particularly within the higher education sector. By 2022, both the numbers of students and full-time teachers in China had reached historic highs. Concurrently, the Chinese government substantially increased its expenditure on education, with funding allocated per student in higher education surpassing that of

**Table 1.17** Number of scientific and technological talent (2016–2022)

| | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|---|
| Total number | 1,403,401 | 1,464,580 | 1,555,003 | 1,650,157 | 1,910,511 | 1,852,109 | 1,977,795 |
| Teaching and scientific research personnel | 979,185 | 1,027,400 | 1,091,319 | 1,147,044 | 1,227,484 | 1,268,970 | 1,345,872 |
| R&D personnel | 381,102 | 391,240 | 414,886 | 445,190 | 606,242 | 516,101 | 557,291 |
| Personnel of scientific and technological services | 43,114 | 45,940 | 48,798 | 57,923 | 76,785 | 67,038 | 74,632 |

*Source* DSTI (2017, 2018, 2020a, 2020b, 2021, 2022, 2023).
*Notes* The data of 2018 and 2019 were both published in 2020

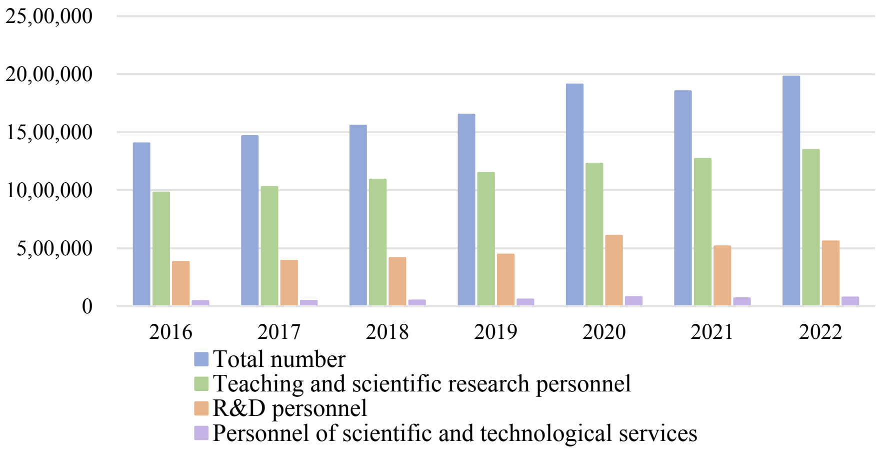


**Fig. 1.18** Number of scientific and technological talent (2016–2022). *Source* DSTI (2017, 2018, 2020a, 2020b, 2021, 2022, 2023). *Notes* The data of 2018 and 2019 were both published in 2020

**Table 1.18** Number of scientific and technological projects (2016–2022)

| | **2016** | **2017** | **2018** | **2019** | **2020** | **2021** | **2022** |
|---|---|---|---|---|---|---|---|
| Total number | 450,726 | 481,264 | 516,752 | 576,260 | 644,100 | 696,714 | 795,998 |
| Basic research projects | 195,575 | 210,477 | 230,359 | 254,651 | 286,509 | 303,197 | 357,643 |
| Applied basic research projects | 216,993 | 229,426 | 246,079 | 271,756 | 298,297 | 328,869 | 363,647 |
| Experiment and development projects | 38,158 | 41,361 | 40,314 | 49,853 | 59,294 | 64,648 | 74,708 |

*Source* DSTI (DSTI (2017, 2018, 2020a, 2020b, 2021, 2022, 2023)
*Notes* The data of 2018 and 2019 were both published in 2020

other education levels. Moreover, there have been significant advancements in the S&T development of China's HEIs, evidenced by the increasing number of academic papers and S&T projects.

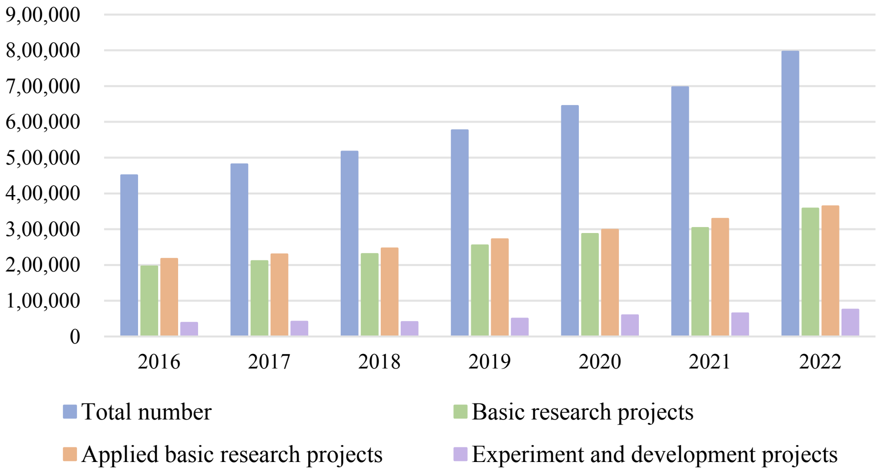


**Fig. 1.19** Number of scientific and technological projects (2016–2022). *Source* DSTI (2017, 2018, 2020a, 2020b, 2021, 2022, 2023). *Notes* The data of 2018 and 2019 were both published in 2020

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# Chapter 2
# Elementary Education in China

**Chen Jing and Kong Ming**

**Abstract** This chapter introduces elementary education in China, the first stage in compulsory education. This chapter begins with an overview of elementary education in China with the situation in major developed countries presented as a reference. To further understand excellence in elementary education, an excellence index is developed. This index consists of ten indicators that not only reflect excellence in elementary education, but are also accessible in public databases, enabling international comparisons between China and major developed countries. Our results demonstrate that elementary education in China has been serving the highest number of children in the world and it is already at the top tier in the world in terms of educational excellence. The elementary education sector in China has the largest amount of government expenditure, the highest survival rate of students successfully advancing to Grade 4, and students have the most advanced social-emotional skills. However, China still falls behind in terms of educational expenditure per student and the student completion rate. The second part of this chapter further introduces elementary education in China from four aspects, including featured educational practices, stories of inspiring teachers, contemporary educational research, and critical educational policies. Examinations in this chapter suggest that policies, research, and practices work together to improve the quality of elementary education in China, emphasizing educational equity, morality in education, reducing student burdens, and promoting students' well-being and holistic development. In sum, elementary education in China has been and will further increase its capacity in supporting students' lifelong development and the sustainable development of the country.

**Keywords** Elementary education · Educational quality · Educational equity · Moral education · Reducing student burden · All-round development

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## 2.1 Introduction

This section provides an overview of elementary education in China. It starts with the history of formal elementary education in China since the end of the nineteenth century and analyzes the major reformation and the accelerated development of this sector in China in the past two decades.

### *2.1.1 The Establishment of Formal Elementary Education in China*

The beginning of formal elementary education in China can be dated back to 1878 when Zhengmeng Academy (*Zhengmeng Shuyuan*) was established in Shanghai. In 1904, the government of the Qing Dynasty implemented *the Memorial School Regulations* (*Zouding Xuetang Zhangcheng*) (Zhang et al., 1904), which stipulated that 7-year-old children could enroll in elementary school with curriculum including morality, Chinese language arts, arithmetic, history, geography, and gymnastics. After the May Fourth Movement in 1919, the Chinese writing system underwent a great change—the Ministry of Education (MOE) promoted simplified Chinese characters to replace traditional Chinese characters starting from the education in the first 2 years in elementary schools. This change has facilitated children's acquisition of reading and writing abilities and contributes to the enlightened role of elementary education.

Since the founding of the People's Republic of China, elementary education has become increasingly popular and has seen robust growth since the late 1970s. In 1952, *Elementary School Teaching Plan* was issued by MOE, which was the first nationwide standard for elementary education. In 1980, the government issued the *Decision on Several Issues Concerning Popularizing Elementary Education*, elevating the popularization of elementary education nationwide and creating an unprecedented enrollment goal to be achieved in the near future (The State Council, 1980). In 1985, the *Decision of the Central Committee of the Communist Party of China on the Reform of the Educational Structure* was issued (Central Committee of the CPC, 1985). This was the first time that 9-year compulsory education was proposed and sought to increase enrollments. In 1986, elementary education became compulsory, safeguarded by the *Compulsory Education Law of the People's Republic of China.* Since then, elementary education has been both a right and an obligation of all Chinese citizens. In 1993, the government promoted the *Program for Educational Reform and Development in China*, and the importance of elementary education for personal and national development (The State Council, 1993).

### *2.1.2 Contemporary Elementary Education in China*

During the twenty-first century, research on elementary education in China has flourished driven by national needs. In 2001, the New Curriculum Reforms were implemented, which encouraged in-depth studies on restructuring curriculum, creating evaluation standards, and establishing an educational management system. In 2016, the State Council issued *Several Guidelines on Comprehensively Promoting Reform and Development to Integrate Urban and Rural Compulsory Education within County Areas,* which target the problem of educational inequality between rural and urban areas (The State Council, 2016). In 2019, the government issued *Guidelines on Deepening the Reform of Education and Teaching and Comprehensively Improving the Quality of Compulsory Education*, which actively responded to issues that have raised great concern in society, such as elementary school enrollment, reducing student burdens, and teachers' right to discipline students when necessary (The State Council, 2019). Further, it emphasized the need to strengthen family education and home-school ties, to collaboratively create a collaborative educational ecology. In 2022, MOE released the *Curriculum Program and Curriculum Standards of Compulsory Education* (MOE, 2022), which updates the content and goals of instructions in elementary schools, strengthening support and guidance for online learning in response to the outbreak of COVID-19.

Nowadays, elementary education in China is free and compulsory for all children who reach 6 years old, and since 2011, universal access to compulsory education in China has been achieved. As a result, elementary education in China serves the largest number of students in the world. With continuous efforts from the government and society, the quality of elementary education is advancing. This is evidenced by growing educational expenditures, increasing gross enrollment rate, high-quality teacher professional development, guaranteed educational facilities in the vast majority of elementary schools, and outstanding student outcomes, such as the high completion rate, extraordinary academic abilities, as well as all-round competence in lifelong learning.

High-caliber schools have emerged in China as a result of continuous innovation in the new era. Schools have continuously explored new education modes, emphasizing students' well-rounded development, and teachers' morality and competencies in teaching. Meanwhile, research on elementary education in China is no longer confined to instructional strategies in select subject domains but has been extended to a wider range of topics, including holistic development, education equity, and individualized development. China has also been refining educational policies to better guide the development of practices in elementary education.

Elementary education in China is now standing at a new historical moment. Now that broad access has been achieved, the next major challenge Chinese elementary education faces is to provide high-quality elementary education to all people in the country. First, from the perspective of educational equity, beyond offering fair opportunities in enrollment, elementary education in China is working on providing fair and high-quality educational resources during the process of education. With regard to the quality of elementary education across regions, there is still a significant gap across the eastern, central, and western regions, between urban and rural areas, and between districts within the same cities in China. Second, teachers and parents do not always share the same educational beliefs and work closely with each other. It is still common among parents who urge their children to pursue high testing scores and high educational degrees without enough support for their children to fully explore personal interests and advantages. Third, although educational technology can facilitate the sharing of high-quality educational resources, the integration of technology in elementary education is still insufficient. Technologies should be designed using evidence-based research and seek to meet specific educational needs. Additionally, teachers and students may need better training in implementing novel technologies. Elementary education in China has taken many steps forward, yet there may still be a long way to provide excellent elementary education to all Chinese youth. The Chinese MOE has been committed to the realization of high-quality and balanced elementary education by 2035.

The following sections of this chapter start with an overview of China's elementary education and its development. An excellence index, consisting of ten indicators, was developed to compare elementary education and its development between China and major developed countries and regions. Then this chapter provides best practices of Chinese elementary schools and shares inspiring stories of three outstanding educators who aim to deliver educational philosophies through their daily work. This chapter ends by reviewing the latest research trends and the national policies significantly shaping elementary education in China.

## 2.2 Highlighting Data

This section provides a statistical overview of elementary education in China by utilizing both national and international databases that are publicly available. Each indicator is juxtaposed with the corresponding indicators from other major countries, providing a reference to help readers better contextualize and understand elementary education in China.

The indicators discussed in this section revolve around several themes, including: duration and scale, enrollment, resources and quality, and student attainment, as summarized in Table 2.1.

### *2.2.1 Duration and Scale of Elementary Education*

The duration of elementary education in China typically is 6 years with a few exceptions, such as in Shanghai for 5 years. Based on statistics from UNESCO Institutes for Statistics (UIS), Chinese elementary schools included 6,683,229 teachers and 107,730,040 enrolled students in 2021. Although India has the largest number of

**Table 2.1** Themes and indicators for highlighting data

| Themes | Indicators |
|---|---|
| Duration and scale | • Duration and scale of elementary education<br>• Gender proportions among teachers in elementary education |
| Enrollment | • Gross enrollment ratio of elementary education<br>• Proportion of enrollment in public institutions |
| Resources and quality | • Government expenditure on elementary education<br>• Government funding per elementary student<br>• Basic facilities in elementary schools<br>• Qualified teachers<br>• Student–teacher ratio<br>• Teacher attrition rate |
| Student attainment | • Survival rate to Grade 4<br>• Elementary education completion rate<br>• Elementary education repetition rate |

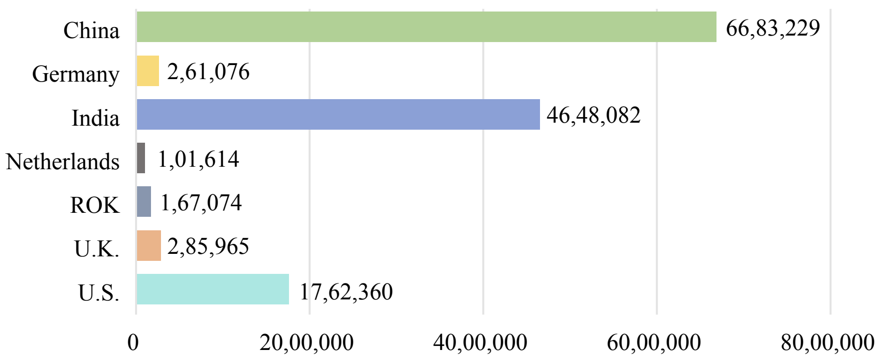


**Fig. 2.1** Number of teachers in elementary education (2021). *Source* UIS (2023)

enrolled elementary school students, the scale of elementary education in China is significantly greater than other major countries including the United States (U.S.), United Kingdom (U.K.), Germany, Republic of Korea (ROK), and the Netherlands (see Figs. 2.1 and 2.2).

### *2.2.2 Gender Proportions Among Teachers in Elementary Education*

Among teachers, 71.43% of them are female, which is lower than that in many developed countries (Fig. 2.3). This suggests a somewhat more balanced gender distribution among elementary school teachers in China.

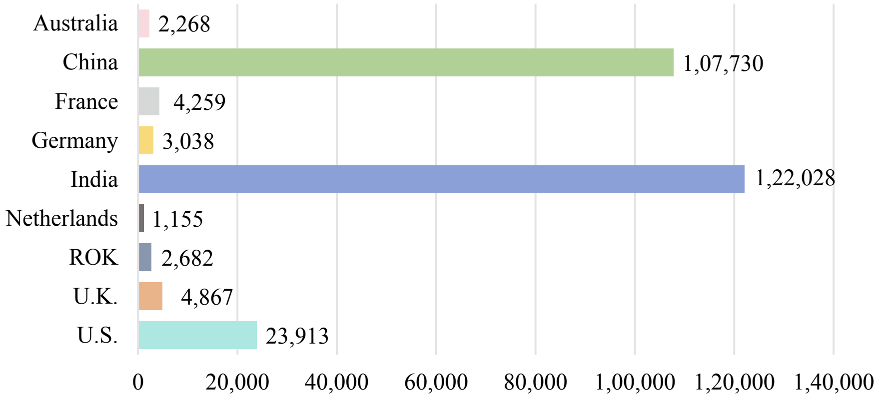


**Fig. 2.2** Number of enrolled students in elementary education (in thousands) (2021). *Source* UIS (2023)

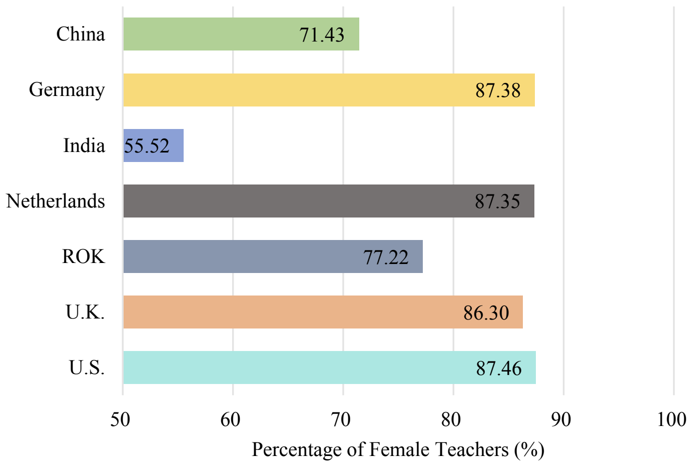


**Fig. 2.3** Percentage of teachers in elementary education who are female (2021). *Source* UIS (2023)

### *2.2.3 Gross Enrollment Ratio of Elementary Education*

The *gross enrollment ratio* refers to the number of students enrolled in each level of education, regardless of age, which is reflected as a percentage of the official school-age population corresponding to the same level of education based on the definition provided by UIS. In China, the gross enrollment ratio for elementary education has been growing in recent years. It reached 99.43% in 2021, which is comparable with other major developed countries (Fig. 2.4). The gross enrollment rate by gender is presented in Fig. 2.5, which favors girls than boys in China, with both rates being comparable with other major developed countries.

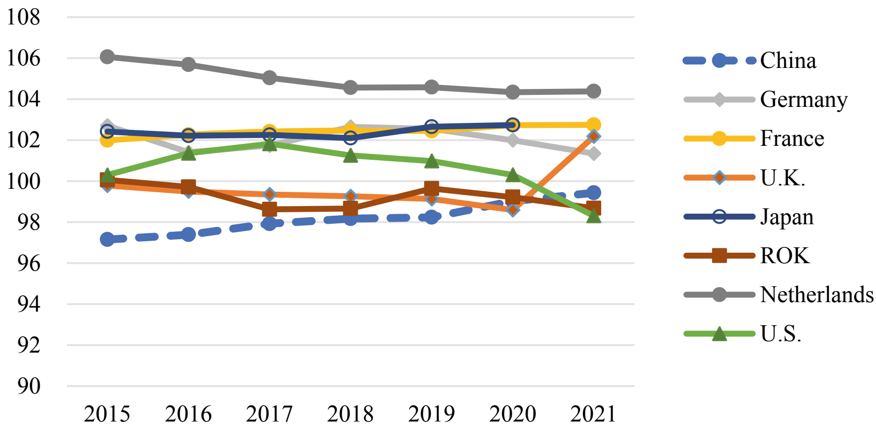


**Fig. 2.4** Gross enrollment ratio in elementary schools (2015–2021) *Source* UIS (2023). *Note* The data were retrieved from the most updated UIS database, where some of the exact values are different from those reported in the previous version of *Education in China and the World*

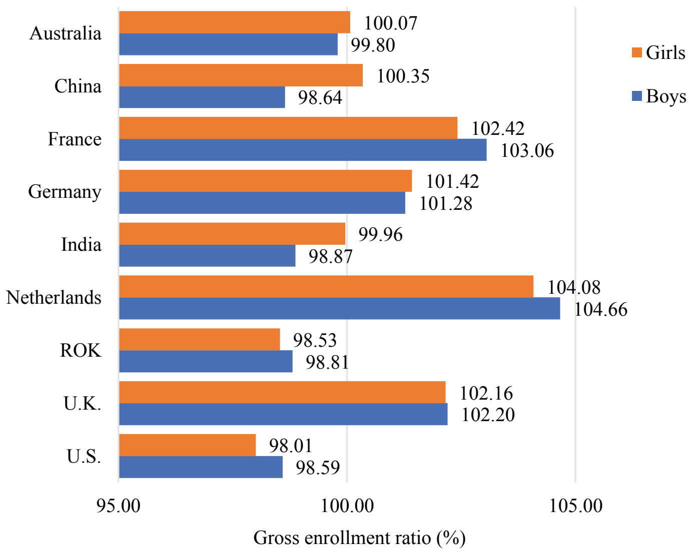


**Fig. 2.5** Gross enrollment ratio by gender in elementary schools (2021). *Source* UIS (2023)

### *2.2.4 The Proportion of Enrollment in Public Institutions*

UIS differentiates public and private educational institutions by whether they are operated by a public authority or controlled and managed by a private body (e.g., non-governmental organization, religious body, special interest group, foundation,

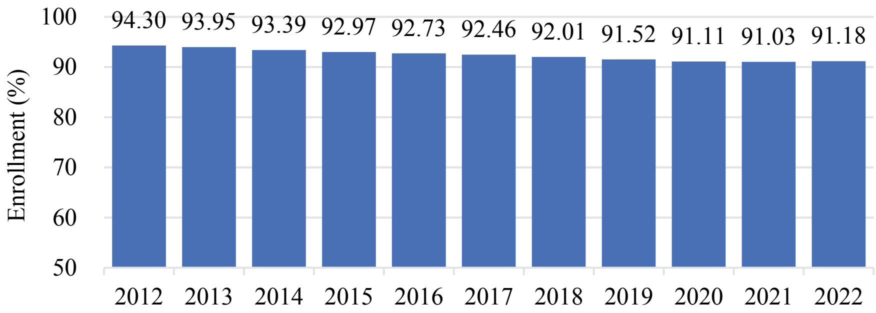


**Fig. 2.6** Proportion of enrollment in public institutions in China (2012–2022). *Source* UIS (2023)

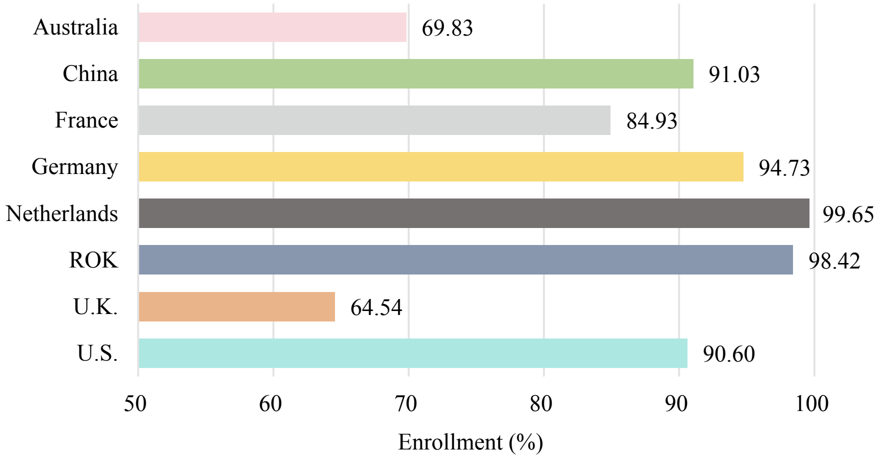


**Fig. 2.7** Proportion of enrollment in public institutions (2021). *Source* UIS (2023)

or business enterprise). In China, among students enrolled in elementary education, more than 90% were enrolled in public (as opposed to private) educational institutions, although this proportion has decreased slightly over the past 10 years (Fig. 2.6). As a reference, the proportions of enrollment in public institutions in major developed countries are presented in Fig. 2.7.

### *2.2.5 Government Expenditure on Elementary Education*

Government expenditure on elementary education refers to the total general (local, regional, and central) government expenditures on elementary education based on the definition from UIS. In China, the governmental expenditure on elementary education amounted to RMB1,468,621 million in 2020 (Ministry of Finance [MOF], 2022),

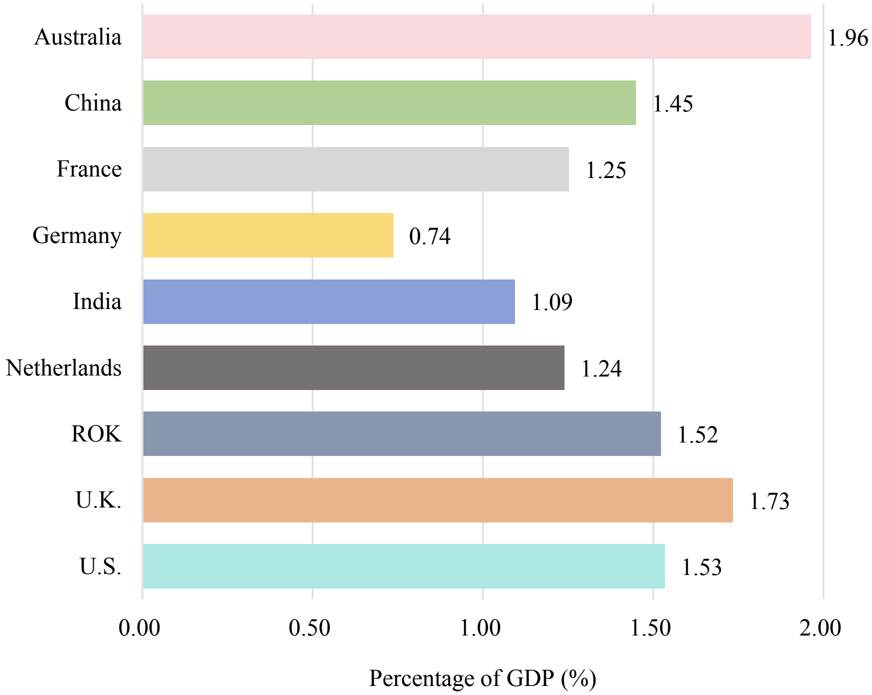


**Fig. 2.8** Government expenditure on elementary education as a percentage of GDP in the year of 2020. *Source* UIS (2023), *Finance Statistical Yearbook* (MOF, 2022), National Bureau of Statistics (NBS, 2022). *Notes* The latest data for all countries except that of China were retrieved from UNESCO, where the latest available information is for 2020. The data for China were missing in the UNESCO database, so the data were manually calculated based on the *China Educational Finance Statistical Yearbook* (Ministry of Finance, 2022) and the *China Statistical Yearbook* (National Bureau of Statistics, 2022)

equivalent to **USD**351,458 million adjusted for purchasing power parity (PPP) or 1.45% of the GDP of the country in 2020 (National Bureau of Statistics [NBS], 2022). For comparisons with other major developed countries, please see Figs. 2.8 and 2.9 based on the latest information retrieved from the UIS database.

### *2.2.6 Government Funding Per Elementary Student*

The above total amount of government expenditure may not provide a complete picture, since the Chinese elementary education system serves a large number of students. The initial government funding per elementary student in China was calculated based on the total expenditure in elementary education retrieved from the *China Educational Finance Statistical Yearbook* (MOF, 2022) and the total enrollment in elementary school retrieved from the *China Statistical Yearbook* (NBS, 2022). As

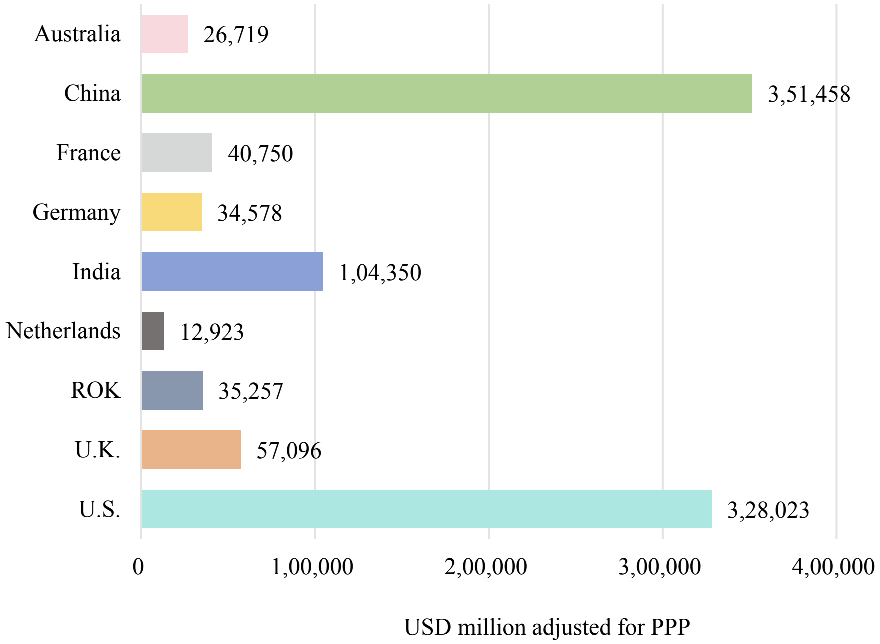


**Fig. 2.9** Government expenditure on elementary education (2020) (USD million adjusted for PPP) *Source* UIS (2023), MOF (2022), NBS (2022), OECD 2023a. *Notes* The latest data for all countries were retrieved from UNESCO was for 2020. The data for China were not available in the UNESCO database, which was manually calculated based on the *China Educational Finance Statistical Yearbook* (MOF, 2022), the *China Statistical Yearbook*PPP conversion rate of the year 2020 (OECD, 2023a)

presented in Figs. 2.10 and 2.11, government funding per elementary student has grown steadily in China in recent years, although it is still far from comparable with other major developed countries.

### *2.2.7 Basic Facilities in Elementary Schools*

The proportion of elementary schools with basic facilities has risen in recent years in China. Since 2021, more than 99% of elementary schools have had access to basic drinking water, electricity, single-sex basic sanitation facilities, and basic handwashing facilities (Fig. 2.12).

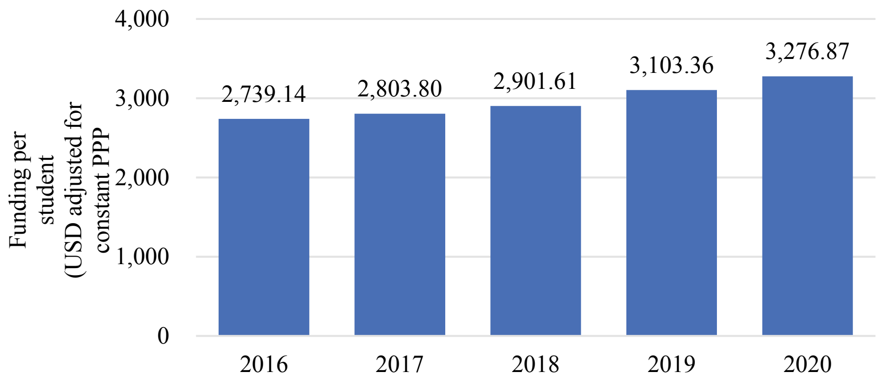


**Fig. 2.10** Initial government funding per elementary student in China (2016–2020) (USD adjusted for constant PPP). *Source* MOF (2022), NBS (2022), OECD (2023a)

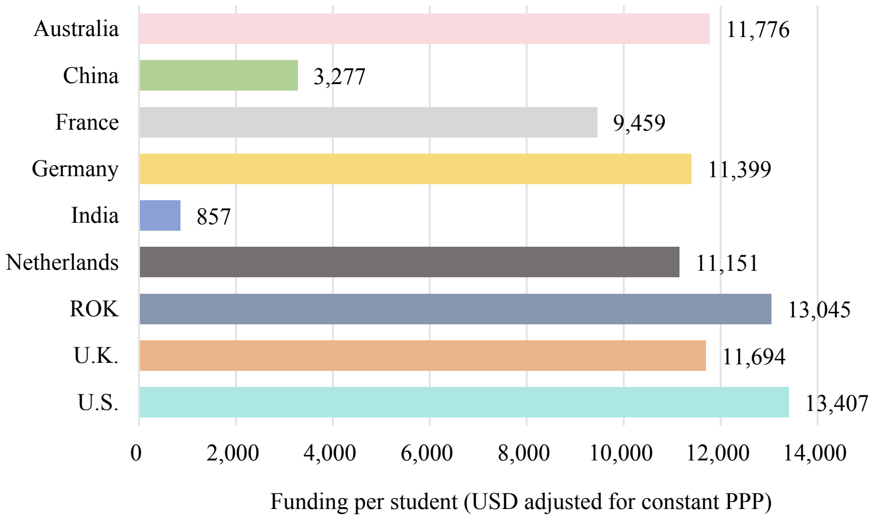


**Fig. 2.11** Initial government funding per elementary student (2020) (USD adjusted for constant PPP). *Source* UIS (2023), MOF (2022), NBS (2022), OECD (2023a). *Notes* The latest data for all countries were retrieved from UNESCO for 2020, except that the data for China were missing in the database. The latest data for China were calculated by dividing the amount of government funding for elementary schools (MOF,) by the number of enrolled elementary school students for the corresponding years (NBS, 2022). The RMB was adjusted for PPP based on the conversion rate for the specific year reported by OECD (2023a)

### *2.2.8 Qualified Teachers*

Qualified teachers refer to teachers who have at least the minimum academic qualifications required for teaching their subjects at the relevant level in a country, in an

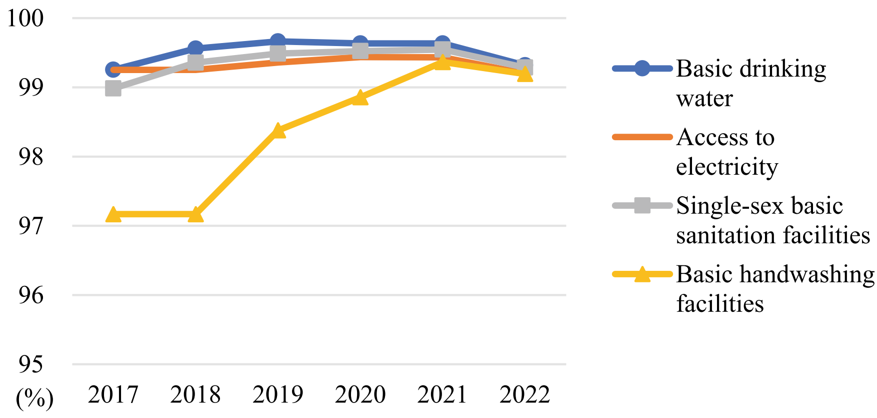


**Fig. 2.12** Proportion of elementary schools with basic facilities in China (2017–2022). *Source* UIS (2023)

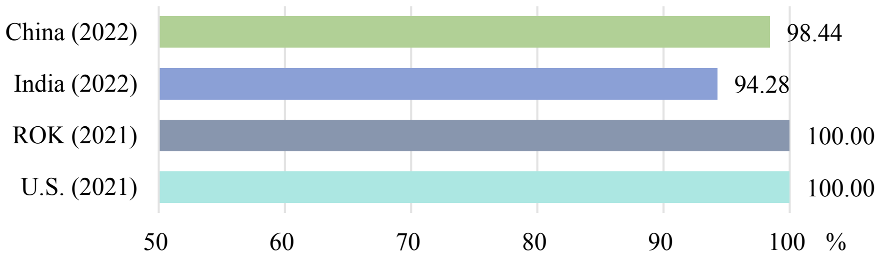


**Fig. 2.13** Percentage of qualified teachers in elementary education. *Source* UIS (2023). *Notes* The latest available information for China and India is 2022, while that for the U.S. and ROK is 2021

academic year. In China, the percentage of qualified teachers in elementary education has remained stable at above 95% since 2015 and reached 98.44% in 2022 based on the data released by the UIS. While the UIS database does not include data on the indicator for the major developed countries mentioned earlier, Fig. 2.13 presents information for a few countries where data are available.

### *2.2.9 Student–Teacher Ratio*

Student–teacher ratio refers to the average number of students per teacher. Student–teacher ratio was calculated by dividing the number of enrolled elementary school students and the number of teachers based on the latest available information released

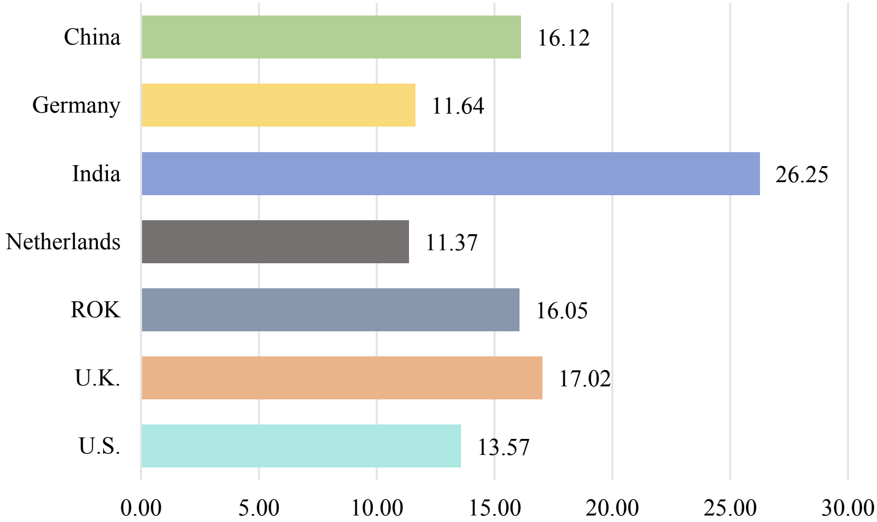


**Fig. 2.14** Average student–teacher ratio in elementary education (2021). *Source* UIS (2023)

by UIS. As presented in Fig. 2.14, the average student–teacher ratio for elementary education in China was about 16 (Fig. 2.14), which is comparable with major developed countries in the world.

#### 2.2.9.1 Teacher Attrition Rate

Teacher attrition rate refers to the percentage of teachers at a level of education leaving the profession in a school year based on the definition from UIS. In China, the overall teacher attrition rate for elementary education increased from 4.69% in 2019 to 9.30% in 2022 (Fig. 2.15). More specifically, the attrition rate was higher for male teachers than that for female teachers. The information for developed countries mentioned in other figures was missing for the current indicator in the UIS database, with only the data for India being available, which was 1.75% in 2022.

#### 2.2.9.2 Survival Rate to Grade 4

UIS defines the survival rate to Grade 4 as the percentage of a cohort of students enrolled in the first grade of elementary education in a school year who are expected to reach fourth grade, regardless of repetition. Based on the latest information, the survival rate for Grade 4 of elementary education in China was 99.84% in 2020, which is comparable (if not higher than) to other countries in the world (Fig. 2.16).

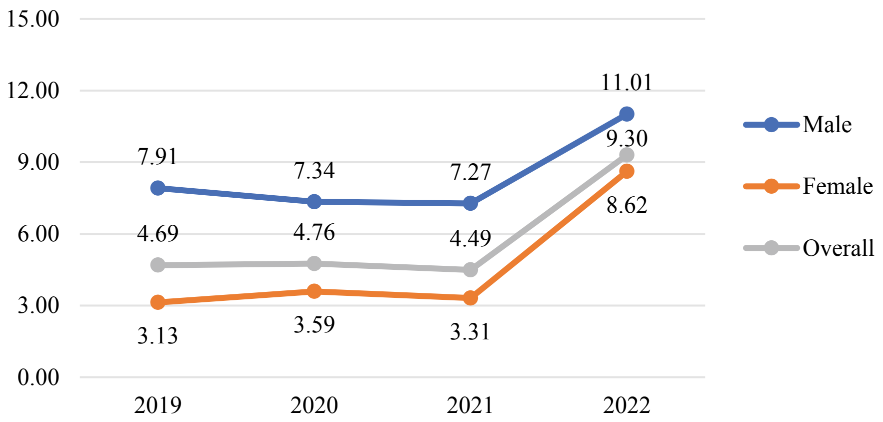


**Fig. 2.15** Teacher attrition rate for elementary education in China (2019–2022). *Source* UIS (2023)

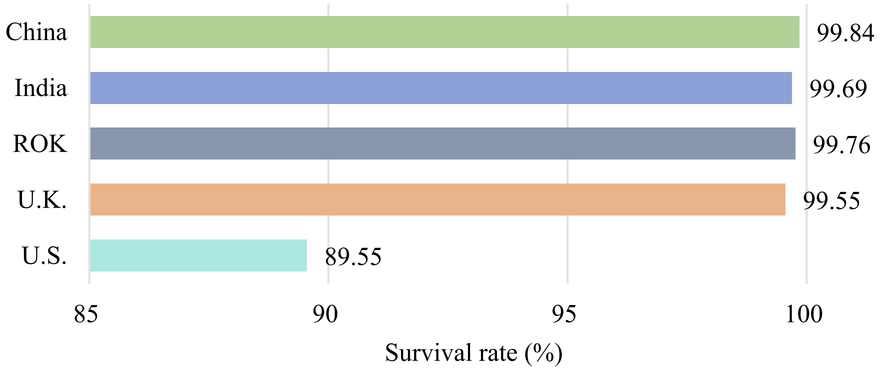


**Fig. 2.16** Survival rate to Grade 4 of elementary education (2020). *Source* UIS (2023)

#### 2.2.9.3 Elementary Education Completion Rate

UIS defines the completion rate for elementary education as the percentage of a cohort of children or young people aged 3–5 years above the intended age for the last grade of elementary education who have completed that grade. In China, the overall completion rate for elementary education was 98% in 2020, which was slightly higher for girls than boys (98.80 and 97.60% respectively). The completion rate is slightly lower than that of other major developed countries (Fig. 2.17).

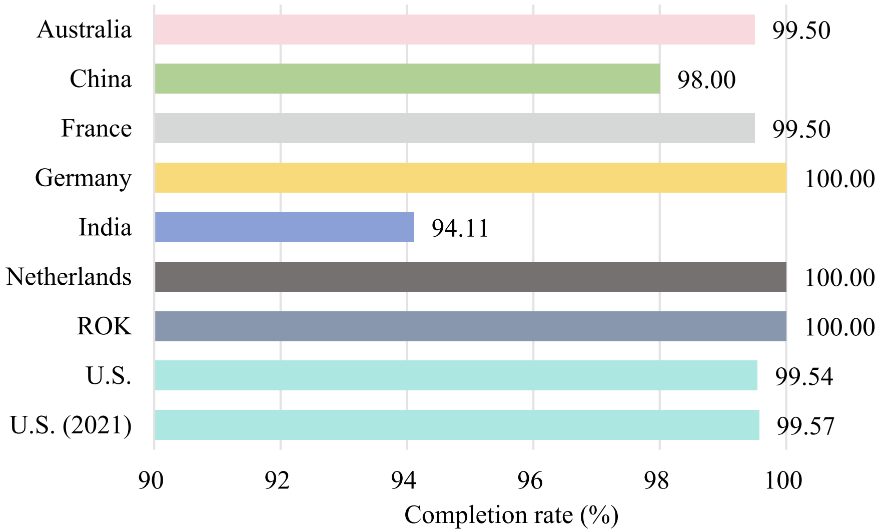


**Fig. 2.17** Elementary education completion rate (2020). *Source* UIS (2023)

#### 2.2.9.4 Elementary Education Repetition Rate

Repetition rate is defined by UIS as the proportion of students from a cohort enrolled in a given grade at a given school year who study in the same grade in the following school year. The repetition rate for elementary education in China was 0.01% in 2020, which is one of the countries that have the lowest repetition rate (Fig. 2.18).

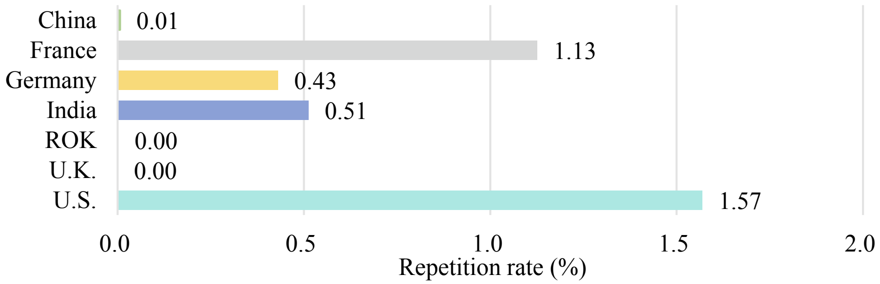


**Fig. 2.18** Elementary education repetition rate (2020) (%). *Source* UIS (2023)

## 2.3 Excellence Index

This section intends to develop an excellence index with indicators to measure elementary education in China and other major developed countries, to assess Chinese elementary education's performance and development in a global context.

### *2.3.1 Design*

The indicators below were selected to reflect education excellence, based on which an excellence index was calculated to compare elementary education in China and that in other major countries in the world. The purpose of this exercise was to analyze the strengths and weaknesses of Chinese elementary education and to compare it with its major international counterparts. The comparison covered nine other major countries in addition to China. Listed in alphabetic order, these countries were Australia, France, Germany, India, Japan, the Netherlands, the Republic of Korea (ROK), the United Kingdom (U.K.), and the United States (U.S.).

Three rules were applied in selecting indicators to be used to calculate the excellence index. First, the indicators were accessible in public databases, and they were available for most of the countries listed above. Second, the indicators needed to be internationally comparable, which means for a certain indicator, the values for all the countries were calculated following the identical operational definition. Third, the indicators should each reflect a unique aspect of educational excellence. Redundancy was eliminated and closely related indicators were combined. As a result, ten indicators from three dimensions were selected to represent excellence in elementary education in China and the world.

Dimension 1: Enrollment

- Gross enrollment ratio for elementary education

Dimension 2: Resources

- Government expenditure on elementary education as a percentage of GDP
- Government expenditure on elementary education adjusted for PPP
- Initial government funding per elementary student adjusted for constant PPP
- Proportion of elementary schools with basic facilities
- Percentage of qualified teachers in elementary education
- Teacher-student ratio in elementary education

Dimension 3: Student Attainment

- Survival rate to Grade 4
- Elementary education completion rate
- Students' social-emotional skills.

### 2.3.2 Definitions and Sources

Following the above-mentioned principles, UIS (2023) was selected as the primary source of information. In instances where China lacked specific indicators in the UIS database, the authors manually calculated the value for China based on UIS's operational definition and utilized raw data retrieved from *the China Statistical Yearbook*. The sources of ten indicators are summarized in Table 2.2, and the definition of each of the ten indicators is explained below.

*Gross enrollment ratio* is defined by UIS as the percentage of the eligible official school-age population corresponding to the same level of education in a given school year (UIS, 2023). The gross enrollment ratio for elementary education for each of the ten countries was retrieved from the UIS database (2023).

*Government expenditure on elementary education as a percentage of GDP* is defined by UIS as the total general government expenditure in elementary institutions, expressed as a percentage of GDP (UIS, 2023). In the UIS database, China was missing this indicator. The value for China, therefore, was manually calculated based

**Table 2.2** Sources of excellence indicators for elementary education

| Excellence indicators | Data source | Year |
|---|---|---|
| *Dimension 1: Enrollment* | | |
| I1. Gross enrollment ratio for elementary education | UIS | 2021 |
| *Dimension 2: Resources* | | |
| I2. Government expenditure on elementary education as a percentage of GDP | UIS & China Statistical Yearbook | 2020 |
| I3. Government expenditure on elementary education adjusted for PPP | UIS & China Statistical Yearbook | 2020 |
| I4. Initial government funding per elementary student adjusted for constant PPP | UIS & China Statistical Yearbook | 2020 |
| I5. Proportion of elementary schools with basic facilities | UIS | 2021 |
| I6. Percentage of qualified teachers in elementary education | UIS | 2021 |
| I7. Teacher-student ratio in elementary education | UIS | 2021 |
| *Dimension 3: Student attainment* | | |
| I8. Survival rate to Grade 4 | UIS | 2020 |
| I9. Elementary education completion rate | UIS | 2020 |
| I10. Students' social-emotional skills | OECD – SSES data | 2019 |

*Note* Year = the year of the latest available data for most of the ten countries included in this section; OECD − SSES = the Survey of Social and Emotional Skills conducted by the Organization of Economic Cooperation and Development on the *China Statistical Yearbook* (NBS, 2022), dividing the government expenditure on elementary education by GDP.

*Government expenditure on elementary education adjusted for PPP* is defined by UIS as the total general government expenditure on elementary education adjusted for PPP. Same as the above, the missing data for China from the UIS database were manually calculated based on the *China Statistical Yearbook* (ibid), The authors first retrieved the government expenditure on elementary education in RMB, and then adjusted for PPP based on the conversion rate in 2020 (as year corresponds to the GDP value) as reported by OECD (2023a).

*Initial government funding per elementary student adjusted for constant PPP* is defined as the total initial government funding for elementary education divided by the number of student enrollment in elementary education. Again, the missing data for China from the UIS database were manually calculated based on the *China Statistical Yearbook* (NBS, 2022), adjusted for PPP based on the conversion rate in 2020 as reported by OECD (2023a).

*The proportion of elementary schools with basic facilities* was retrieved from the UIS database, where separated indicators for four types of basic facilities were available in UIS (2023). The four types of basic facilities are basic drinking water, electricity, single-sex basic sanitation facilities, and basic handwashing facilities. These four proportions were averaged for a comprehensive indicator representing the proportion of elementary schools with basic facilities in a given country.

*The percentage of qualified teachers in elementary education* is defined as the percentage of teachers who have at least the minimum academic qualifications required for teaching their subjects in elementary education in a given country, in an academic year. The data were retrieved from UIS (2023), where four out of the ten countries have available information.

*The teacher-student ratio in elementary education* was manually calculated by dividing the number of teachers by the number of enrolled students in elementary education based on the latest available information in UIS (2023).

*Survival rate to Grade 4* is defined by UIS as the percentage of a cohort of students enrolled in the first grade of elementary education in a school year who are expected to reach fourth grade, regardless of repetition (UIS, 2023).

*Elementary education completion rate* is defined by UIS as the percentage of a cohort of children aged 3–5 years above the intended age for the last grade of elementary education who have completed that grade (UIS, 2023).

*Students' social-emotional skill* was retrieved from the Survey of Social and Emotional Skills (SSES) conducted by OECD (2023b). Based on the OECD's report, the first round of assessment took place in 2018–2020 in ten cities around the world. Three out of these ten cities were from the countries of interest in this section, which are Suzhou (China), Daegu (ROK), and Houston (U.S.). SSES includes two cohorts: 10-year-olds and 15-year-olds—the data for the younger cohort were used in this section to represent students' social-emotional skills in elementary education. In SSES, social-emotional skills include six dimensions, which are open-mindedness, task-performance, engaging with others, emotion regulation, collaboration, and additional indices. The total number of items was 17—the first five dimensions each includes three items, and the additional indices include achievement motivation and self-efficacy. For the purpose of this chapter, the average score on each item for each city (country) was first calculated. Second, as the items did not share the same scale, the country-mean was standardized. Among the country-means, the highest value on each item was treated as the benchmark and assigned a score of 100. The score of the other cities (countries) equals the proportion of the raw scores against the benchmark and times 100. Third, the standardized scores were aggregated across items for individual cities (countries) using the mean function, which was then used to represent students' social-emotional skills in elementary education in the country.

### *2.3.3 Findings*

To create a comparable and standardized excellence index for each country based on the ten excellence indicators, we followed three steps. First, the raw data of the ten excellence indicators were retrieved from sources explained in the previous section. Second, to make the unit and the scale of the ten indicators comparable, the raw scores were standardized: for each indicator, the country with the highest value (the most optimal and the benchmark) was assigned a score of 100. For the other countries, the standardized score on this indicator equals the proportion of its raw score against the benchmark and then times 100. Third, the excellence index for each country was calculated by averaging its standardized scores on all the indicators.

The raw scores are presented in Table 2.3 and the excellence index and rank based on averaging the standardized scores across indicators are presented in Table 2.4. For a robustness check, the excellence index and ranks were calculated with and without the social-emotional skills based on the SSES (I10), since only three out of the ten countries have available information and the social-emotional survey conducted by OECD is based on particular cities which may or may not well represent the situation in the entire countries. As shown in Table 2.4, with or without the social-emotional scores, the ranks stayed the same. Note that Japan has a significant amount of missing data in the UIS dataset, which, therefore, was excluded from the excellence index calculation as well as the ranking.

Overall, the United States ranked the top in educational excellence at the elementary stage, and China ranked at the second, followed by the Republic of Korea. Regarding each indicator, compared to other countries, elementary education in China has been superior in terms of government expenditure adjusted for PPP (ranking #1 out of 9), students' survival rate to Grade 4 (ranking #1 out of 5), and students' social-emotional skills (ranking #1 out of 3), but fall short on initial government funding per student adjusted for PPP (ranking #8 out of 9), completion rate (ranking #7 out of 8), and proportion of schools with basic facilities (ranking #6 out of 7). China ranked in the middle on gross enrollment ratio (ranking #6 out of 9), government expenditure as the percentage of GDP (ranking #5 out of 9), proportion of qualified teachers (ranking #3 out of 4), and teacher-student ratio (ranking #5 out of 7).

**Table 2.3** Raw scores by excellence indicators

| | Enrollment | Resources | | | | | | Student attainment | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | I1 | I2 | I3 | I4 | I5 | I6 | I7 | I8 | I9 | I10 |
| Australia | 99.93 | 1.96 | 26,719.18 | 11,776.32 | 100.00 | NA | NA | NA | 99.50 | NA |
| China | 99.43 | 1.45 | 351,457.59 | 3276.87 | 99.50 | 96.25 | 0.06 | 99.84 | 98.00 | 99.42 |
| France | 102.74 | 1.25 | 40,750.18 | 9459.25 | 100.00 | NA | NA | NA | 99.50 | NA |
| Germany | 101.35 | 0.74 | 34,577.80 | 11,398.66 | 100.00 | NA | 0.09 | NA | 100.00 | NA |
| India | 99.39 | 1.09 | 104,350.07 | 857.44 | 90.06 | 93.26 | 0.04 | 99.69 | 94.11 | NA |
| Netherlands | 104.38 | 1.24 | 12,923.20 | 11,150.59 | 100.00 | NA | 0.09 | NA | 100.00 | NA |
| ROK | 98.68 | 1.52 | 35,257.00 | 13,045.36 | 100.00 | 100.00 | 0.06 | 99.76 | 100.00 | 95.18 |
| U.K | 102.18 | 1.73 | 57,096.08 | 11,693.85 | NA | NA | 0.06 | 99.55 | NA | NA |
| U.S | 98.31 | 1.53 | 328,023.22 | 13,407.35 | NA | 100.00 | 0.07 | 89.55 | 99.54 | 91.64 |
| Japan | 102.74 | NA | NA | NA | NA | NA | 0.07 | NA | NA | NA |

*Notes* NA means the data for the specific country are not available in the UIS database
I1 = Gross enrollment ratio
I2 = Government expenditure on elementary education as the percentage of GDP (%)
I3 = Government expenditure on elementary education adjusted for PPP (USD million)
I4 = Initial government funding per elementary student adjusted for constant PPP
I5 = Proportion of elementary schools with basic facilities
I6 = Percentage of qualified teachers in elementary education
I7 = Teacher-student ratio in elementary education
I8 = Survival rate to Grade 4
I9 = Elementary education completion rate
I10 = Students' social-emotional skills

**Table 2.4** Excellence index and rank based on averaging standardized scores across indicators

| | Enrolment | Resources | | | | | | Student attainment | | | Excellence index | Rank | Excellence index (ex. SSES) | Rank (ex. SSES) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I1 | I2 | I3 | I4 | I5 | I6 | I7 | I8 | I9 | I10 | | | | |
| Australia | 95.74 | **100** | 7.60 | 87.83 | **100** | NA | NA | NA | 99.50 | NA | 81.78 | 4 | 81.78 | 4 |
| China | 95.26 | 73.83 | **100** | 24.44 | 99.50 | 96.25 | 70.51 | **100** | 98.00 | **100** | 85.78 | 2 | 84.20 | 2 |
| France | 98.43 | 63.84 | 11.59 | 70.55 | **100** | NA | NA | NA | 99.50 | NA | 73.99 | 8 | 73.99 | 8 |
| Germany | 97.10 | 37.51 | 9.84 | 85.02 | **100** | NA | 97.67 | NA | **100** | NA | 75.31 | 7 | 75.31 | 7 |
| India | 95.22 | 55.73 | 29.69 | 6.40 | 90.06 | 93.26 | 43.30 | 99.85 | 94.11 | NA | 67.51 | 9 | 67.51 | 9 |
| Netherlands | **100** | 63.11 | 3.68 | 83.17 | **100** | NA | 100 | NA | **100** | NA | 78.57 | 5 | 78.56 | 5 |
| ROK | 94.54 | 77.54 | 10.03 | 97.30 | **100** | **100** | 70.81 | 99.92 | **100** | 95.74 | 84.59 | 3 | 83.35 | 3 |
| U.K | 97.89 | 88.31 | 16.25 | 87.22 | NA | NA | 66.78 | 99.71 | NA | NA | 76.03 | 6 | 76.03 | 6 |
| U.S | 94.18 | 78.17 | 93.33 | **100** | NA | **100** | 83.77 | 89.69 | 99.54 | 92.17 | 92.32 | 1 | 92.34 | 1 |
| Japan | 98.43 | NA | NA | NA | NA | NA | 76.99 | NA | NA | NA | | | | |

*Notes* NA means the data for the specific country are not available in the UIS database
I1 = Gross enrollment ratio
I2 = Government expenditure on elementary education as the percentage of GDP
I3 = Government expenditure on elementary education adjusted for PPP
I4 = Initial government funding per elementary student adjusted for constant PPP
I5 = Proportion of elementary schools with basic facilities
I6 = Percentage of qualified teachers in elementary education
I7 = Teacher-student ratio in elementary education
I8 = Survival rate to Grade 4
I9 = Elementary education completion rate
I10 = Students' social-emotional skills

### *2.3.4 Discussion*

Overall, our findings show that China is at the top tier in the world in terms of educational excellence in the stage of elementary education. It has the largest amount of government expenditure, the highest student survival rate to Grade 4, and students have the most advanced social-emotional skills.

However, there are aspects to be improved. First and foremost, due to the large scale of student enrollment in China, although the total government expenditure on elementary education is at the top in the world (USD351,457.59 million adjusted for PPP in 2020), government funding per student (USD3276.87 adjusted for PPP) is still far from excellence.

Second, it is interesting that although students' survival rate to Grade 4 ranked the top among the countries (99.84%), the completion rate still shows room for improvement (98%, ranking #7 out of 8). It is possible that although once students are enrolled in elementary schools in China, they are likely to survive in grade 4 and complete the entire elementary education, there is still a proportion of children at school age who are not enrolled in elementary schools—given the gross enrollment ratio in China was relatively low (99.43%, ranking #6 out of the nine countries). Further, as reported in the previous section (Fig. 2.18), elementary education in China has a very low repetition rate (0.01%), while a reasonable level of tolerance to repetition might help increase the completion rate.

Regarding the results of social-emotional skills, although with or without this indicator, the overall ranks did not change, we look forward to more cities and countries participating in the survey in the future. This would improve the validity of the indicator in representing country-wide social-emotional skills at the stage of elementary education.

## 2.4 Best Practices

This section introduces two best practices in Chinese elementary education in terms of developing scientific literacy and nurturing mental well-being. These case studies provide analysis of educational excellence from a qualitative perspective.

### *2.4.1 Project-Based Practices Bringing "Ecological Civilization Education" to Life*

Developing students' scientific literacy has long been emphasized for cultivating future scientific and technological talents. But scientific literacy itself is not enough, education should prepare students to be responsible citizens. For this purpose, science education has been accompanied by civic education under the umbrella of Ecological

Civilization Education in elementary schools in China. Guiyang Primary School Attached to Beijing Normal University is an elementary school located in Guiyang city, the capital of Guizhou province, south China. The school has implemented various strategies to nurture students' scientific and environmental awareness through school experiences.

First, the school creates rich non-formal educational environments and facilities on-campus, such as a science and technology museum, a firefighting experience center, a planting gallery, and plenty of meteorological observatory instruments (Yuan, 2022). With these facilities, the school tries to help students bridge science and technology knowledge and skills with their everyday lives and enables them to make observations and conduct research in both formal and informal curricula.

Second, the school enhances ecological civilization education through a systematic Project-Based Learning (PBL) program, which incorporates civic education by emphasizing and practicing the concept that "lucid waters and lush mountains are invaluable assets". When developing PBL courses, teachers follow the "one principle, five modules" framework. "One principle" refers to the principle that the program should focus on cultivating students' ecological civilization education. "Five modules" refer to five PBL themes tailored for students from different grades, which include Finding Rich Natural Resources in Guizhou (Grade 1 and 2), Experiencing Diverse Cultures in Guizhou (Grade 3), Exploring Ecological Developments in Guizhou (Grade 4), Exploring Technological Developments in Guizhou (Grade 5), and Introducing Guizhou's Story to the World (Grade 6) (Wang, 2020). A wide range of activities are organized under each theme, such as visiting museums and acting as delegates from different countries at the Model Climate Change Conference of Parties. One of the activities is called Being Bridge Designers, in which students work in groups and design a bridge connecting two school buildings. With the teachers' scaffolding, the students measure the distance between the two buildings, calculate the construction cost, make a bridge model, and present their group work both in Chinese and English.

Through such practices, Guiyang Primary School Attached to Beijing Normal University allows students to practice knowledge from multiple subject domains, gain critical thinking and problem-solving abilities, develop interpersonal cooperation and communication skills, and meanwhile gain solid self-concept as future responsible citizens.

### *2.4.2 Enhancing Students' Mental Well-Being and Happiness*

The significance of students' mental well-being in elementary education cannot be overstated. Illustrated by the case of Qing Shui Road Primary School in Jiading District in Shanghai, the school places a strong emphasis on its students' mental well-being and happiness and sees it as the heart of elementary education. Through the collaborative efforts of all teachers at school, the school hopes students can freely and happily swim in the sea of knowledge as little dolphins, the school's mascot.

Qing Shui Road Primary School established a mentorship system, ensuring every student can receive individualized care, assistance, or guidance (Qing Shui Road Primary School, 2022). For each student, the mentorship system includes efforts and collaboration from a mentor, subject teachers, as well as parents. All teachers in the school participate in the mentorship system and receive regular training and workshops to enhance teachers' skills and competencies in providing mental guidance for students (ibid).

Along with the mentorship system, the school emphasizes home-and-school collaboration in enhancing students' mental development within and outside the school environment. Through various initiatives such as workshops and Parent–Child Growth Camp, the school aims to help parents better understand adolescent development and mental health related topics and issues (Qing Shui Road Primary School, 2018). Further, the school mentors offer professional and customized suggestions to parents to promote their children's mental well-being. This home-and-school collaboration has proven effective in facilitating students' mental well-being. For example, during the COVID-19 pandemic, mentors introduced engaging games to help students relax and strengthen child-parent relationships (Qing Shui Road Primary School, 2022).

Enhancing mental well-being is highly emphasized in elementary schools in China. The efforts taken by Qing Shui Road Primary School, such as providing individualized mental health care and guidance to both students and families, and incorporating engaging games, serves a notable case of the school's commitment to enhancing mental education in elementary schools in China.

## 2.5 Inspiring Stories

While the previous section describes practices at the elementary school level, this section shifts the focus to individual teachers and showcases their resilience and innovative spirit of educators in the pursuit of excellence.

### *2.5.1 Ye Haihui: Bringing Innovations to Physical Education Classes*

Ye Haihui is a physical education teacher at Yuhuan Kanmen Haidu Primary School in Zhejiang Province. Dedicated to physical education for 27 years, he has been well-known for bringing innovation to his classes—thus far, he has created more than 4200 pieces of sports equipment and obtained eight national patents (Jiang &

Lin, 2021). Such innovative practices not only boost students' interest in sports but also cultivate their creativity.

Ye entered education after retiring from military service. At that time, the school was in desperate need of sports equipment. To tackle this problem, Ye began inventing and building sports equipment on his own. He spent several nights making balls in different sizes from old newspapers—equivalent to ping pong balls, soccer balls, and basketballs in size, which were used as sports equipment and were surprisingly attractive to students (ibid). This further Ye's interest in inventing sports equipment utilizing unexpected materials. For example, he transformed a pressure cooker sealing ring into a frisbee and made skateboards using discarded school desks. Along with creating sports equipment, Ye is committed to innovating his pedagogical approaches to make class activities more interesting and engaging. For instance, he integrated the rock-paper-scissors game into a sports game and made it a full-body exercise.

With Ye's support and encouragement, his students also engaged in making their own innovative sports equipment, such as soft discus, handmade dumbbells, and paper volleyballs. He was so proud of his students, and to this day, he still treasures the sports equipment made by his students more than 10 years ago (ibid).

Ye's dedication to innovating physical education and building sports equipment boosts students' interest in sports and makes the sports activities interesting and engaging. Students cultivate hands-on skills and creative thinking skills while making sports equipment.

### *2.5.2 Li Qinglin: Boosting Students' All-Round Development and Education Equality*

Li Qinglin is the principal and a Chinese language art teacher at Qujing No.2 Primary School in Yunnan Province. Since working at the school for three decades since 1991, she has been dedicated to teaching and nurturing students in and outside of the standard curriculum in rural areas in China. Her life motto is "standing at the podium year after year through all seasons and weather to light up stars, guiding students in their growth and fulfilling my life-long commitment to education" (ibid).

First, Li has been dedicated to developing customized courses to facilitate students' holistic development through Chinese traditional culture. For instance, Li developed a customized course featuring Cuan-style Calligraphy, and later led a group of teachers to design more than 40 customized courses for the school, including Classics Reading, Chinese Guzheng, Chinese Printmaking, Dragon Dancing, Chinese Kungfu, and so on (Department of Teacher Education, 2023a). These diverse extracurricular courses not only broaden students' horizons but allow individual interests and creativity to freely unfold and flourish. Second, Li not only cares about students at her school but also aims to promote educational quality in rural areas. She established the Li Qinglin Outstanding Teacher Studio, which provides teachers in rural areas with open educational resources and opportunities to learn new educational theories and approaches (Zheng & Lin, 2023). So far, she has offered more than 100 open classes and delivered speeches nationwide. Further, serving as a leader of a national training program, Li and her team have provided rounds of training, which has benefited more than 1000 principals and teachers from rural areas in Yunnan Province (ibid).

Li enhances the individualized and all-round development of the students and stays committed to the principle of putting students first. She continually shares her teaching experience with teachers and principals from schools in rural areas, which has been boosting education equality in the broader region.

### 2.5.3 Lan Zhen: Dedicated to Improving Rural Education and Cultivating Rural Teachers

Lan Zhen is a Chinese language art teacher at the Zhangzhou Experimental Primary School in Fujian Province. Having taught for 35 years, from a junior teacher to a distinguished educator and team leader regardless of the role or position, Lan regards teaching and educating as her top priority. More specifically, beyond merely organizing activities to make the courses appear interesting, Lan emphasizes students' actual cognitive development and higher-order thinking. One of her colleagues shared that "whenever entering Lan's classroom, people would be expressed by the teacher's and students' enthusiasm, as well as the rich interactions among them. Through students' eyes, one could tell that these students have been so satisfied in pursuing knowledge with Lan" (ibid).

Besides pursuing educational excellence herself, Lan has also dedicated herself to promoting teacher professional development in rural areas. In 2013, she established Lan Zhen Teacher Studio dedicated to helping rural teachers improve their teaching skills (Department of Teacher Education, 2023b). Every year, Lan and her team provide training and teaching support for schools in remote areas. To date, Lan's studio has organized 16 sessions of the Rural Teachers' Training Program covering various subjects. Furthermore, they have visited rural elementary schools 106 times, observing demonstration classes, delivering lectures on curriculum reform, and providing on-site guidance for teaching, which has benefited thousands of teachers and countless students (Department of Teacher Education, 2023b).

Lan has made a great contribution to professional development for in-service teachers in rural areas, which has improved educational quality across regions and passed along on her love and passion for teaching to generations of educational practitioners.

## 2.6 Latest Research

This section offers a scholarly overview of elementary education in China from scholarly perspective. Academic articles published in Chinese in the past two decades are synthesized, to examine trends, major research focuses, and original contribution in the field.

### *2.6.1 An Overview of Research on Elementary Education in China*

Academic articles written in Chinese on elementary education and published in the past two decades (from 2004 to 2023) were searched in a major Chinese academic database—China National Knowledge Infrastructure (CNKI). The keywords used for this searching included elementary education (*xiaoxue jiaoyu* or *chudeng jiaoyu* or *xiaoxue*). To understand the relative importance of Chinese research focusing on elementary education based on the number of publications, we divided the number of publications focusing on elementary education by the number of publications discussing compulsory education, which includes education in both elementary and junior high schools. As presented in Fig. 2.19, there has been a general increase in the number of publications focusing on elementary education in the past two decades. Although there has been a downward trend since the peak in 2019, publications focusing on elementary education still occupy more than 80% of all of publications discussing compulsory education.

One reason that might explain the recent decrease in the number of Chinese publications focusing on elementary education might be Chinese researchers' spending more effort in communicating with the international community. As presented in

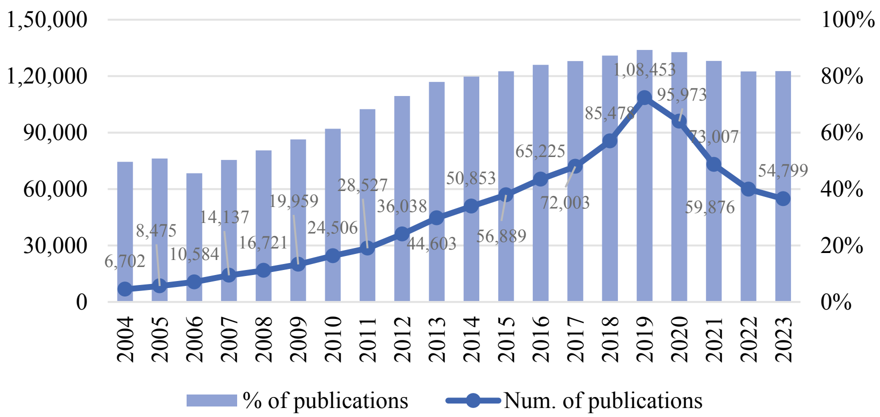


**Fig. 2.19** The amount of publications in Chinese on elementary education

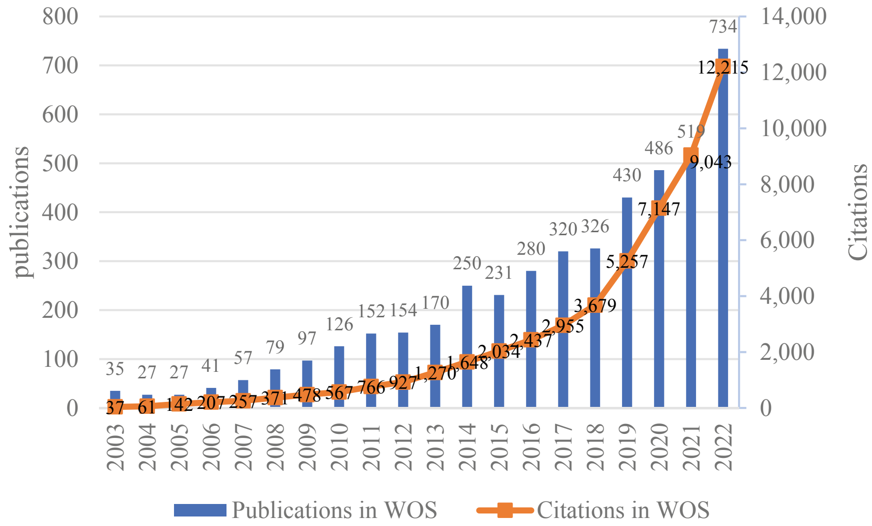


**Fig. 2.20** Number of publications in English focusing on Chinese elementary education

Fig. 2.20, academic articles written in English that focus on Chinese elementary education have been sharply increasing in the past 10 years regarding both the number of publications and the number of citations. The search for English articles was based on the Web of Science and selected publications containing Chinese elementary education in the topic or keywords.

### 2.6.2 *Research Focus and Originality*

Featured topics in Chinese educational research and practices focusing on the elementary education stage can be summarized into the following three: emphasizing the holistic development of students, promoting educational equity and justice across regions, and protecting individual differences and creativity. Each of these themes is elaborated in the sections below.

#### 2.6.2.1 Holistic Development (*Quanmian Fazhan*)

Elementary education in China emphasizes students' all-round development, which is grounded in everyday instructions in each subject domain. For instance, Li (2004) discussed a reading-and-writing integrated teaching mode, which treats reading as the foundation for writing and regards writing as an opportunity to promote reading. More recent research (Liu et al., 2023) discussed the possibility of incorporating AR technologies in reading instructions at elementary schools, which focuses not only on increasing students' reading comprehension and storytelling abilities, but also emphasizes their competence and self-regulation skills in reading. Focusing on math education in elementary schools, Su (2004) discussed that teachers should invite students to engage in observation, analysis, analogy, supposition, induction, generalization, and deduction, so as to promote the development of divergent thinking and critical thinking. In more recent research, educational researchers and policymakers have promoted the notion of core competencies (*hexin suyang*) in each subject domain. For teaching and learning in math, the core competencies focus on connecting content knowledge with everyday practices, bridging pieces of knowledge into comprehensive applications in explaining and solving real-world problems, which highlights the process of learning and problem solving as well as the cultivating of mathematical thinking (Li, 2023). In terms of English education, Lu (2021) emphasized the importance of real-life scenarios in helping students learn to use English in context and enhancing their awareness and competencies in cross-cultural communication.

One major feature of holistic education in elementary education in China is "Integrated Education", which refers to the integration of five education domains: moral, intellectual, athletic, aesthetic, and labor education (Zhu, 2003). Wang (2023) discussed that moral education enables students to apply knowledge appropriately; intellectual education is an essential intellectual guarantee for learning; athletic education provides the physical foundation for mastering knowledge; aesthetic education is the fundamental motivation to inspire students to learn; and labor education is an important avenue for students to practical knowledge and skills. Regarding specific instructional practices that actualize the integration of the five educational domains, there is a rich body of literature. For instance, Jia (2018) discusses a moral education approach based on tea culture. Liu (2021) proposed incorporating traditional dough sculpture in elementary school art education. Shi and Zhao (2022) integrated labor education and science education in elementary schools through STEM curriculums. Further, Zheng (2021) suggested that Integrated Education should be intentionally incorporated into instructions with thoughtful discussions among teachers' co-design of lesson plans.

Another major feature of all-round education is its future orientation, which focuses on cultivating students' competencies to become lifelong learners. For instance, Liu (2001) discussed the essential role of information and technology education in cultivating lifelong learners in elementary and secondary schools. Zheng (2014) reported a farewell curriculum designed for students prior to their elementary school graduation, which includes three components: experiencing life in middle school, graduation travel, and critical thinking on social issues. Xiao et al. (2021) developed an instrument assessing elementary students' competencies in STEM with particular emphasis on analyzing and solving problems with interdisciplinary knowledge, which is believed to be essential for students' learning in later school stages. Similarly, Yu et al. (2021) developed an evaluation framework for mid- and upper grade elementary school students, targeting their skills in searching and utilizing information via technologies.

Additionally, researchers have emphasized the importance of meeting students' needs and gaining competencies in physical exercises, laying a solid foundation for students' lifelong participation in sports (Peng & Liu, 2015), and enhancing psychological resilience and well-being (Yuan et al., 2022). To achieve these goals, Feng (2021) emphasized the critical influence of school culture in helping students form a lifelong affinity for sports. Further, Huang (2020) suggested turning elementary school students into "facilitators of sports and health" in their community to strengthen students' competencies and beliefs in living healthy lives. In sum, it has been well recognized that elementary schools play an essential role in building a solid foundation for future citizens to live healthy and happy lives by providing access, guidance, and support for students to engage in sports activities and shaping their beliefs in healthy lives.

#### 2.6.2.2 Promoting Educational Equity Between Schools and Regions

To address the issue of unequal distribution of education resources between "top-notch" schools and other schools in the same city, the *Enrollment Based on Local Residency* (*jiujin fenpei*) policy suggests that all students should be able to receive compulsory education services in the school district based on the place of residence of their household registration regardless of the students' academic abilities or their family background. This policy represents the interests of the vast majority as it could facilitate the integration of the educational resources across social classes (Huang, 2016; Zheng & Wang, 2014). However, Shao (2019) discussed two essential aspects of implementing the nearby enrollment policy to provide high-quality education for all students: one is the collaboration between public and private education institutions, and another is evidence-based admission policy and procedure with support from information technology. Further, to address educational inequality within schools, tracking has been discouraged or forbidden in more and more cities. Instead, Zhang (2021) proposed an "ecologically balanced" approach to increase diversity within classrooms, which includes factors such as students' interests and specialization and family background and parenting styles.

The unequal allocation of educational resources throughout China has long been acknowledged, with rural and Middle and Western regions facing a more pronounced scarcity compared to their economically affluent counterparts. A key factor contributing to this scarcity is the lack of high-quality teachers. To address this challenge the *National Training Plan for Elementary and Secondary School Teachers* (or the *National Training Plan*) put forward by the Chinese government is aimed to promote professional development for in-service teachers in regions of need. Researchers discuss that, through top-down designs and evidence-based teacher education, this plan significantly improves teachers' competencies in instruction, facilitates professional development, and promotes nationwide public welfare (Cui et al., 2019; Zhu, 2010). On the other hand, the *Special-Post Teacher Recruitment Program* (or the *Special-Post Program*) jointly launched by MOE and three other departments aims to increase teacher quality in regions in need from the start, by recruiting high-quality college graduates to serve elementary and middle schools in rural and the Middle and Western Parts of China. It is believed that this program updates the staffing structure in rural areas (An & Ding, 2014) and creates new employment options for college students, which helps alleviate their job-searching anxiety and offers opportunities to make a difference (Shi, 2006).

In addition to the above national plans, researchers have discussed other approaches to promoting educational equity across regions. For instance, Chen et al. (2019) discussed training all-subject teachers in rural schools, who would not only be content experts across subject domains but should deeply believe in education to shape the future, even for children growing up in unfavorable conditions. Shi (2011) discussed a teacher exchange program, which allows the mobility of educational resources as urban teachers serve as volunteers in rural schools in turn. Sheng and Zhang (2021) discussed building Hope schools, a charity endeavor in supporting education in remote areas, with a joint effort between the schools and the local communities.

Besides improving teacher quality, financial support has been provided to rural students from impoverished families during compulsory education. For instance, the "Two Exemptions and One Subsidy" policy is a national policy, which provides rural students with free textbooks, exempts them from miscellaneous fees, and subsidizes certain living expenses for them. Researchers have discussed that the policy has diminished economic obstacles for numerous students in need, accelerated the popularization of free compulsory education in rural regions, and has made a significant achievement in reducing poverty, which optimizes the configuration of education resources and supports the nation in realizing sustainable economic and social growth (Li, 2008; Nong, 2015).

#### 2.6.2.3 Supporting Autonomy and Creativity

Elementary education in China values students' autonomy in learning and creative thinking. Taking research focusing on language art in elementary schools as an example, on the one hand, significant individual differences in the accuracy and fluency in reading comprehension have been evidenced, and such individual differences have been shown to increase as students moved from grade one to grade three (Zhang et al., 2022). On the other hand, researchers suggest that reading and writing are processes of individualized learning and creating, where personalized observations and unique perspectives would be valued, rather than being trimmed based on certain obsolete answers for the sake of standardized testing (Cao, 2009). Thus, Du (2021) highlighted the importance for educators to observe students' individualized reading experiences and support students' autonomy in reading. Specifically, Ge (2022) proposed a form of writing workshops, where students engage in topic selection, brainstorming, writing, and revision. During the process, students and teachers can discuss as partners with equal status, and conversations among peers are encouraged to engage and inspire students in creative writing.

Similarly, autonomy and individual differences are highly valued in instruction in other subject domains. In the context of math education, Meng (2019) discussed customizing the learning environment, learning content, and learning strategies for elementary school students. In arts education, Yu (2016) discussed the importance and values of students' unique expressions in instructional moves, such as appreciation, creation, and evaluation. Further, Li (2020) advocated the project-based learning approach for school-based curriculums, where students are allowed to customize their learning by engaging in in-depth discussions with teachers and collaborations with peers. Even for homework assignments, Peng (2014) recommended that teachers and students should be partners in co-designing assignments to meet individualized instructional goals, which is specified by Lin (2021) as a hierarchy of homework—basic homework, extended homework, and innovative homework.

Creativity has been highly valued in elementary education in China. Ren and Qi (2020) discussed an instructional pattern that could facilitate innovative thinking, which is divided into five instructional moves including induction, creation, design, realization, and summary. Qiu (2021) emphasized the essential role of collaborative learning in cultivating spirit and competencies in creativity, where students collaborate with peers in exploring novel ideas driven by issues grounded in practice. From the assessment perspective, Liu and Mencius (2011) developed a creativity assessment scale for elementary and secondary school students, which includes three dimensions: creative personality, sense of creativity, and creative thinking. Feng (2017) created a scale assessing creative problem-solving skills for elementary school students based on the information processing theory, which includes identifying problems, processing information, and analyzing and solving problems.

## 2.7 National Policies

This section provides a summary of fundamental Chinese educational policies pertaining to contemporary elementary education. The themes of these policies mainly concentrate on teacher ethics and professional development, and all-round development of students. In alignment with these foundational policies, educational policies in elementary education have been primarily focusing on alleviating students' burdens since 2021.

### *2.7.1 Fundamental Policies on Elementary Education in China*

Fundamental educational policies regulating elementary education in China can be grouped into two major categories. One focuses on teacher professional development and the other focuses on student all-round development.

#### 2.7.1.1 Teacher Ethics and Professional Development

*Professional Ethics for Elementary and Secondary School Teachers* (MOE, 2008) emphasizes Chinese traditions of teachers' ethics and reflects the increasing demands from society regarding the professional development of teachers in elementary and secondary schools. The document defines teacher professional ethics from the following six aspects: patriotic and law-abiding, devoted to work, caring for students, delivering knowledge and cultivating spirit, being exemplars for students, and life-long learning. The document is a guideline for educational practices and has served as a criteria for evaluating teachers' interactions with students, schools, and society. Below is a clause from the document, as well as that from two subsequent policies.

> Elementary and secondary schools should prioritize teacher ethics development, which needs to be incorporated into the whole process of teacher professional development and evaluation.
>
> —*Guidelines on Building the Long-term Mechanism of Teacher Morality Construction in Elementary and Secondary Schools* (MOE, 2013).
>
> Training programs for in-service teachers of elementary and secondary schools should address the needs of the nation and the requirements of the society of the times. The design of teacher training programs should take related theories and practices at home and abroad as references, which is encouraged to include the following four modules: ideal and faith, moral sentiments, solid content knowledge, and love and benevolences.
>
> —*Guiding Standards for Elementary and Secondary School Teacher Training Curriculum (Teacher Morality)* (MOE, 2020a).

#### 2.7.1.2 Student All-Round Development

There have been several national policies dedicated to promoting all-round education in the stage of elementary and secondary education. It has been well recognized that students' learning outcomes should be evaluated beyond testing scores and also include a focus on merit, creativity, and all-round development (MOE, 2008). As shown in the clauses below, these policies cover domains such as art, physical exercise, and moral development:

> The evaluation of students' learning outcomes in art education should adhere to theories and science in education and child development. It should simultaneously consider students' learning in the art classroom and their experiences in artistic practices, should highlight students' learning achievements as well as their learning attitudes, and should keep a balance between designing basic requirements for all students and encouraging specialized students based on their interests and strength.
>
> —Methods for Evaluating the Artistic Quality of Elementary and Secondary School Students (MOE, 2015).
>
> P.E. should reflect the notion of educational equity. The government and schools should ensure every elementary school student's right to receive physical education. Facing the reality of imbalanced development across regions and between rural and urban areas, *the Standard* regulates physical equipment and facilities in elementary schools by clarifying two categories of requirements: basic and optional. The basic requirements are compulsory regulations for all elementary schools, and the optional requirements allow autonomy and serve as goals for schools.

– Equipping Standard of Equipment and Facilities for Physical Training in Elementary Schools (MOE, 2020b).

Labor education should be incorporated in elementary school through college. In lower grades in elementary schools, labor education should be grounded in children's personal living needs. With safety awareness embedded throughout, the goal of labor education at this stage is to help children understand that everyone needs to work in society and to provide opportunities for them to enjoy working and cherish fruitful results.

—Guidelines on Labor Education for Elementary, Secondary, and Higher Education (Trial) (MOE, 2020c).

Moral education plays a big role in elementary and secondary education. In middle and upper grades in elementary school, students should be offered opportunities to understand the culture, history, and development of their hometown as well as the country. Based on stories in daily life and those shining through Chinese culture and history, students gain a sense of social norms, develop merits, and enhance their love for the country and people.

—*Guide to Moral Education for Elementary and Secondary* Schools (MOE, 2017).

### *2.7.2 Current Policy Highlights*

In recent years, a significant effort in elementary education in China has been spent on easing students' excessive burdens, which is driven by the *Guidelines on Further Easing the Burdens of Excessive Homework and Off-Campus Tutoring for Students Undergoing Compulsory Education* (The State Council, 2021). The document is released in the social context where the on-campus formal education seems to be overshadowed by extensive off-campus tutoring institutions during the stage of compulsory education, which has created a significant mental and financial burden to students and their families. To bring students back to campus, the document indicates that, besides regulating off-campus tutoring practices, it is critical to improve the quality of teaching and other educational services offered on campus. The document provides specific guidance to schools, such as designing homework assignments based on scientific evidence and reducing the amount of time students need to spend on homework as much as possible, implementing after-school services to address students' diverse needs, and optimizing educational administration practices to better supports students and teachers. Below are quoted clauses and a follow-up policy.

Standards regarding the total amount of homework across subject domains in each educational stage need to be established. For elementary school students in the first and second grades, they should not be given any written assignments that have to be finished at home, although they may take a certain amount of exercises in school to reinforce what they have learned. For third to sixth graders, their written assignments should not take more than 60 min on average, and that for middle school students should be kept under 90 min.

—Guidelines on Further Easing the Burdens of Excessive Homework and Off-Campus Tutoring for Students Undergoing Compulsory Education (The State Council, 2021).

Examinations in written formats are not allowed in the first and second grades. For other grades in compulsory education, schools can hold examinations once at the end of each semester. Middle schools may add a mid-term exam based on the practical needs of certain subjects. Regional or cross-school examinations are forbidden throughout compulsory education, except for students in the graduating grade in middle school.

—Notice on Strengthening the Management of Examinations in Compulsory Education Schools (MOE, 2021).

## 2.8 Summary

Elementary education is the beginning of formal education and the starting point of compulsory education in China, which serves as the foundation for individuals' lifelong development and the sustainable development of the country. Thus, receiving elementary education is both a right and an obligation of every citizen in China.

Nationwide, the number of students and teachers in elementary education in China ranks top in the world. With strong support from the government and great efforts from all educational practitioners, the advancement of public elementary schools is ensured. This is evidenced by the comparable government expenditure on elementary education as a percentage of GDP in most developed countries, the guarantee of fine infrastructure and teachers' qualifications, the high student survival rate to Grade 4, and the low student repetition rate. Further, the proposed excellence index, consisting of comprehensive excellence indicators that are public available and comparable, shows that China has already attained top-tier status globally in terms of educational excellence in the stage of elementary education. The distinction is notably evident in indicators, such as total government expenditure on elementary education, student survival rate to Grade 4, and student social-emotional skills.

Nonetheless, elementary education in China still falls behind developed countries in a few aspects, particularly in terms of the expenditure on education per student and student completion rate. Although the expenditure on education per student in China has grown in recent years, it is still not comparable with developed countries, which could be explained by the huge population and significant diversity within the country. Regarding the completion rate, although it has been as high as 98%, it ranked low when compared to other major countries, which might again relate to the high scale of student enrollment and the extremely low repetition rate (0.01%).

In addition to comparisons based on statistics, this chapter also qualitatively demonstrates the philosophy and characteristics of elementary education in China through featured teaching practices, contemporary educational research, and critical educational policies. First, morality could not be emphasized enough in Chinese education, which not only refers to cultivating students' virtue but also highlights teachers' professional ethics. Second, students' all-round development and well-being are the ultimate goals of elementary education in China. Beyond content knowledge in certain subject domains, emphases have been drawn on students' physical and mental health, interdisciplinary ability, creative thinking, and competencies in applying knowledge in solving real-life problems. Third, policies, practices, and research have been going hand-in-hand in elementary education in China. With the evidence provided by educational research, educational policies have been providing guidance and serving as the safeguard for educational practices, such as reducing student burden, promoting all-round development, and addressing the issue of educational equity.

In summary, elementary education in China has been offering a solid and comprehensive foundation for individuals in their early stages of lifelong development. Elementary education in China has been and will further improve its capacity in fulfilling its mission helping students gain competencies and prepare for the further.

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# Chapter 3
# Secondary Education (Middle School) in China

**Ma Yue**

**Abstract** Compulsory education in China refers to the mandatory, free, and universal education that all school-age children and teenagers receive, which includes 6-years of elementary school and 3-years of junior secondary school (middle school). Nine-years of compulsory education in China is of great significance because it is closely associated with the healthy growth of hundreds of millions of children, the development of the country, and the future of the nation. This chapter focuses on the latter stage of compulsory education in China, namely the 3 years of junior secondary education (middle school), and presents the educational landscape by including both quantitative and qualitative information. This chapter first provides an introduction to compulsory education and junior secondary education in China; then it highlights important education data of China in an international context. The third section presents representative indicators to reflect the excellence level of junior secondary education in China and the world. The next two sections share best practices in the development of junior secondary education and inspiring stories of educators in this sector. It then reviews the latest literature and research focus on the field of junior secondary education. Lastly, the chapter outlines key policy documents on developing junior secondary education. The Chinese government has been striving to facilitate the well and balanced development of junior secondary education. Significant progress has been made over the years, yet aspects that should be improved and strengthened are also discussed.

**Keywords** Junior secondary education · Well-rounded education (*Suzhi* education) · Core competencies

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## 3.1 Introduction

### *3.1.1 Compulsory Education in China*

Since the founding of the People's Republic of China (PRC) in 1949, a low literacy rate has plagued the country. According to statistics, over 80% of the population in China was illiterate in 1949, with illiteracy rates in rural areas exceeding 95% (Cheng, 2010). To battle illiteracy, the Chinese government launched several rounds of adult literacy campaigns and proposed various initiatives over the years, including the issuing of the *Compulsory Education Law of the People's Republic of China* in 1986. According to the law, children who reach 6 years old should be enrolled in elementary schools, and in areas where conditions are not available, the age for children to enter elementary schools could be postponed to the age of seven. Moreover, in places where junior secondary education is universalized, all elementary school graduates should enter nearby middle schools without taking entrance examinations (National People's Congress, 1986).

Since the implementation of the *Compulsory Education Law*, significant progress has been made in terms of increasing literacy levels in China. In 2001, Chinese government declared that the country had basically succeeded in promoting 9-year compulsory education and eradicating illiteracy in most areas of the country (Zhai et al., 2012). In 2011, the Chinese government announced universal access to the compulsory education system (*ibid*). In 2018, the 9-year compulsory education graduation rate of China reached 94.2%, and there was a total of 213,800 elementary and secondary schools with 149.9 million students (Chu, 2019).

China has achieved one of the highest literacy rates in the world, which is an even greater achievement given that the country's elementary school enrollment rate was only about 25% in 1949 (*ibid*). More importantly, children in China enjoy greater opportunities to enter school and have more equal access to a quality education. In the modern era, China continues to improve the quality of compulsory education in a more balanced way. In 2021, the Chinese government launched an initiative to promote the high-quality and well-balanced development of compulsory education at the county level (Xinhua, 2021a). According to a directive *Notice on Promoting Quality and Balanced Development of Compulsory Education at County Level* issued by the Ministry of Education (MOE) of China, the initiative will be spearheaded by several county-level areas in each provincial-level region in the next 3 to 5 years-before being implemented nationwide (MOE, 2021a). Under the initiative, relevant mechanisms are being developed and improved to allow schools greater autonomy and to help stimulate school vitality in their daily operations. Measures are being rolled out to promote the balanced distribution of education resources, and policies are being devised to enhance the education and care of children who do not live with their parents, students with disabilities, students from ethnic minority areas, and other groups of special need. By 2035, the goal of achieving a high-quality and well-balanced compulsory education is expected to be fully completed.

### *3.1.2 Junior Secondary Education (Middle School) in China*

As part of compulsory education, junior secondary education (middle school) helps ensure the transition from elementary school to senior secondary school is smooth, strong, and consistent for all students, which plays an important role for the healthy development of children, for social progress, as well as for the future of the nation. According to *Educational Statistics Yearbook of China 2021*, the total number of junior secondary schools in China reached 52,871 in 2021. The total number of entrants to junior secondary schools reached 17,054,376, which increased by 4.49% compared to that of the previous year; and the total number graduates of junior secondary school students in 2021 was 15,871,485, which increased by 3.38% compared to that of the previous year (MOE, 2022a, 2022b).

Junior secondary education in China typically lasts for 3 years consisting of the seventh through ninth grades. Students of the same grade are divided into different classes. The number of students in each class varies according to the enrollment of a particular year, typically ranging from fewer than 25 students to more than 66 students with the mode between 46 and 55 students (MOE, 2021b). According to statistics, among the total 1,098,900 junior secondary classes in 2021, oversized class (with student number exceeding 66) accounted for 0.01% ($n$ = 106), which decreased by 0.01% compared to that of the year of 2020 (MOE, 2022a, 2022b). In junior secondary schools, students are required to learn a variety of liberal arts and science subject courses, such as Chinese language arts, mathematics, a foreign language (i.e., English, Japanese), physics, chemistry, biology, politics, history, geography, as well as physical education (P.E.), music, and art. The national prescribed curriculum is supposed to be an extension of that of the elementary school both in depth and size, and thus students are expected to have deeper and better understanding of the course materials. At the end of junior secondary education, students are required to take graduation tests for all the subjects, and those who pass receive a graduation certificate and are eligible to take the High School Entrance Examination (*Zhongkao*). The High School Entrance Examination is an important local unified examination, which usually takes place annually at the end of June. Student performance on this examination serves as the main admission criteria for senior secondary schools. According to statistics, the promotion rate from junior senior secondary schools to senior secondary schools has been increasing from 40.60% in 1990 to 98.42% in 2022 (MOE, 2022a, 2022b).

In addition to regular subject courses, students in junior secondary schools also participate in a variety of school-based extracurricular activities (i.e., sports teams, dance clubs), particularly in the context of the “Double Reduction” policy that aims to reduce student academic burden, improve student mental health, and lower family spending on after-school tutoring. By the end of October, 2021, it is estimated that 99% of the 143 thousand elementary and middle schools have provided after-school services, 92.7% for physical and art-related activities, 88.3% for reading activities, and 87.3% for science-related or interest clubs (Ding, 2022). Students can choose activities based on their interests. The intent of providing such diverse extracurricular activities is to help students expand their knowledge and widen their vision so that they can be better prepared for the ever-changing world.

Junior secondary school students are also required to engage in service such as general cleaning. Students take turns cleaning their classrooms and the playgrounds once a day in a group. Cleaning requirements are intended to cultivate a sense of personal responsibility and a strong work ethic. Moreover, the *Course Standard of Labor Education of Compulsory Education* published in 2022 also requires students to participate in such activities as cleaning, family cooking, and ceramics (MOE, 2022a, 2022b).

## 3.2 Highlighting Data

This section aims to highlight important data on junior secondary education of China in an international context. To be more specific, eleven relevant variables were selected from open databases including the Program for International Student Assessment (PISA) and the Teaching and Learning International Survey (TALIS). For comparison purposes, results for seven developed countries, i.e., the United States (U.S.), Germany, France, the United Kingdom (U.K.), Japan, the Republic of Korea (ROK), the Netherlands, are presented in parallel.

It is worth noting that the target population of the PISA assessment is 15-year-old students, and only selected provinces and/or cities in China (i.e., Beijing, Shanghai, Jiangsu, Zhejiang) have participated in the assessment. Similarly, only teachers sampled from Shanghai participated in the TALIS assessment. Thus, the following analysis provides only partial insights, and can be only generalized to and represent junior secondary education in the relatively developed regions in China.

### *3.2.1 Learning Time Per Week in Total*

Student learning time has been linked to school academic pressure. The total learning time of students per week (minutes) is retrieved from the PISA 2018 dataset. The results are presented in Fig. 3.1.

As seen in Fig. 3.1, student total learning time per week ranges from 1592.07 to 1880.40 min among the eight countries. Students in China tend to have the longest learning time, followed by the U.S., ROK, Japan, France, the Netherlands, the U.K., and students in Germany report the shortest learning time per week.

Moreover, it seems that the learning time of students in the Asian countries (i.e., China, ROK, Japan) is much longer than that of students in the Western countries (i.e., Germany, the U.K., the Netherlands, France), which may relate to the different education systems between the countries.

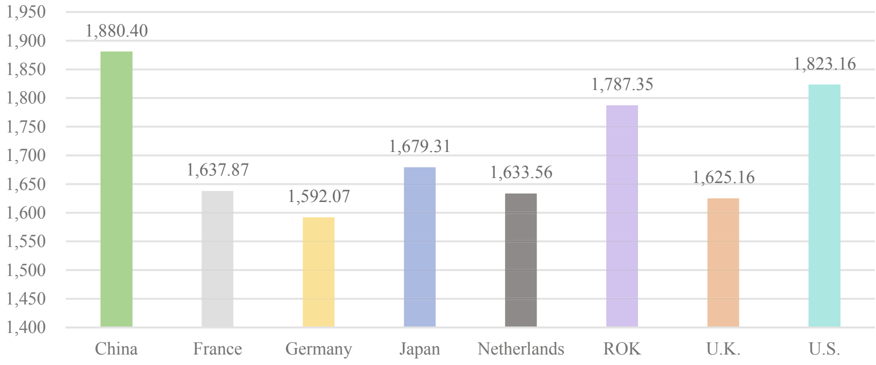


**Fig. 3.1** Learning time per week in total (minutes). *Source* Adapted from OECD (2019a)

### *3.2.2 Economic, Social, and Cultural Status*

Economic, Social, and Cultural Status (ESCS) is one of the most important predictors of student learning outcomes (Ma, 2021). The PISA 2018 index of ESCS is derived from three variables associated with family background: "parents' highest occupational status", "parents' highest level of education", and "home possessions" (OECD, 2019a). The ESCS scores are transformed to a scale with a mean of zero and a standard deviation of one in PISA 2018. A score above zero means that the socioeconomic status of students in the specific country is higher than the average of the OECD countries, while a score below zero means that the socioeconomic status of students in the specific country is lower than the average of the OECD countries. The results of student ESCS scores are presented in Fig. 3.2.

As seen in Fig. 3.2, the average ESCS of students shows different levels across the eight countries. Specifically, the ESCS score of Chinese students is the lowest

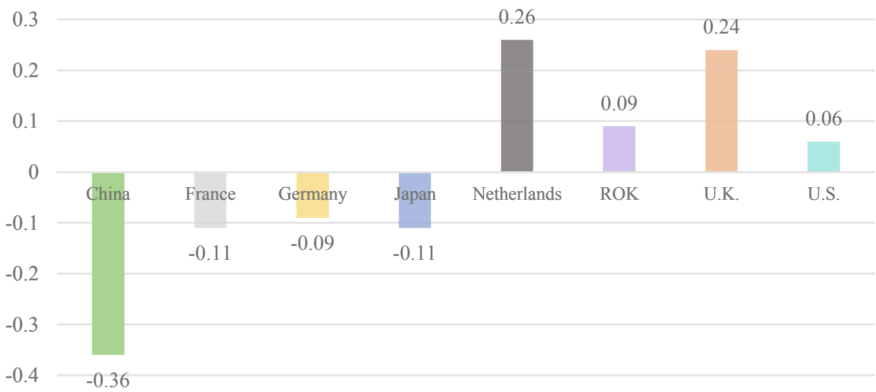


**Fig. 3.2** Student economic, social, and cultural status (ESCS). *Source* Adapted from OECD (2019a)

(index score is −0.36), followed by France, Japan, Germany, the U.S., ROK, and the U.K., and students in the Netherlands have the highest ESCS level. The results reflect that China is still categorized as a developing country with the largest student population in the world, while the others are developed countries.

### 3.2.3 Academic Literacy

In PISA 2018, 15-year-old student academic literacy in math, reading and science are measured and recorded. Specifically, "mathematical literacy" in PISA 2018 refers to an individual's capacity to "formulate, employ, and interpret math in a variety of contexts" (OECD, 2019a). It includes "reasoning mathematically, and using mathematical concepts, procedures, facts, and tools to describe, explain and predict phenomena" (*ibid*). It assists individuals to recognize the role that math plays in the world and to make the well-founded judgements and decisions needed by constructive, engaged, and reflective citizens. Reading literacy in PISA 2018 refers to the ability to "understand and use those written language forms required by society and/or valued by the individual" (*ibid*). Readers can construct meaning from texts in a variety of forms. They read to learn, to participate in communities of readers in school and everyday life, and for enjoyment. Scientific literacy in PISA 2018 assesses students' content, procedural and epistemic knowledge, as well as scientific competencies to "explain phenomena scientifically, evaluate and design scientific inquiry, interpret data and evidence scientifically" (*ibid*). The results for mathematical, reading, and scientific literacy are presented in Figs. 3.3, 3.4 and 3.5, respectively.

As seen in figures above, Chinese students consistently rank first among the countries in all of the three subjects. Moreover, it seems that students in Asian countries (i.e., ROK, Japan) perform better than their counterparts in the Western countries (i.e., the U.S., Germany, France, the U.K., the Netherlands).

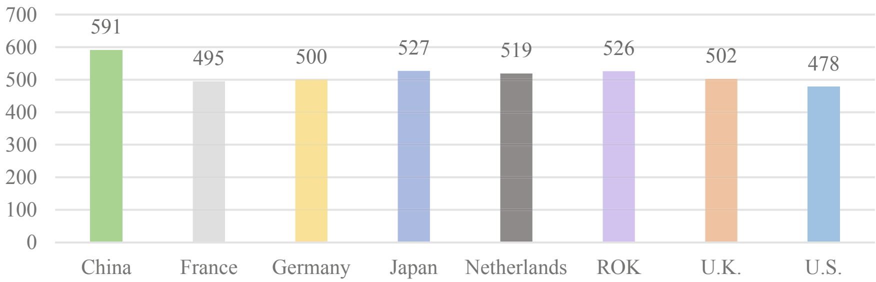


**Fig. 3.3** Mathematical literacy by country. *Source* Adapted from OECD (2019a)

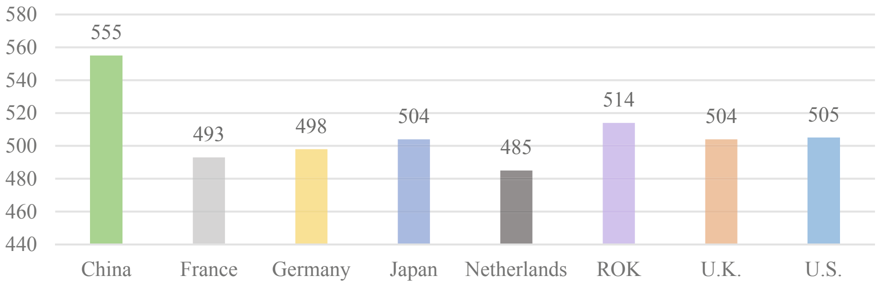


**Fig. 3.4** Reading literacy by country. *Source* Adapted from OECD (2019a)

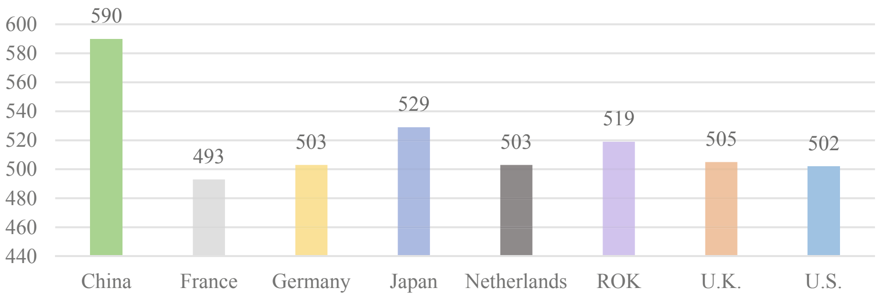


**Fig. 3.5** Scientific literacy by country. *Source* Adapted from OECD (2019a)

### *3.2.4 Fear of Failure*

In PISA 2018, students are asked to report the extent to which they agree with the following statements: "When I am failing, I worry about what others think of me"; "When I am failing, I am afraid that I might not have enough talent"; and "When I am failing, this makes me doubt my plans for the future". These statements are combined to create the index of fear of failure.

Positive values in this index mean that the student expresses a greater fear of failure than did the average student across the OECD countries. Negative values in this index mean that the student expresses a lower level of fear of failure than the average student across the OECD countries. The results are presented in Fig. 3.6.

As seen in Fig. 3.6, the fear of failure of Chinese students are at an average level compared with that of students in other countries. Students from Japan, the U.K., ROK, and the U.S. tend to have higher levels of fear of failure, while students in Germany and the Netherlands tend to have lower levels of fear of failure. The results might occur due to a variety of reasons such as student past success or failure experiences and school teachers' guidance for students to face failures.

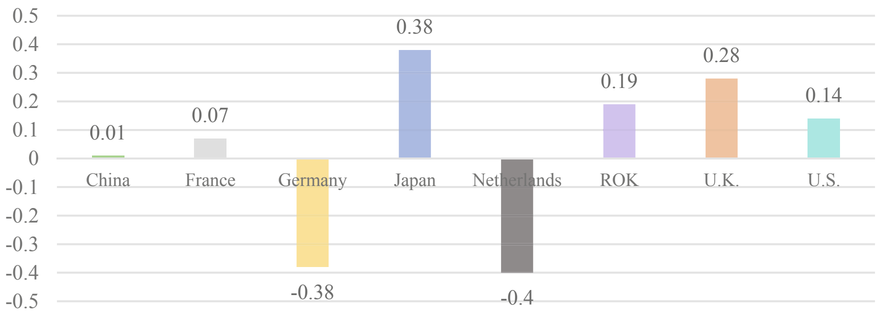


**Fig. 3.6** Fear of failure. *Source* Adapted from OECD (2019a)

### *3.2.5 Eudaemonia: Meaning in Life*

Perceived meaning in life reflects student attitudes toward life. In PISA 2018, students are asked to report the extent to which they agree with the following statements: "My life has clear meaning or purpose"; "I have discovered a satisfactory meaning in life"; and "I have a clear sense of what gives meaning to my life". These statements are combined to form the index of meaning in life.

Positive values in the index indicate greater meaning in life than the average student across the OECD countries. Negative values in this index indicate lower meaning in life than the average student across the OECD countries. The results are presented in Fig. 3.7.

As seen in Fig. 3.7, the level of Chinese students' perceived meaning in life is similar with that of students in the U.S., Germany, France, and ROK. However, students in the U.K., Japan and the Netherlands tend to have lower levels of perceived meaning in life.

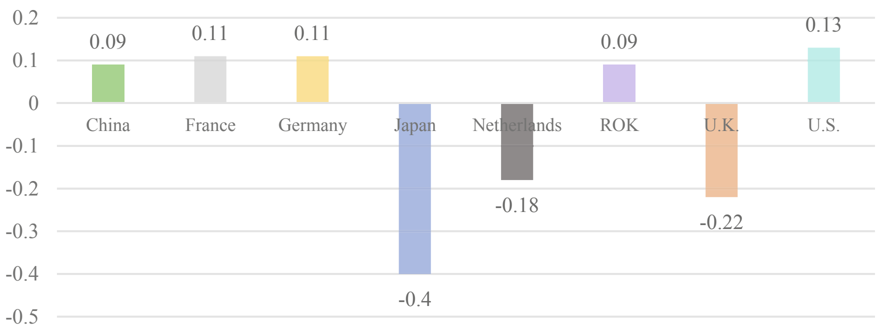


**Fig. 3.7** Eudaemonia: meaning in life. *Source* Adapted from OECD (2019a)

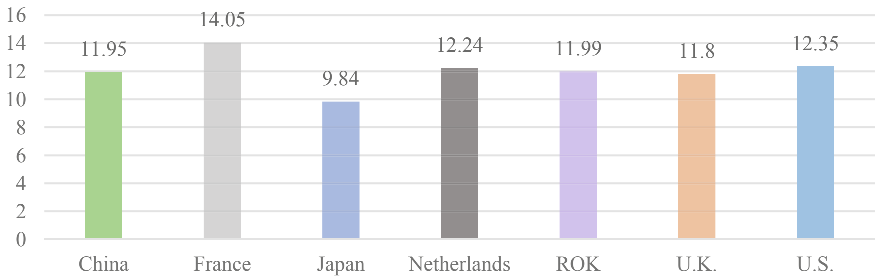


**Fig. 3.8** Professional development. *Source* Adapted from OECD (2019b). *Note* Germany data is not available

### *3.2.6 Professional Development*

Professional development refers to the various activities (i.e., courses/workshops, education conferences, qualification program, observation visits to other schools, mentoring) that can help develop an individual's knowledge and skills, as well as other characteristics as a teacher. In TALIS 2018, teachers from different regions or countries were asked to evaluate how effective they perceive the professional development they have participated in. The results are presented in Fig. 3.8.

As seen in Fig. 3.8, the scores of perceived effective professional development ranges from 9.84 points to 14.05 points across the countries. Teachers in China tend to report a relatively lower level of effective professional development (= 11.95 points) compared to those from the U.S., France, ROK, and the Netherlands, while it is higher than that from teachers from the U.K. and Japan.

### *3.2.7 Teacher Self-efficacy*

TALIS 2018 elicits teachers' self-efficacy beliefs by asking them to assess their ability to perform well in a range of tasks related to classroom management, instruction, and student engagement. The results are presented in Fig. 3.9.

As seen in Fig. 3.9, the teacher reported self-efficacy are at similar levels across the countries, ranging from 12.62 points to 12.83 points. In particular, teachers from the U.S. tend to have the highest level of self-efficacy, followed by ROK, China, France, the U.K., Japan, and teachers from the Netherlands tend to report the lowest self-efficacy.

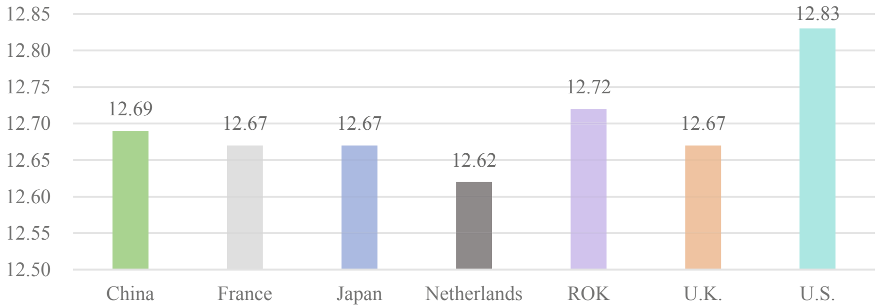


**Fig. 3.9** Teacher self-efficacy. *Source* Adapted from OECD (2019b). *Note* Germany data is not available

### *3.2.8 Teacher Workload Stress*

In TALIS 2018, teachers from different regions or countries were asked to report the extent to which they had experienced stress at work. This may reflect education pressure from the perspective of teachers. The results are presented in Fig. 3.10.

As seen in Fig. 3.10, teachers in Shanghai of China report lower levels of workload stress than that of teachers in other countries except for France. Teachers in ROK report the highest level of workload stress, followed by the Netherlands, the U.K. (England), Japan, the U.S., China (Shanghai), and then France. In general, it seems that the workload stress of teachers in the Asian countries (i.e., ROK, Japan) is higher than that of teachers from the Western countries (i.e., France, the U.S.).

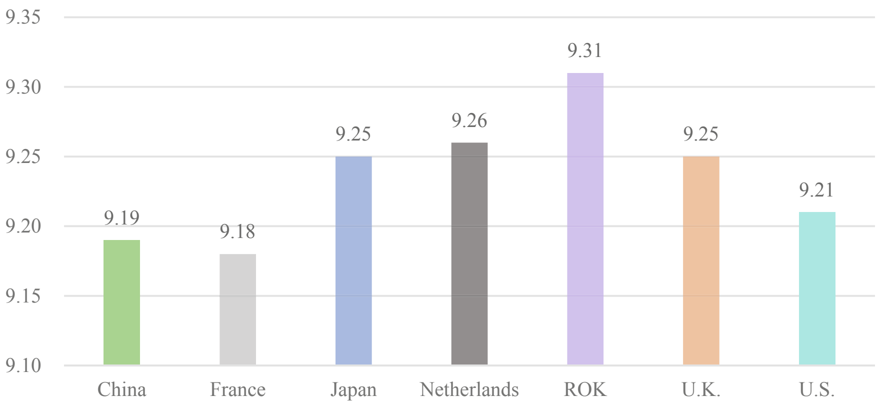


**Fig. 3.10** Teacher workload stress. *Source* Adapted from OECD (2019b). *Note* Germany data is not available

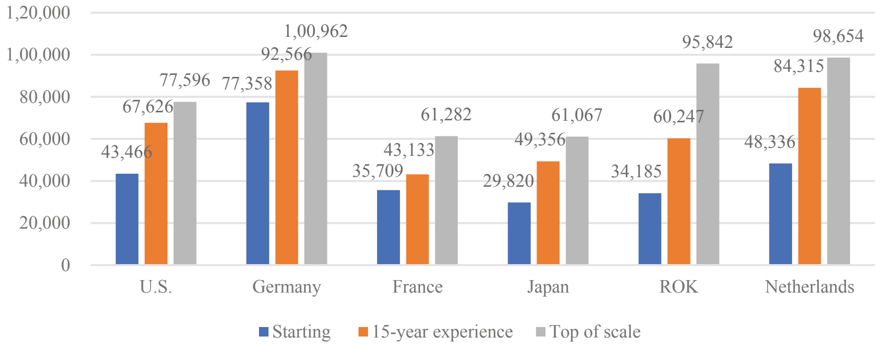


**Fig. 3.11** Teachers' salaries (in USD). *Source* Adapted from OECD (2019b). *Note* China and the UK data are not available

### 3.2.9 Teachers' Salaries

In *Education at a Glance 2021*, junior secondary school teachers of different levels (i.e., starting, 15 years' experience, top of scale) were asked to report their working salaries. The results are presented in Fig. 3.11 (in US dollars).

As seen in Fig. 3.11, starting teachers in Germany report the highest level of salaries, followed by the Netherlands, the U.S., ROK, France, and Japan. For teachers with 15 years of experience, those in Germany report the highest level of salaries, followed by the Netherlands, U.S., ROK, Japan, and France. For top-of-scale teachers, those in Germany report the highest level of salaries, followed by the Netherlands, ROK, U.S., France, and Japan.

### 3.2.10 Shortage of Educational Materials

PISA 2018 measures school resources by asking school principals' perceptions of potential factors hindering instruction at school ("Is your school's capacity to provide instruction hindered by any of the following issues?"). An index of shortage of educational staff is derived from the following indicators: "a lack of educational material", and "inadequate or poorly quality educational material", "a lack of physical infrastructure", and "inadequate or poorly quality physical infrastructure" (OECD, 2019a).

Positive values in this index mean that principals view the amount and/or quality of educational material in their schools as an obstacle to providing instruction to a greater extent than the average across the OECD countries. Negative values in this index mean that principals view the amount and/or quality of educational material in their schools as an obstacle to providing instruction to a lesser extent than the average across the OECD countries. The results are presented in Fig. 3.12.

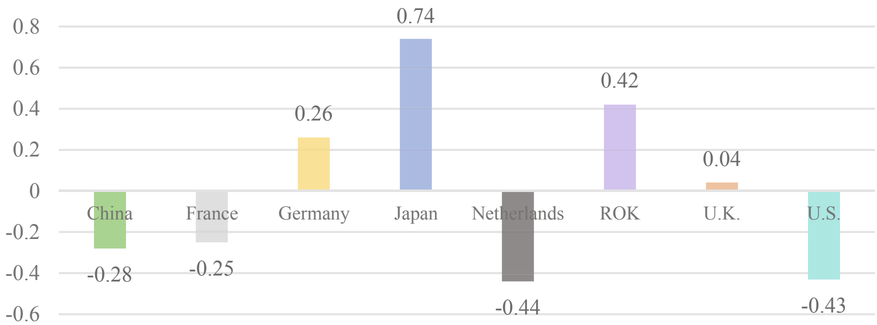


**Fig. 3.12** Shortage of educational materials. *Source* Adapted from OECD (2019a)

As seen in Fig. 3.12, principals in China report a lower level of shortage of educational materials than the average of OECD countries (<0). Also, the value tends to be lower than that of Japan, ROK, Germany, the U.K., and France, while higher than that of the U.S. and the Netherlands.

### *3.2.11 Shortage of Educational Staff*

Like the shortage of educational materials, PISA 2018 also measures the shortage of school personnel resources. An index of shortage of educational staff was derived from the following four indicators: “a lack of teaching staff”, “inadequate or poorly qualified teaching staff”, “a lack of assisting staff”, and “inadequate or poorly qualified assisting staff” (OECD, 2019a).

Positive values in this index mean that principals view the amount and/or quality of the human resources in their schools as an obstacle to providing instruction to a greater extent than the average across the OECD countries. Negative values in this index mean that principals view the amount and/or quality of the human resources in their schools as an obstacle to providing instruction to a lesser extent than the average across the OECD countries. The results are presented in Fig. 3.13.

As seen in Fig. 3.13, principals in China report a higher level of shortage of educational staff than the average of OECD countries (>0). Also, the value tends to be lower than that of Japan, while higher than that of Germany, ROK, France, the Netherlands, the U.K., and the U.S.

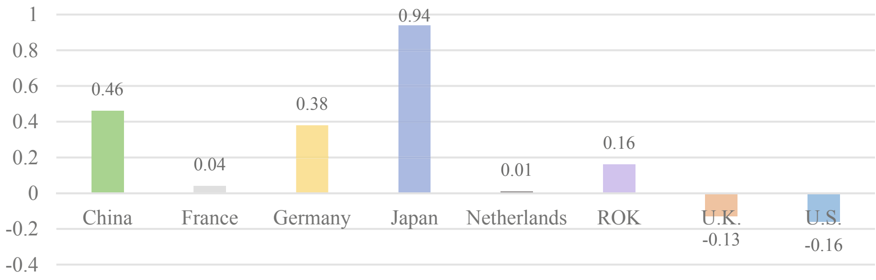


**Fig. 3.13** Shortage of educational staff. *Source* Adapted from OECD (2019a)

## 3.3 Excellence Index

### *3.3.1 Design*

When it comes to education, excellence is on top of the agenda. Yet, the meaning attributed to the notion of excellence differs remarkably among educators, researchers, and policymakers. This section attempts to propose representative indicators that can comprehensively reflect the excellence levels of junior secondary education in China in a global context.

In addition to China, a total of seven developed countries are selected in this section for comparison purposes, i.e., the U.S., the U.K., France, Germany, the Netherlands, Japan, and ROK. The objective of this section is to allow for a global view of the junior secondary education systems, and to help countries review current education conditions and thus develop informed educational policies.

While selecting excellence indicators, two general principles or rules are followed, that is, the indicators need to be internationally comparable and provide comprehensive coverage. The indicators should make sense for China and the world. Moreover, specific data associated with the indicators should also be available for most of the countries. Also, the proposed indicators should comprehensively reflect the excellence levels from different perspectives (i.e., education context, education input, education process, and education output) and from different stakeholders (i.e., governments, schools, teachers, and students).

Following the above two principles, a total of nine excellence indicators were selected for inclusion, which can be divided into four dimensions:

- Educational context, including junior secondary school enrolment rate, and student economic, social, and cultural status;
- Educational input, including government expenditure on junior secondary education as a percentage of GDP (%), and total expenditure on junior secondary education per full-time equivalent student;
- Educational process, including the proportion of teachers fully certified by the appropriate authority, and student–teacher ratio;

- Educational product, including Student academic performance (i.e., mathematics, science, reading), student repetition rate, and student sense of belonging to the school.

### *3.3.2 Definitions and Sources*

A total of nine indicators were selected to reflect the excellence level of junior secondary education in China and for the world. Data sources of these excellence indicators are presented in Table 3.1, and definitions for each of the indicators are also defined below. As seen, OECD has been the primary data source with gaps filled in with other sources (i.e., UNESCO, *China Statistical Yearbook*).

#### 3.3.2.1 Junior Secondary School Total Net Enrolment Rate

This indicator reflects the educational context for junior secondary schools, represented by the ratio of enrolled students. Data for China and for other countries were retrieved from OECD-sponsored *Education at a Glance 2021*.

#### 3.3.2.2 Student Economic, Social, and Cultural Status

This indicator reflects the educational context for junior secondary schools, referring to the family socioeconomic status of students. Data for both China and other countries were retrieved from OECD-sponsored PISA 2018. In PISA 2018, student economic, social, and cultural status is derived from three variables associated with family background: "parents' highest occupational status", "parents' highest level of education", and "home possessions" (OECD, 2019a).

#### 3.3.2.3 Government Expenditure on Junior Secondary Education as a Percentage of GDP (%)

This indicator reflects national education input for junior secondary schools, which is calculated by dividing the national gross domestic product by education input for junior secondary schools. Data was retrieved from OECD-sponsored *Education at a Glance 2021*.

**Table 3.1** Data sources of excellence indicators

| Dimensions | Indicators | Source (China) | Source (other countries) |
|---|---|---|---|
| Educational context | 1. Junior secondary school total net enrolment rate | / | OECDEducation at a Glance 2021 |
| | 2. Student economic, social and cultural status | OECD—PISA 2018 | |
| Educational input | 3. Government expenditure on junior secondary education as a percentage of GDP (%) | / | OECD—Education at a Glance 2021 |
| | 4. Total expenditure on junior secondary education per full-time equivalent student | China Statistical Yearbook 2020 | OECD—Education at a Glance 2021 |
| Educational process | 5. Proportion of teachers fully certified by the appropriate authority | OECD—PISA 2018 | |
| | 6. Student–teacher ratio | China Statistical Yearbook 2021 | OECD—Education at a Glance 2021 |
| Educational product | 7. Student academic performance (i.e., mathematics, science, reading) | OECD—PISA 2018 | |
| | 8. Student repetition rate | UNESCO—Institute for Statistics 2020 | |
| | 9. Student sense of belonging to the school | OECD—PISA 2018 | |

*Notes* OECD = Organization of Economic Cooperation and Development; UNESCO = United Nations Educational, Scientific and Cultural Organization; PISA = Program of International Student Assessment

#### 3.3.2.4 Total Expenditure on Junior Secondary Education Per Full-Time Equivalent Student

This indicator reflects national education input for junior secondary schools, which is calculated by dividing the government's total expenditure on junior secondary education by the corresponding full-time equivalent enrolment. Expenditure in national currency is converted into equivalent US dollars (USD) by dividing the national currency figure by the purchasing power parity (PPP) index for GDP. The PPP conversion factor is used because the market exchange rate is affected by many factors (interest rates, trade policies, expectations of economic growth, etc.) that have little to do with current relative domestic purchasing power in different countries. Data for China is retrieved from *China Statistical Yearbook 2021*, and for other countries from OECD-sponsored *Education at a Glance 2021.*

#### 3.3.2.5 Proportion of Teachers Fully Certified by the Appropriate Authority

This indicator reflects education input for junior secondary schools, which refers to the ratio of teachers who have the required credentials to teach in junior secondary schools. Data for both China and other countries is retrieved from OECD-sponsored PISA 2018.

#### 3.3.2.6 Student–Teacher Ratio

This indicator reflects education input for junior secondary schools, which refers to the ratio of students to teaching staff. Data for both China and other countries is retrieved from OECD-sponsored *Education at a Glance 2021.*

#### 3.3.2.7 Student Academic Performance

This indicator reflects education output from the perspective of students. Data for both China and other countries was retrieved from OECD-sponsored PISA 2018, in which student academic performance is specified in terms of three aspects: scientific literacy, reading literacy, and mathematical literacy. Specifically, scientific literacy refers to students' ability to "explain phenomena scientifically, evaluate and design scientific inquiry, interpret data and evidence scientifically" (*ibid*). Reading literacy refers to students' ability to "understand and use those written language forms required by society and/or valued by the individual" (*ibid*). Readers can construct meaning from texts in a variety of forms. They read to learn, to participate in communities of readers in school and everyday life, and for enjoyment. Regarding mathematical literacy, it refers to students' ability to "formulate, employ and interpret math in a variety of contexts" (*ibid*). It includes "reasoning mathematically and using mathematical concepts, procedures, facts, and tools to describe, explain and predict phenomena" (*ibid*). It assists individuals to recognize the role that math plays in the world and to make the well-founded judgements and decisions needed by constructive, engaged, and reflective citizens.

#### 3.3.2.8 Student Repetition Rate

This indicator reflects education output from the perspective of students, which refers to the proportion of students from a cohort enrolled in a given grade at a given school year who study in the same grade in the following school year. Ideally, the repetition rate should approach 0%. High repetition rates reveal problems in the internal efficiency of the education system and possibly reflect a poor level of instruction. Data for China and other countries was retrieved from the UNESCO Institute for Statistics (UIS) 2020.

#### 3.3.2.9 Student Sense of Belonging to School

This indicator reflects education output from the perspective of students, which refers to students' feelings of being accepted and valued by their peers and by others at school. Data for both China and other countries is retrieved from OECD-sponsored PISA 2018.

### *3.3.3 Findings*

#### 3.3.3.1 Raw Data Results

The raw means of the nine excellence indicators for the eight countries are presented in Table 3.2.

As seen in Table 3.2, the total net enrolment rate for junior secondary schools is maintained at high levels for all the selected countries, which ranges from 98.84 to 99.98%. The economic, social, and cultural status of students in China, Germany, France, and Japan were relatively lower (<0), while students from the U.S., the U.K., ROK, and the Netherlands were relatively higher (>0).

In terms of education input, the government expenditure on junior secondary education as a percentage ranged from 0.64 to 1.31. Germany has the highest government expenditure, followed by France, the Netherlands, the U.S., ROK and Japan. The total expenditure on junior secondary education per full-time equivalent student ranges from USD3,940 to USD16,320 across the countries. Obviously, the total expenditure per student in China is much lower than that of developed countries.

Regarding the education process, the proportion of teachers fully certified by the appropriate authority ranges from 74.80 to 96.20% across the countries. In particular, China has the highest proportion of teachers certified by the appropriate authority. Student–teacher ratio ranges from 13 to 17 across the eight countries. China is among the countries with the lowest student–teacher ratio. A lower student-to-teacher ratio may indicate more opportunities for one-on-one time with students so that their learning challenges can be identified early, and effective measures can be implemented quickly. It may also lead to better relationships between teachers and students, and lower behavior problems and disruptions. Teachers of smaller classrooms spend less time on discipline and classroom management. This leaves more time for building a meaningful relationship with each student, as well as actual teaching.

**Table 3.2** The raw means of excellence indicators, by country

| | Raw means for countries | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | China | U.S. | Germany | France | U.K. | Japan | ROK | The Netherlands |
| 1. Junior secondary school total net enrolment rate (%) | N/A | 98.84 | 99.33 | 99.98 | 98.32 | 99.95 | 98.92 | 99.60 |
| 2. Student economic, social, and cultural status | −0.36 | 0.06 | −0.09 | −0.11 | 0.24 | −0.11 | 0.09 | 0.26 |
| 3. Government expenditure on junior secondary education as a percentage of GDP (%) | N/A | 0.86 | 1.31 | 1.26 | 0.90 | 0.64 | 0.84 | 1.09 |
| 4. Total expenditure on junior secondary education per full-time equivalent student (in thousands) | 3.94 | 15.30 | 14.20 | 12.14 | 12.72 | 11.62 | 14.81 | 16.32 |
| 5. Proportion of teachers fully certified by the appropriate authority | 96.20 | 92.60 | 87.80 | 74.80 | 95.60 | 95.90 | 94.50 | 86.60 |
| 6. Student–teacher ratio | 13 | 15 | 13 | 15 | 17 | 13 | 13 | 16 |
| 7. Student academic performance (average of mathematics, science, reading literacy) | 549.33 | 495 | 500.33 | 493.67 | 503.67 | 520 | 519.67 | 502.33 |
| 8. Student repetition rate (%) | 0.01 | 1.68 | 1.49 | 1.07 | N/A | N/A | 0.01 | N/A |
| 9. Student sense of belonging to the school | −0.19 | −0.24 | 0.28 | −0.07 | −0.19 | 0.02 | 0.28 | 0.20 |

*Note* N/A means that the data for the specific country is not available. The unit measure of total expenditure on junior secondary education per full-time equivalence student is equivalent to USD using Purchasing Power Parity (PPP)

Finally, regarding education outcomes, the average scientific, mathematical, and reading literacy of students from Asian countries (i.e., Japan, ROK, China) tend to have better achievements than their Western counterparts (i.e., the U.S., the U.K., Germany, France, the Netherlands). In particular, China ranks at the top among all the selected countries. The repetition rate ranges from 0.01 to 1.49. In particular, China has the lowest repetition rate. In addition, students' sense of belonging to school ranges from −0.24 to 0.28 across the countries. The mean score of China is −0.19 (<0), which is lower than the average score of the OECD countries.

#### 3.3.3.2 Transformed Data Results

As seen above, the unit and scale of the nine excellence indicators are different, and thus it may be hard to make international comparisons among the countries as a whole. In order to facilitate comparison, the raw data has been transformed in this section using the following method: the country with the highest mean value in a specific variable would be assigned a score of 100, and the score allotted to other countries would be based on the raw score ratio between the specific country and the country with the highest value. For example, China is assigned a transformed score of 100 on academic performance because its raw score is the highest (with a raw score of 549.33 points). The raw score of the U.S. is 495 points. The ratio between China and the U.S. is 1: 0.9011, and thus the transformed score for the U.S. is 90.11. The above data transformation method has been applied for seven out of the nine indicators in this section except for the student net enrolment rate and repetition rate. The total net enrolment rate is at a relatively high level (>98%) for the countries; The repetition rate for the countries is at a relatively low level (<5%), thus all the countries were given a score of 100 on these two indicators. The transformed data results are presented in Table 3.3.

### *3.3.4 Discussion*

China has shown both strengths and weaknesses in junior secondary education when compared with developed countries. Chinese students' economic, social, and cultural status is at a low level compared with those from other developed countries. The total expenditure on junior secondary education per equivalent full-time student in China is also much lower than that of the other countries. These results seem to be reasonable because China is still a developing country. However, China has the highest proportion of teachers fully certified by the appropriate authority, and the student–teacher ratio was the lowest among the selected countries. This seems to reflect that China has put great emphasis on the qualification and professionalization of teachers to ensure education quality. From the perspective of education output, the repetition rate in China is low, and Chinese students tend to excel in scientific, mathematical, and reading literacy compared with other countries. However, some

**Table 3.3** The transformed means of excellence indicators, by country

| | Transformed means for countries | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | China | U.S. | Germany | France | U.K. | Japan | ROK | The Netherlands |
| 1. Junior secondary school total net enrolment rate | N/A | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| 2. Student economic, social, and cultural status | −138.46 | 16.67 | −34.62 | −42.31 | 92.31 | −42.31 | 34.62 | 100 |
| 3. Government expenditure on junior secondary education as a percentage of GDP (%) | N/A | 65.65 | 100 | 96.18 | 68.70 | 48.85 | 64.12 | 83.21 |
| 4. Total expenditure on junior secondary education per full-time equivalent student (in thousands) | 24.14 | 93.75 | 87.01 | 74.39 | 77.94 | 71.20 | 90.75 | 100 |
| 5. Proportion of teachers fully certified by the appropriate authority | 100 | 96.26 | 91.27 | 77.75 | 99.38 | 99.69 | 98.23 | 90.02 |
| 6. Student–teacher ratio | 100 | 84.62 | 100 | 84.62 | 69.23 | 100 | 100 | 76.92 |
| 7. Student academic performance (i.e., mathematics, science, reading) | 100 | 90.11 | 91.08 | 89.87 | 91.69 | 94.66 | 94.60 | 91.44 |
| 8. Student repetition rate | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| 9. Student sense of belonging to the school | −67.86 | −85.71 | 100 | −25.00 | −67.86 | 7.14 | 100 | 71.43 |

*Note* N/A means that the data for the specific country is not available of the student social-emotional development (i.e., sense of belonging to school) may still need to be improved.

## 3.4 Best Practices

This section provides three practices in junior secondary education in China, in terms of meeting student learning needs, developing innovative approaches within the community, and improving education quality.

### *3.4.1 Meeting Student Diversified Learning Needs with Technology*

In response to the "Double Reduction" policy, as well as concerns from parents and students, Minhang District in Shanghai China has explored a data-driven approach. The district develops various online teaching platforms and tools, to tailor pedagogical methods in accordance with student academic performance and aptitudes. This practice has been selected as a "Double Reduction" exemplary case by the Ministry of Education in China (Shine, 2021).

Employing a data-driven approach allows Minhang District to optimize the supply of educational resources through accurate and effective data analysis and promote educational accessibility for all. This was primarily achieved through their "1258 platform" that is, a single platform with two helpers (i.e., AI learning companion and AI assistant teacher) tailored for five different users (such as students, parents, and teachers) and eight main possible scenarios (such as classroom teaching, course selection, community engagement, and many others) to increase the accessibility of education for all in compliance with the "Double Reduction" policy (*ibid*).

The "1258 platform" offers the following important features: First, through a main online platform, teachers can access up to 700,000 homework resources online, including picture books, interactive exercises, reading passages, and other tools that are catered to various age groups. Myriad resources are included on the cloud to ensure that teachers can set personalized homework according to students' different ability levels and learning styles. Second, in addressing the main concern of homework overload, a supervisory system has been implemented to manage tasks on the platform. Third, an interface displays a comprehensive overview of the difficulty, time needed, and nature of the homework set by teachers, encouraging them to consider students' workload and avoid excessive homework. Also, schools have implemented a lesson preparation system categorized from "2G" to "5G", guiding teachers through different levels of comprehension, from basic concepts, up to "5G to in-depth explanation and evaluation (*ibid*).

### *3.4.2 Implementing Double Reduction Policy with Innovative After-School Services*

In order to meet students diversified needs and alleviate parents' caring pressure, primary and middle schools are encouraged to provide students with after-school services, particularly in the context of the "Double Reduction" policy. For example, as early as in the year of 2021, the city of Nanjing of Jiangsu Province in China has made remarkable achievements in this respect, it is reported that so far one hundred percent of compulsory schools have been able to provide after-school services and these services have covered the needs of one hundred percent students. According to statistics, a total of 716 thousand primary and middle school students in Nanjing have participated in after-school services, and the overall satisfaction level of parents has achieved 92.5%. The good practices and acquired achievements of Nanjing made attempts in three aspects: (Nanjing Education Bureau, 2022).

#### 3.4.2.1 Development of School-Based Courses

In fact, after-school services should not only meet parents' custody needs, but also provide students with rich and diversified learning opportunities to foster their overall development. In Nanjing, schools put the needs of parents and students into full consideration by surveying their needs through telephone and questionnaire, and then designed after-school service courses based on their needs. For example, the No.9 Junior Secondary School in Nanjing has revised and extended its original school-based curriculum, opening 23 new and interesting school-based courses for ninth-grade students. These courses dealt with many different themes, ranging from Chinese culture, historical stories, antithetical couplet, Kunqu Opera to biological experiments, mathematics, and logics. Moreover, the school has also exploited social resources, inviting scientists and researchers to after-school service classes, to get them know the frontiers of science and improve student scientific literacy (*ibid*).

#### 3.4.2.2 Joint Efforts from Different Government Departments

In order to improve the quality of after-school services, Nanjing strived to unite social resources, pushing different government departments, e.g., Bureau of Education, Cultural and Tourism Bureau, and Sports Bureau, to work together. The joint efforts from different departments have indeed brought great impacts. For example, by availing of the social powers, Xuanwu District in Nanjing launches a "fifteen-minute education circle" activity. Schools build a cooperation relationship with the local public welfare education places (e.g., museums, libraries) that are within a 15-min walk, and they jointly provide resources for student learning. Furthermore, the government in Nanjing has also advocated for retired teachers, parents, as well as university teachers and students to actively participate in after-school services (*ibid*).

#### 3.4.2.3 Elaborate-Design Assignments

In response to the Double Reduction policy, the government in Nanjing issued a school assignment management guidance in 2022, stipulating how to design, revise, comment and demonstrate assignments to better serve student growth. Moreover, Nanjing has also hosted a variety of activities to improve assignment quality, e.g., assignment design competition, excellent case selection, and a disadvantage-student help program. For example, the Xuanwu District in Nanjing has developed a digital platform. While this platform helps teachers design assignments for students at different levels, it would also be helpful for teachers to know the current progress of students and diagnose student problems in time (*ibid*).

### *3.4.3 Promoting Education Quality Through Assessment*

Wenzhou is a populous city with an overall population accounting for one-sixth of that of Zhejiang Province in China. However, due to practical constraints, educational resources are not well balanced in Wenzhou. In order to solve this problem, building up an education quality assessment system is of great necessity, as it may help diagnose existing problems timely, and motivate students, teachers, as well as schools to make necessary changes. What does Wenzhou do to improve their regional education quality, given that they have such a large population? (People's Education, 2019).

#### 3.4.3.1 Building Up a City-Town-School Three-Level Assessment Network

In order to effectively promote the assessment of education quality and clarify main responsibilities, the government in Wenzhou built up a three-level assessment network. Specifically, at the city level, Wenzhou established a third-party educational assessment institute—Wenzhou Educational Assessment Institute in October 2013, and carried out a comprehensive evaluation for more than 200 compulsory schools in 2018; at the town level, Wenzhou required local county governments to set up specialized assessment department within Teacher Development Center and build professional teams in the field of educational assessment. According to statistics, a total of eleven towns have established the specialized assessment department and the total number of professional assessment personnel has increased from two to twenty-seven. At the school level, within 2 years (from 2017 to 2019), a total of 167 schools in Wenzhou have been identified as the pilot school. They were allowed to explore their unique pathway to conduct educational quality assessment (*ibid*).

#### 3.4.3.2 Constructing a Literacy-Centered Four-Dimensional Assessment Framework

In order to comprehensively reflect educational quality, Wenzhou has put forward a literacy-centered four-dimensional framework. The framework includes 18 assessment indicators and can be specified in terms of four dimensions: (1) Index of academic performance level, including knowledge and skills, subject thinking and method, practical skills, as well as innovation awareness; (2) Index of moral development, including behavioral habits, personality traits, civic literacy, as well as ideals and beliefs; (3) Index of physical and mental health, including body shape and physical function, physical quality, lifestyle, aesthetics culture, as well as emotional and behavioral regulation; (4) Index of learning and life happiness, including learning environment, learning habits, learning psychology, learning burden, as well as specialty and hobbies (*ibid*).

#### 3.4.3.3 Reform Education Based on the Assessment Results

Wenzhou strives to make full use of the assessment results to push education reform. Specifically, they have utilized a variety of statistical methods (e.g., correlation, clustering, prediction) to analyze and describe the current development of student cognitive and noncognitive skills, and explored school-, teacher-, and student-level associated factors. In addition, they have formulated an effective feedback mechanism. That is, the feedback from the assessment results would be directly given to relevant stakeholders (e.g., director of educational bureau, school principals, and teachers) (*ibid*).

## 3.5 Inspiring Stories

This section shares two inspiring stories to acknowledge the excellence and devotion of Chinese educators and set good examples for individuals who are passionate about education.

### *3.5.1 Cai Xiaoxiong: Nurturing Talents Heartedly and Innovatively*

Cai Xiaoxiong currently serves as the principal and party secretary of the No. 2 Senior Secondary School in Hangzhou, Zhejiang Province of China. So far, he has been awarded as the "National Role Model of Teaching", "Excellent Teacher in

Zhejiang Province", "National Excellent Educator", and many other honorary titles (People's Education, 2023).

#### 3.5.1.1 Excellent Mathematics Teacher and Researcher

Cai has been a mathematics teacher and a senior coach for the Chinese Mathematics Olympic Competition for more than 30 years. He believes that teaching mathematics is to equip students with mathematics thinking skills rather than simply imparting static mathematics knowledge. He also pays great attention to creating real-life scenarios to stimulate student learning interest. He has created his own teaching studio that is managed by the Department of Education of Zhejiang Province in China. The studio has housed more than 2,000 teachers. Through the studio, Cai organized teachers to polish courses, organize seminars, carry out education research, and publish research papers. In fact, Cai's pupils in turn have become established and well-respected teachers within their respective schools (*ibid*).

#### 3.5.1.2 Principal with Innovative Spirits

In 2012, Cai began to serve as the principal of Hangzhou High School. During his tenure as a principal, he has implemented many innovative measures to improve the overall education quality of the school. For example, he emphasized that schools, teachers, and students should be aware of their respective responsibilities and obligations. Schools should establish clear goals to cultivate talents; teachers should keep pursuing excellence; and students should be always curious about learning and pursue to achieve high. In 2021, Cai was appointed as the principal of the No. 2 Hangzhou Senior Secondary School. During that time, he paid great attention to the cultivation of innovative talents, establishing Olympic College and Huilan Humanity College in his school. He has also developed a variety of school-based curriculum to provide students with rich learning opportunities and set up many talent-rewarding programs named by well-known alumni to motivate students to achieve high (*ibid*).

#### 3.5.1.3 Educator with Great Love

Cai is also an educator with great love. As one of the educational experts in the Ministry of Education of China, he has been to support many disadvantaged schools, e.g., Jingning Secondary School, Kaihua Secondary School, Tonglu Secondary School, No.1 Yuhang Secondary School in Zhejiang Province, and No. 2 Ganzikangding Secondary School XiZang District. During this process, he indeed encountered many challenges. For example, the schools in Xizang District are of different education levels, but the expectation from the local government is very high. Therefore, how to effectively improve the education quality of all kinds of schools within a short period of time is challenging. To solve this problem, Cai developed some innovative strategies, e.g., holding principal management forums and administrative cadres lectures, and organizing teachers to work in pairs. In addition, based on his experience of supporting education, Cai writes a series of educational research papers, offering his opinions about how to pursue high-quality education (*ibid*).

### *3.5.2 Yang Mingsheng: Holding Education Faith Consistently and Regretlessly*

Yang Mingsheng has successively served as a teacher, vice principal, and principal in the county of Huoqiu, Anhui Province for over 38 years after graduating from the School of Chemistry of Anhui Normal University. Over the past 38 years, he has been awarded the "China National Advanced Worker", "Excellent Teacher in Anhui Province", "Jianghuai Good Principal", and many other honorary titles (Lu'an Municipal Bureau of Education & Sports, 2022).

#### 3.5.2.1 Determined Education Practitioner

Over the 38 years in Huoqiu, Yang has resisted many temptations from outside education. For example, in August of 1992, he was admitted by the Department of Youth Work of China Youth University of Political Science. This is without doubt a splendid opportunity that could have changed his life. However, Yang finally gave up this opportunity to pursue further education because he knew that no one would teach the students if he left the school. In recent years, many schools and education institutions have invited him to work there, but he persisted in working in his hometown. As he once said, the choice is indeed related to whether I would live with money or regret for the rest of my life. Due to hard work, he suffers from many diseases, e.g., thyroid neoplasms, hypertension, diabetes, cholecystitis, kidney stone, gastric ulcer, and severe eye disease. However, he has never asked for a leave and always be the first to arrive at the school and the last to leave school (*ibid*).

#### 3.5.2.2 Brave Education Reformer

Yang has taken many brave and innovative measures to reform school education. For example, in order to improve students moral level, he proposed a moral education cultivation system in which he encouraged every student to remember three key elements: moral ethics, gratitude, and hometown. In addition, he believed that moral education needs to be exercised by different cultural activities. He innovatively put forward that moral education should emphasize a sense of ritual. He proposed the model of moral education: $y = f(x) + a + b + c$, in which $x$ is the form of moral activity, $a$, $b$, and $c$ are traditional moral education content, and no matter how $x$

changes, the effect should be guaranteed. This model has been put into practice for over 10 years, and it has been applied in many different schools. He has now been appointed as the teacher for the Principal Training Class organized by the National Academy of Education Administration, and he has opened such classes as Cultural Guidance of Moral Education in Primary and Secondary Schools, Chinese Traditional Culture and Moral Education in Primary and Secondary Schools, and the Moral Education Leadership of Primary and Secondary School Principals. In addition, he pays attention to art and sports education. For example, he created an art class and has helped many students to have been admitted to art college such as Tsinghua Academy of Fine Arts, and Central Academy of Fine Arts. In addition, he built the school becoming the Sports Characteristic Demonstration School, and cultivates many sports talents such as the champion of the National Games Hu Qing (*ibid*).

#### 3.5.2.3 Excellent Education Researcher

Since he started teaching, he has also continued teaching-related research. In 1989, his article *A Summary of Redox* was published in the journal Modern Secondary School. In fact, he often wrote papers by hand at that time because of no modern digital devices. Within 9 years, he used up eight notebooks. So far, Yang has published more than 600 research papers, among which more than 50 papers have been published in *Chemistry Education*, *Chemistry Teaching*, *Reference for Chemistry in Secondary School*. He is good at finding problems in teaching, and he has now hosted 11 province-level projects. These results of the projects are important and useful for textbook editing (*ibid*).

## 3.6 Latest Research

This section summarizes the latest research in the field of junior secondary education, to present the current research focuses on the Chinese context.

### *3.6.1 An Overview of Research on Junior Secondary Education in China*

Using “junior secondary education” as the keyword, the latest 10-year Chinese Social Science Citation Index (CSSCI) journal papers (2013–2023) were searched on the China National Knowledge Infrastructure (CNKI) website. The distribution of the most studied topics related to junior secondary education is presented in Fig. 3.16.

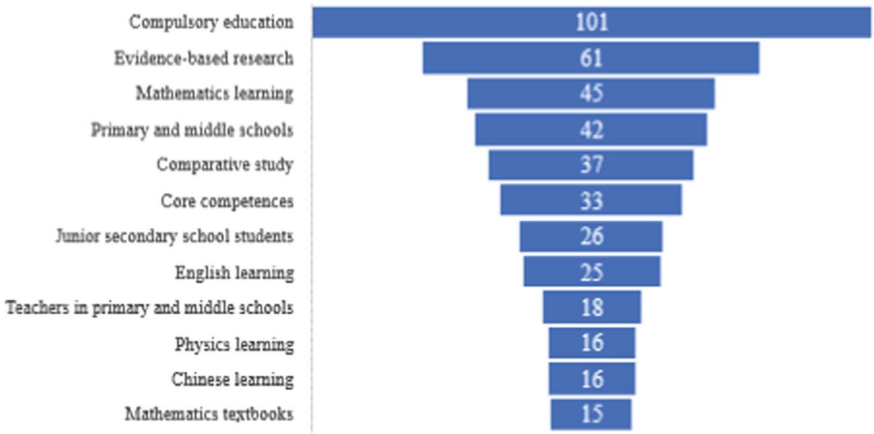


**Fig. 3.16** Recent topics in CSSCI journals on junior secondary education (2013–2023). *Source* Compiled from search results in CNKI

As seen in Fig. 3.16, the most studied topic related to junior secondary education was compulsory education (with 101 CSSCI journal papers from 2013 to 2023), followed by topics featured by evidence-based research (with 61 journal papers), mathematics learning (with 45 journal papers), primary and middle schools (with 42 journal papers), comparative study (with 37 journal papers), core competences (with 33 journal papers), junior secondary school students (with 26 journal papers), English learning (with 25 journal papers), teachers in primary and middle schools (with 18 journal papers), physics and Chinese learning (with 16 journal papers respectively), and mathematics textbooks (with 15 journal papers).

From the distribution of the topics, evidence-based research is receiving increasing attention over the past decade. In addition, these topics can roughly be summarized into two major categories: school subject teaching and learning (i.e., math learning, English language learning, physics learning, and Chinese language arts learning); and student core competencies (*hexin suyang*). Additional information about each of these categories/areas is provided below.

### 3.6.2 Research on School Subject Teaching and Learning

One of the most studied topics around junior secondary education in China is school subject teaching and learning, which deals with topics related to exploring general rules and efficient ways for educators to impart subject-related knowledge for students to better understand subject matter and foster core competencies, as well as for designing and analyzing textbooks and curriculum standards (i.e., Gu & Zhang, 2021; Wang, 2020; Zhang & Hu, 2022).

For instance, Lin et al. (2021) conducted an experimental study to explore the effect of mind mapping on junior secondary school students' Chinese language arts learning and creative thinking. Results indicate that four-month mind map training, that is, drawing diagrams to help visualize thoughts and communicating them to others, could significantly improve student Chinese language arts learning interest and creative thinking skills. Wu and Zhang (2019) examined the effect of math writing on math performance among Chinese minority middle school students. In their study, math writing refers to writing down the understanding of relevant math concepts and recording the problem-solving processes. Results suggest that math writing could significantly improve student math performance, as well as their math learning motivation.

### *3.6.3 Research on Balanced Development of Junior Secondary Education*

Recent years have witnessed an increasing number of journal papers focusing on the balanced development of junior secondary education, including such topics as comparing educational resources between rural and urban areas, as well as employing technology to narrow down the gap between different areas.

For instance, Liu (2014) discussed the effect of IT on the balanced development of regional education from five aspects: construction of the IT environment, education resource construction, application of IT teaching, teachers' professional development, and students' information literacy training. Zhang et al. (2019) reviewed China's history of reform and opening-up, and they found that the balanced development of China's compulsory education has experienced great changes, from "unbalanced development" to "basic balanced development", and then to the goal of "quality and balanced development". In fact, the development of compulsory education in China has made outstanding achievements over the years, as demonstrated in the increasing funding, the qualification of teaching staff, and better conditions for running schools. Meanwhile, the educational gap between urban and rural areas has been significantly narrowed.

Moreover, researchers have also paid special attention to improving the compulsory education of special groups of students including left-behind children (i.e., parents working in the city, while children are left behind in rural areas) and migrant children. For example, Duan et al. (2020) investigated the effect of parents' working from countryside to city on left-behind children's compulsory education using the data from the *China Family Panel Studies* (CFPS). The propensity score indicated that parents who migrate from rural to urban areas to work has a negative impact on their children's academic performance. Researchers argued that the negative impact might occur because migrant parents may not value education as much as those who do not work from the countryside to the city. Moreover, left-behind children might have fewer opportunities to attend extra-curricular lessons, and they might be distracted by the use of phones more easily.

### *3.6.4 Research on Fostering Core Competencies for Student Success*

Fostering core competencies of junior secondary school students has been a key topic over the past several years. Related research topics include comprehensive quality assessment and senior high school entrance examination reform.

For example, Liu and Li (2021) identified some potential issues or problems with student evaluation of comprehensive practical activities in primary and junior secondary schools. They suggested that educators should pay more attention to selective evaluation rather than promoting evaluation, to unified evaluation rather than individualized evaluation, to teacher evaluation rather than diversified evaluation, to quantitative evaluation rather than qualitative evaluation, and routine work rather than normal evaluation. Feng et al. (2022) proposed the idea of assessing students' comprehensive skills using big data analytical techniques. Specifically, they suggested that the comprehensive quality assessment should evaluate students from diverse aspects such as physical health, mental health, moral characteristics, scientific literacy, and humanity literacy. In order to achieve accurate assessment, educators should collect relevant data from teachers, peers, parents, and students themselves, and establish individual development profile for each student. This profile would record student learning progress and growth, and help teachers design and implement more adaptive and individualized instruction.

## 3.7 National Policies

This section provides an in-depth overview of junior secondary education in China, focusing on both foundational and contemporary national policies. Its aim is to offer comprehensive insights into the landscape of junior secondary education in China from a policy standpoint. It is worth noting that these policies are stated and organized into themes in this section, to promote a better understanding of the policies.

### *3.7.1 Policy Development on Junior Secondary Education in China*

One major goal of junior secondary education is to nurture children so that they will become adults with well-rounded abilities, not just people who can achieve high test scores. In order to promote holistic development, the Chinese government has issued a series of relevant guidelines or policies over the past 30 years. These policies are primarily focused on two important aspects: fostering student core competencies that help them be better prepared for the future world; and relieving student academic burden to make room for their well-rounded development. Below some basic education policies around these two aspects are summarized.

#### 3.7.1.1 Fostering Student Core Competencies

In 1999, the Third National Education Work Conference themed "Deepen Educational Reform, Promote Well-Rounded Development" was held in Beijing. During the same year, *Decisions on Deepening Educational Reform and Promoting Well-Rounded Education* was issued (The State Council, 1999), stipulating the goal and the essence of China's well-rounded education, as well as the specific measures that could be taken to guarantee the implementation of the policy, which marked the beginning of China's well-rounded education.

In 2006, the *Compulsory Education Law of the People's Republic of China* was amended, in which well-rounded education was first highlighted at the country's level (National People's Congress, 2006). According to the law, the national policy on education shall be implemented and well-rounded education shall be carried out in compulsory education to improve the quality of education and enable children and adolescents to achieve well-rounded development—morally, intellectually, and physically—to lay the foundation for cultivating well-educated and self-disciplined builders with high ideals and moral integrity. In addition, the educational and teaching work shall be in line with the education rules and the characteristics of the physical and mental development of students, be geared to all students, impart knowledge and enlighten people, integrate moral education, intellectual education, physical education, and aesthetic education in the educational and teaching activities. Moreover, it should focus on the cultivation of the students' independent thinking skills, creativity, and practical skills so as to promote the well-rounded development of students.

In 2010, the *Outline of the National Plan for Medium- and Long-term Education Reform and Development (2010–2020)* (The State Council, 2010) was issued, further stipulating that education shall promote student well-rounded development. The *Outline* specified that moral education, intellectual education, physical education, and aesthetic education shall be stepped up and improved in an all-around way. It is imperative to give equal footing to cultural learning and moral edification, to theoretical study and social practice, and well-rounded education and individual characteristics. Great importance should be attached to physical health. Students' physical education courses and time for extracurricular activities must be guaranteed and the quality of physical education must be improved. In the meantime, fine education in mental health shall be provided to improve students' mental and physical health. Education in arts shall be intensified to instill a cultured aesthetical taste and enhance their cultural attainment. Labor education should be strengthened to cultivate their love for work and the working people.

In 2014, MOE issued a guideline for deeper curriculum reform to strengthen moral education and cultivate talents, which stipulates that the cultivation of student core competencies should be tailored to different grades and embedded in subject teaching.

In 2016, MOE put forward the concept of student core competencies. In the same year, the *Core Competencies and Values for Chinese Students' Development* (People's Daily, 2019) was released, which was an iconic event in the well-rounded education field. Policies attach more importance to students' comprehensive competencies instead of test scores, and MOE proposed that tests of students' aesthetic abilities will be added to the senior high school exams in 2022.

In June 2019, the *Guidelines on Deepening the Reform of Education and Teaching and Comprehensively Improving the Quality of Compulsory Education* was issued. The *Guidelines* aim to develop an education system that fosters citizens with holistic moral, intellectual, physical, and aesthetic grounding, in addition to a hard-working spirit, according to the document. The key points of the *Guidelines* include:

- According to the *Guidelines*, compulsory education should emphasize the effectiveness of moral education with an emphasis on cultivating ideals and faith, core socialist values, China's excellent traditional culture, ecological civilization, and mental health.
- The *Guidelines* stress elevating intellectual grounding levels to develop the cognitive ability and the sense of innovation of the students.
- The *Guidelines* also call for strengthening physical education, enhancing aesthetic training with more art curriculums and activities, and encouraging students to participate in more physical work to boost their hard-working spirit. (The State Council, 2019)

In April 2022, the Ministry of Education of China published the revised curriculum plan and standards for a total of 16 different subjects for compulsory education schools. In the plan and standards, core competency has been mentioned many times. The purpose of this document is to make the cultivation of core competency to the ground, which is beneficial to student all-round development.

#### 3.7.1.2 Relieving Students' Academic Burden

As indicated by student learning time per week in total in Chap. 2 Highlighting Data, it seems that the academic pressure of Chinese students is more intense than the other countries. According to statistics, the market share for private tutoring in China exceeded eighty million in 2020, and over 13.70 million elementary and middle school students attended private tutoring activities (Sina, 2020). In order to reduce student academic workload, the government released the *Guidelines on Further Easing the Burdens of Excessive Homework and Off-Campus Tutoring for Students Undergoing Compulsory Education* (as mentioned earlier in the chapter as the "Double Reduction" policy) on July 24, 2021 (The State Council, 2021). The *Guidelines* took immediate effect.

The "Double Reduction" in the *Guidelines* refers to a reduction in the total amount and time of commitment required by school homework and a reduction in the burden of off-campus or after-school training programs. Based on the *Guidelines*, the "Double Reduction" policy is intended to improve the overall quality of school education, reduce excessive study burdens, protect the health of students, relieve the burdens and anxiety of parents, reduce social inequity, further regulate, and standardized off-campus training (including both online and off-line training), and strictly implement the *Compulsory Education Law*, the *Protection of Minors Law* and other laws and regulations governing the education industry.

While the *Guidelines* set out various goals and requirements for in-school education, particular emphasis is placed on regulating after-school private tutoring activities. For example, it is required that new subject-based off-campus and after-school training institutions targeting compulsory education students will not be approved by local authorities; All existing subject-based off-campus training institutions will be required to convert to or register as "non-profit organizations"; For non-subject-based training institutions (i.e., sports, art, music programs), local governments should clarify the corresponding departments in-charge, formulate standards by subject area, and implement a strict review and approval regime; Training institutions are prohibited from enticing teachers away from public schools through improper means; Developed cities in China such as Beijing, Shanghai and Guangzhou will launch pilot programs to re-examine existing "subject-based" training institutions and offer in-school extracurricular programs by using school resources or inviting off-campus training institutions through a government-led selection process.

The "Double Reduction" policy will bring a fundamental change to the landscape of China's compulsory education, which aims to address the most prominent problems in compulsory education, that is, the excessive academic burden on primary and middle school students, and the off-campus tutoring that overloads parents financially and mentally, and seriously hedged the outcomes of education reform. MOE and local education authorities in different localities are in the process of formulating detailed rules to implement the "Double Reduction" policy.

In addition to the "Double Reduction" policy, the Chinese government has also issued a set of additional guidelines to ease student excessive workload. For example, on August 30, 2021, MOE issued a notice criticizing the high frequency and difficulty of exams and the emphasis placed on test results, which harms the body and minds of students (MOE, 2021c). The amount of testing and homework has since been reduced in primary and middle schools, while measures have been taken to prevent test scores from being published and ranked. After-school services in public schools are being extended to support working parents, non-curriculum training sectors such as in the arts and sports are expanding, and new commitments to increase teachers' salaries in public schools have been made.

Moreover, Chinese lawmakers have adopted a new law on family education promotion at a session of the National People's Congress Standing Committee on October 23, 2021. The *Family Education Promotion Law of the People's Republic of China* (National People's Congress, 2021) stipulates that parents or other guardians of the minors shall be responsible for family education, while the state, schools, and society provide guidance, support, and services for family education. In response to the country's drive to relieve the academic workload of young students, the law requires local governments at or above the country level to take effective measures to reduce the burden of excessive homework and off-campus tutoring in compulsory education. The law prohibits parents from imposing undue workload on their children, stating guardians of the minors should appropriately organize children's time for study, rest, recreation, and physical exercise. Parents are also required to play their part in preventing their children from being addicted to the Internet. Pinning high hopes on their children, many Chinese parents would bend over backward to help their kids succeed. They would rather spend their savings to tutoring classes to help their children score high on tests(Xinhua, 2021b). Weighed down by workload, Chinese students are facing increasing incidences of myopia, more sleep deprivation, and poor fitness that worries many.

### *3.7.2 Current Policy Highlights*

Complying with the "Double Reduction" policy, several relevant guidelines and notices have been issued by the Chinese government recently. The overall purpose of these new regulations is to promote the implementation and smooth development of the Double Reduction Policy.

Specifically, in March 2021, the General Office of the Ministry of Education in China issued a notice on strengthening student sleep time management, which requires schools to strengthen the publicity of the science of sleep, avoid undue assignment, and make sure that students have sufficient sleeping time.

In addition, in April 2021, the General Office of the Ministry of Education in China has also issued a notice on strengthening the management of homework, which requires schools to balance the homework load for students, innovate the type of homework, as well as make sure that the homework is of high quality and teachers should give effective and timely feedback to students.

## 3.8 Summary

This chapter provides an overview of junior secondary education (middle school) in China. Over the past decades, the Chinese government has issued a series of national and/or regional policies to meet current and anticipated future needs and challenges as the world is becoming more globalized and diverse, and great achievements have been made in improving the quality of the junior secondary education, particularly in eliminating illiterates, decreasing drop-out rates, and strengthening education equity. Moreover, a number of good education practices and inspiring stories emerged, which have become the most valuable assets in the development of China's education cause.

From an international comparison perspective, results from international large-scale assessments indicate that Chinese students tend to excel in academic literacy (i.e., mathematics, reading, science), and the qualifications of teachers in junior secondary schools is also at a satisfactory level. However, the academic burden (i.e., total learning time per week) of Chinese junior secondary school students is still heavy, and there is still room to promote the development of student noncognitive skills.

However, it should be noted that the results in this chapter, particularly for the Highlighting Data section and the Excellence Index section, are primarily based on data retrieved from international large-scale assessments such as PISA 2018 and TALIS 2018. The students/teachers in each country are only stratified samples selected from the whole country. Hence, the results' generalizability is limited to a certain extent. Moreover, some data (i.e., fear of failure, teacher self-efficacy) may suffer from self-report bias.

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# Chapter 4
# Secondary Education (High School) in China

**Cao Lu and Chen Ruoxi**

**Abstract** Secondary education or high school in China refers to the general upper secondary education, which aligns with the International Standard Classification of Education (ISCED) Level 3. In China, this stage typically includes students aged 15 to 18 years old, corresponding to grade levels 10 to 12, and excludes vocational education. This chapter reports the current stage of China's high school education, focusing on the key themes of educational effectiveness and resource allocation. It utilizes data sourced from the Organization for Economic Cooperation and Development (OECD), the 2018 PISA database, and official statistics from the Ministry of Education of China (MOE) and other countries. The data indicates that, in international comparisons, Chinese high school students lead in gross enrollment rates, graduation rates, and academic performance. Notable accomplishments in educational infrastructure, such as science labs, multimedia-equipped classrooms, and widespread Wi-Fi access in schools, are also highlighted. Nevertheless, compared to many developed countries, China faces challenges in several key indicators, including the total spending per full-time student, the proportion of teachers holding a master's degree or higher, and the percentage of students gaining admission to top 4-year universities. This chapter also presents best practices and inspiring stories and within China's high school education, and it examines recent trends through the lens of the latest research, national policies, and recommendations for the future.

**Keywords** High school education · Digital literacy · Career education · AI education · Creativity · High-quality education

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## 4.1 Introduction

In the early years following the establishment of the People's Republic of China, over 80% of the population was illiterate or semi-literate, and the enrollment rate for school-age children was only about 20%. As a result, the primary focus of educational efforts at that time focused on basic education, with a particular emphasis on elementary education (Wang, 2019). During this stage, upper secondary education was accessible to only a very small portion of the population. Even when considering both general high schools and vocational high schools, the enrollment rate was just 1.1% in 1949 (Chu, 2020), which was even lower than the current admission rate to China's Double World-Class Project Universities in the 2020s. By 1978, coinciding with the reform and opening-up period, there was a significant increase in the enrollment rate for high school education, which includes both vocational and general high schools, though it remained below 30%.

*Universalization Phase*. In 1982, the Constitution of the People's Republic of China was amended to include the universalization of primary compulsory education for the first time. The enactment of the *Compulsory Education Law of the People's Republic of China* in 1986 also marked a significant milestone. Stimulated by this legal framework, the number of junior secondary school students began to rise, leading to an increased number of people who were both qualified and eager to pursue general high school education. Furthermore, the expansion of higher education institutions beginning in 1999 accelerated the universalization of high school education. Over the past two decades, the gross enrollment rate in high schools has been steadily climbing. The enrollment rate in general high schools had exceeded 50% by 2018 and has continued to show a consistent improvement in universal access since then.

*Quality Improvement Phase*. High school education has become more widespread in China. Recently, China has intensified its efforts to enhance the quality of this educational stage, offering high school students with both diverse and high-quality educational experiences. The rapid growth of high schools led to challenges such as uniformity in educational approaches and high student-to-teacher ratios. Addressing these issues, a series of initiatives launched in 2010 to improve the quality of high school education. Key policies include the *Education Planning Outline*, the *High School Stage Education Universalization Tackling Plan (2017–2020)*, and the *Guiding Opinions on Implementing the Reform of Education Methods in General High Schools in the New Era*. These policies aim not only to diversify and develop distinctive high school education but also to raise the overall quality of education.

In recent years, notable achievements have been observed in the quality of China's high school education, including enhanced infrastructure, improved teacher qualifications, and refined evaluation criteria. The government document China *Education Modernization 2035* further indicates China's ongoing commitment to pursuing high-quality and distinctive development in general high schools in the future.

In summary, since 1949, China's high school education has transitioned from an elite to a universally accessible system. Initially, efforts were concentrated on alleviating high illiteracy rates and expanding basic education. Subsequent phases have seen significant increases in high school enrollment and a focused drive to enhance educational diversity and quality. These developments have been marked by legal reforms and policy initiatives, reflecting China's ongoing commitment to providing an improved and equitable high school education.

## 4.2 Highlighting Data

This section offers a report and analysis of data related to high school education in China, with a focus on the academic performance, enrollment and graduation rates, human resources (e.g., teacher-student ratio), and infrastructure (e.g., Wi-Fi coverage). For some of these data international comparisons are provided for a more complete picture. Key indicators are detailed in Table 4.1.

The data have been sourced from various reputable organizations and institutions. Primary sources include OECD's annual *Education at a Glance* report, the 2018 PISA database, data from MOE, and the National Bureau of Statistics (NBS). Additional data come from country-specific, official statistics of education ministries from other countries, such as French Ministry of Higher Education, Research and Innovation, and Ministry of Education, Culture, Sports, Science and Technology of Japan (MEXT). Certain indicators have been manually calculated using this publicly available data.

**Table 4.1** An overview of the indicators in highlighting data

| Type of resources | Indicators | Data resources |
|---|---|---|
| Academic achievements | Reading<br>Mathematics<br>Science | 2018 PISA database |
| Enrollment and graduation rate | Gross enrollment rate<br>Graduation rate | OECD, MOE, NBS, French ministry of higher education, Research and innovation |
| Human resources | Student–teacher ratio<br>Percentage of teachers with a bachelor's degree or higher | OECD, MOE, MEXT |
| Infrastructure | Teacher and student digital device coverage rate<br>Wi-Fi coverage rate<br>Network multimedia classroom coverage rate<br>Facility and equipment standard compliance rate | MOE |

### 4.2.1 Academic Achievements: Reading, Mathematics, Science

The academic achievements of high school students are core indicators regarding the quality of China's high school education. As this section focuses on the general upper secondary students, vocational students are excluded. It is also important to note that the PISA 2018 assessment reflects the performance of students from four regions in China: Beijing, Shanghai, Guangdong, and Zhejiang. This concentration of data from economically developed regions may limit the generalizability of the findings to the entire country, as these areas may not represent the situations in other parts of China. Lastly, this section primarily describes the surface data for China.

*Reading*. Reading literacy is defined as students' capacity to understand, use, evaluate, reflect on and engage with texts to achieve one's goals, develop one's knowledge and potential, and participate in society (OECD, 2019c). Reading literacy is fundamental to nearly all learning processes and is essential for students not only in language acquisition and literature study but also as a foundational skill for tackling text-based problems across other disciplines (Geske & Ozola, 2008).

The results adopted from PISA 2018 Database shows that the average reading score for Chinese high school students is 598 points (OECD, 2019b). According to PISA's reading proficiency levels, the highest level for 15-year-old students is Level 6, corresponding to 698 points. Chinese high school students' reading proficiency level is placed between Level 5 (626 points) and 4 (553 points). According to PISA's detailed interpretation (OECD, 2019c), the results indicate that, on average, Chinese high school students can understand and interpret extended passages in both single and multi-text settings and extend their understanding to some extent. However, on average, they do not reach the level of being able to deal with concepts that are abstract or counterintuitive, process complex information, or conduct higher-order reasoning and analysis.

*Mathematics*. Mathematics literacy is defined as students' capacity to formulate, employ, and interpret mathematics in a variety of contexts. It includes reasoning mathematically and using mathematical concepts, procedures, facts, and tools to describe, explain, and predict phenomena (*ibid*). Mastery of mathematics is vital for students, as it underpins the development of analytical skills necessary not only in scientific and technical subjects but also in everyday problem solving and decision making (Common Core State Standards, 2010). High school students have an average mathematics score of 630 points (OECD, 2019b), which is between Level 5 (607 points) and Level 6 (669 points), the highest level regarding the proficiency of mathematics. According to the proficiency levels used for analysis by PISA, on average, Chinese high school students are proficient in developing and working with mathematical models and can tackle complex mathematical situations effectively. However, they may not consistently demonstrate the highest order of mathematical thinking and reasoning characteristic of Level 6 performers.

*Science*. Science literacy is defined as the ability to engage with science-related issues and with the ideas of science, as a reflective citizen. A scientifically literate person is willing to engage in reasoned discourse about science and technology, which requires the competencies to explain phenomena scientifically, evaluate and design scientific enquiry, and interpret data and evidence (OECD, 2019c). The importance of science literacy extends beyond the classroom; it is essential for informed decision-making in a world increasingly shaped by scientific and technological advancements (NGSS Lead States, 2013).

According to PISA's reading proficiency levels, the highest level for 15-year-old students is Level 6, corresponding to 708 points. The average science score for Chinese high school students is 631 points (OECD, 2019b), closely matching Level 5 (633 points). With an average score that is around Level 5, Chinese high school students demonstrate substantial science literacy, showing competence in addressing and understanding scientific problems of a significant level of complexity. However, this score suggests that there is room for growth towards the highest level of scientific thought and inquiry characterized by Level 6, which would indicate the ability to tackle the most challenging scientific issues and use what they learned to solve novel, cross-domain problems.

### *4.2.2 Gross Enrollment Rates*

Many countries strive to achieve universal completion of upper secondary education, a goal that China has embraced since the 1980s (see Sect. 4.1 for details). Equipping students with general skills is often considered to be particularly important in a fast-changing economy, as it should enable individuals to change occupations and respond more quickly to technological change (Hall, 2016). High school education enrollment rates are often linked to positive outcomes in workforce development, economic stability, and societal progress, as they indicate a broader base of individuals receiving education that can lead to higher-skilled employment (OECD, 2023a). Therefore, the gross enrollment rate in high school education serves as a benchmark for assessing progress towards educational equity and quality. Currently, China's overall upper secondary education enrollment rates, which include both general and vocational education, have surpassed 91.6% (MOE, 2023c). MOE has set a goal to achieve a 92% gross enrollment rate in high schools by 2026 (MOE, 2021d). This target indicates an anticipated continued rise in the accessibility of high school education.

In recent years, China has sought to increase access to high school education. The gross enrollment rate for Chinese high schools was 56% in 2020. This rate is calculated by comparing the number of high school students, regardless of age, to the population aged 15–17 years (MOE, 2023c). In China, the typical age range for high school entry falls between 15 and 17 years, thus this demographic is frequently utilized by MOE to compute gross enrollment rates. It's important to note that this methodology contrasts with that of OECD, which employs the age group of 15 to 19 years for comparison (OECD, 2023a).

The following analysis will compare China's data with eight major developed countries, including the U.S., Germany, France, the U.K., Japan, Republic of Korea

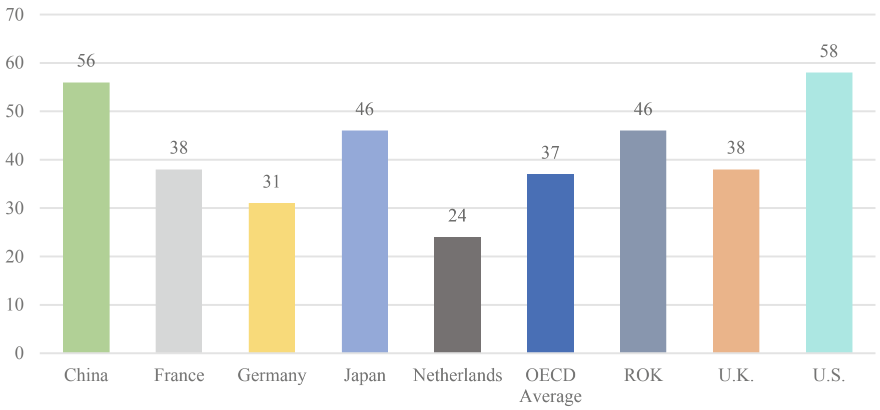


**Fig. 4.1** Gross enrollment rate for high school education (2020). *Source* OECD (2021a); China Population Census (2021); MOE (2021a)

(ROK), and the Netherlands. The following reflects the gross enrollment rates of high schools in 2020 for these core countries and the average for OECD member countries, as shown in Fig. 4.1.

As shown in Fig. 4.1, the average gross enrollment rate for high schools among OECD member countries is 37%. China's rate significantly exceeds this average, ranking second among the eight major developed countries, just behind the U.S. at 58%. The higher enrollment rate in China may be linked to the generally higher rates observed across high schools in Asian countries. Overall, China's high school enrollment rate is in at satisfactory state.

### *4.2.3 Graduation Rates*

Graduation rates are crucial as they estimate the percentage of individuals from a specific age group who are expected to complete high school at some point in their lifetime (OECD, 2021b). Graduation rates serve as a measure of the effectiveness of government policies in increasing the number of people who meet the minimum standards for entering the workforce (Heckman & LaFontaine, 2010). While high school education is not compulsory, it still provides fundamental knowledge and skills. The consequences of not completing this level of education can be significant for both the individual and society. Those who do not graduate are more likely to face challenges in employment and further education, potentially leading to wider social and economic implications.

China has a remarkably high school graduation rate. In 2020, the graduation rate in China was 98.3%. The rate is calculated based on the total number of graduates in a given year divided by the number of students who enrolled 3 years earlier

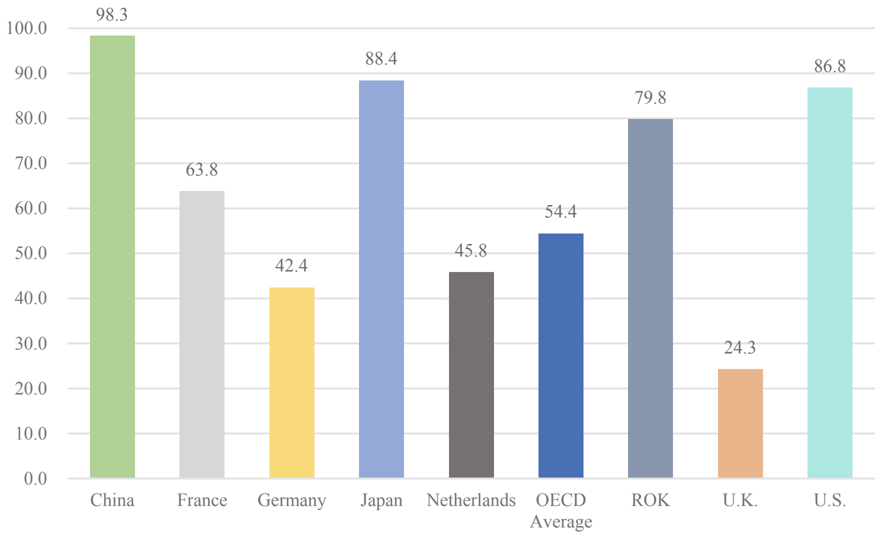


**Fig. 4.2** Graduation rate for high school education (2020) (%). *Source* OECD (2021a); MOE (2019a, 2021a); MEXT (2023b); French Ministry of Higher Education, Research and Innovation (2021)

(MOE, 2019a, 2021a). This high rate is a testament to the success of China's educational system in ensuring that a large majority of students complete their high school education, which is positive both for individual prospects and societal development.

Figure 4.2 reflects the graduation rates of high schools in 2020 for the eight core countries and the average for OECD member countries. Internationally, China ranks first among the eight core countries in terms of high school graduation rate, surpassing the second-ranked Japan by approximately 10 percentage points, and is significantly above the average for OECD member countries. However, it is important to note that due to varying high school completion years in different countries, different methodologies are used for international comparisons. For the U.S., Germany, the U.K., ROK, the Netherlands, and OECD average, the graduation rates are calculated as net graduation rates, i.e., as the sum of age-specific graduation rates up to a threshold age of 25. The net graduation rate for a single age is obtained by dividing the number of first-time graduates of that age in each type of tertiary education by the total population of the corresponding age (OECD, 2021b). For France, graduation rate is calculated by the percentage of students obtaining the general and technological baccalaureate (baccalauréat généra) in 2020 (French Ministry of Higher Education, Research and Innovation, 2021). Because specific data on the number of first-time graduates at each age is unavailable, Japan employs the same method for calculating graduation rates as China, as described in the above paragraph. Therefore, these international comparisons should be interpreted with caution. Furthermore, the lower high school graduation rates in certain countries, such as the U.K., do not necessarily indicate a lack of individuals meeting the minimum standards for entering the workforce.

This is partly due to the U.K.'s highly flexible educational system, which includes options beyond general high school, such as vocational training programs and the General Certificate of Secondary Education (GCSE), ensuring diverse pathways into the job market.

### *4.2.4 Student–Teacher Ratio*

The ratio of students per teacher is calculated by comparing the number of full-time equivalent students at a specific education level to the number of full-time equivalent teachers directly involved in teaching at the same level of education (OECD, 2022).

As a measure of teaching resource allocation, the student–teacher ratio is a determining factor of learning outcomes and a significant indicator of educational quality (OECD, 2023a). Research indicates that a lower student–teacher ratio correlates with increased support and individual attention for students (Biddle & Berliner, 2002), potentially leading to improved academic performance (Koc & Celik, 2015).

The student–teacher ratio in Chinese high schools is generally acceptable. In 2021, the ratio in China was 12.8. Looking at the longitudinal trend (see Fig. 4.3), from 2017 to 2021, the student–teacher ratio in Chinese high schools has been steadily decreasing. In 2017, the ratio was 13.4, and over the following years, it showed a gradual decline, reaching 12.8 by 2021. Here the student–teacher ratio in high schools in China is calculated by dividing the total number of enrolled students in a given year by the number of full-time equivalent teachers for that year.

The data on the student–teacher ratio in Chinese high schools reflects an effective allocation of teaching resources. The consistent decrease in this ratio in China indicates an improvement in the distribution of teachers relative to the number of students, suggesting a positive trend in the educational environment and the level of individual attention students receive.

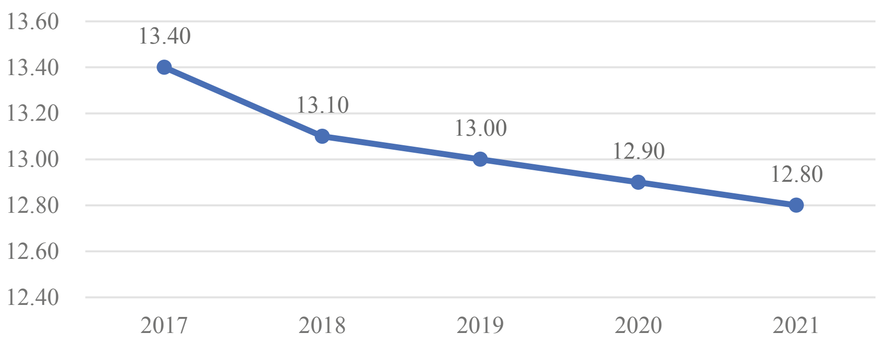


**Fig. 4.3** Graduation rate for high school education (2020) (%). *Source* MOE (2018a, 2019a, 2020a, 2021a, 2022b)

### *4.2.5 Percentage of Teachers with a Bachelor's Degree or Higher*

Studies indicate that educational quality is significantly associated with teachers' educational attainment (Rivkin et al., 2005). Despite the debates about the impact of teacher education level (Betts et al., 2003; Henry et al., 2014), many studies find that teacher education level is positively related to students' academic performance (Lee & Lee, 2020).

Since teachers' academic level could influence the quality of education, many countries have set minimum requirements on educational attainment for teachers. In China, high school teachers must have a bachelor's degree or above (MOE, 2021c). Longitudinal data (See Fig. 4.4) indicate that from 2017 to 2021, the proportion of general high school teachers in China with a bachelor's degree or higher has shown an overall upward trend. In 2017, the percentage stood at 98.2%, followed by a gradual increase over the next few years, reaching 98.8% in 2020. There was a slight decrease in 2021, with the percentage dipping to 98.7%. This demonstrates that in recent years, the proportion of general high school teachers in China holding a bachelor's degree or higher has been relatively high and stable.

When compared internationally, the percentage of high school teachers with a bachelor's degree or above in the core eight countries is generally high or close to 100% (See Fig. 4.5). Apart from the three countries with a perfect score, China ranks fourth, positioning it in the middle range. However, the gap between the top four countries is not significant. Therefore, the proportion of high school teachers in China with a bachelor's degree or above is within a reasonable range.

It is important to note that the original data offered by OECD include the distribution of upper secondary school teachers by education levels according to the International Standard Classification of Education (ISCED). In the framework of ISCED, the 6th and above level corresponds to a bachelor's degree or higher (OECD, 2022). It should be noted that OECD data does not distinguish between general and vocational upper secondary programs, meaning the statistics for countries other than China include both types of teachers. The data specific to China and Japan for this

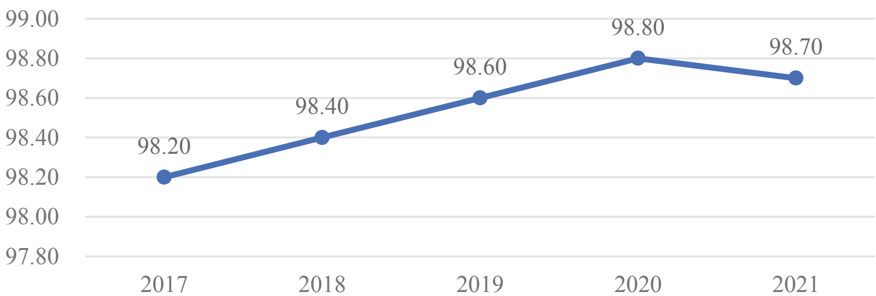


**Fig. 4.4** Percentage of Chinese high school teachers with a bachelor's degree or above, 2017–2021 (%). *Source* MOE (2018a, 2019a, 2020a, 2021a, 2022b)

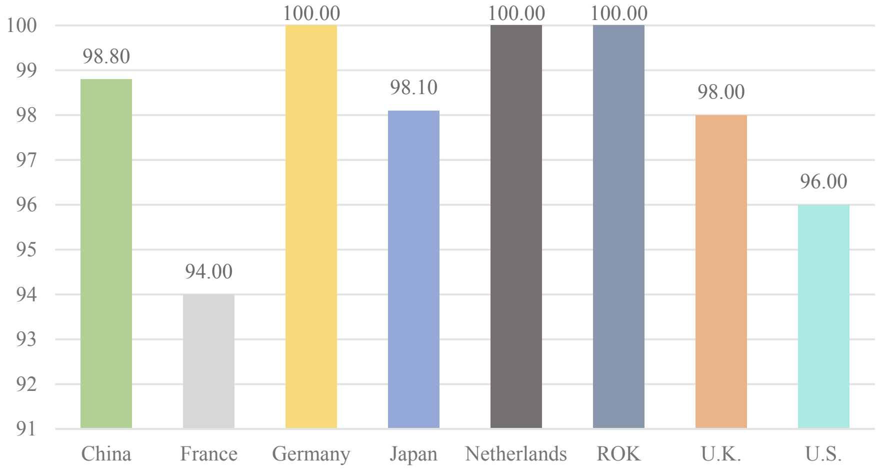


**Fig. 4.5** Percentage of high school teachers with a bachelor's degree or above (2020) (%). *Source* MOE (2021a); OECD (2022); MEXT (2023b)

indicator were computed based on the original figures from MOE (2022b) and MEXT (2023c).

### *4.2.6 Digital Facilities in School Infrastructures*

This section defines and evaluates several key sub-indicators of digital facilities. These indicators are critical in measuring the extent to which schools have integrated digital technologies into their educational and administrative processes (OECD, 2023b). The effective use of these technologies can significantly enhance the teaching and learning experience, promoting innovative educational approaches (*ibid*).

*Teacher and Student Digital Terminal Coverage Ratio.* The teacher and student digital terminal coverage ratio refers to the number of full-time teachers and students in schools divided by the number of digital terminals they possess within the school. According to the *Elementary and Secondary Schools Digital Campus Construction Standards (Trial)* introduced by MOE (2018b), digital terminals are defined as digital computing devices that facilitate information technology applications, supporting digital teaching and management activities for teachers, students, and administrators. This means that digital terminals include not only traditional desktop computers but also tablets and other devices. These ratios are essential for assessing the level of digital infrastructure in schools. For this section, the ratios were calculated based on the total number of full-time high school teachers and students in 2021 divided by the number of digital terminals they had that year.

In 2022, MOE began reporting the number of digital terminals in schools, replacing the previous reports on the number of desktop computers. According to

MOE (2022b), in 2021, the teacher digital terminals coverage ratio in Chinese high schools was 3.9, while the student digital terminals coverage ratio was 6.5. The findings show that high schools are yet to achieve the goal of providing one computer for every teacher. A student ratio of 6.5 is considered reasonable, given that students primarily use computers in IT classrooms. Nonetheless, in line with the continuous drive to enhance digital infrastructure in schools, there should be an emphasis on reducing the ratio of students to digital terminals in the future.

*Wi-Fi Coverage Rate*. The Wi-Fi coverage rate in schools is defined as the percentage of the school area that has access to Wi-Fi networks. Since many digital devices, like tablets, rely on wireless networks over wired connections, the Wi-Fi coverage rate is vital for assessing a school's digital connectivity and infrastructure. In 2021, the Wi-Fi coverage rate in Chinese high schools was 76.3% (MOE, 2022b). This demonstrates a significant level of digital infrastructure, showing progress in ensuring that a considerable portion of school areas have wireless internet access. Such connectivity is vital for modern educational methods and provides students and teachers with the necessary resources to facilitate mobile learning and ubiquitous learning experiences.

*Network Multimedia Classroom Coverage Rate*. The network multimedia classroom coverage rate is defined as the proportion of classrooms equipped with facilities that allow teachers to easily present multimedia teaching resources and access the internet and various digital educational resource libraries. These classrooms also maintain the functionalities of traditional teaching environments (MOE, 2014).

In 2021, the Network Multimedia Classroom Coverage Rate was 76.3% (MOE, 2022b). This is a positive indication of the advancement of educational technology within schools. Having such a high rate of networked multimedia classrooms means that many students have access to interactive and diverse learning tools, which can significantly enhance the educational experience.

In summary, these rates reflect a commendable level of digital integration in Chinese high schools. The significant coverage of both Wi-Fi and network multimedia classrooms indicates a strong commitment to incorporating modern technology into the educational environment, benefiting both teaching and learning. However, in terms of digital terminals, there is a need to increase the availability of digital devices for both teachers and students, especially for teachers.

### *4.2.7 Facility and Equipment Compliance Rate*

The requirement for sufficient facilities and equipment is fundamental to school infrastructure and educational goals. In China, high schools are required to have certain essential facilities and equipment, including sports fields, sports equipment, musical instruments, art materials, and science laboratory instruments. In this section, the facility and equipment compliance rate is calculated by dividing the number of high schools that meet the standards by the total number of high schools. The

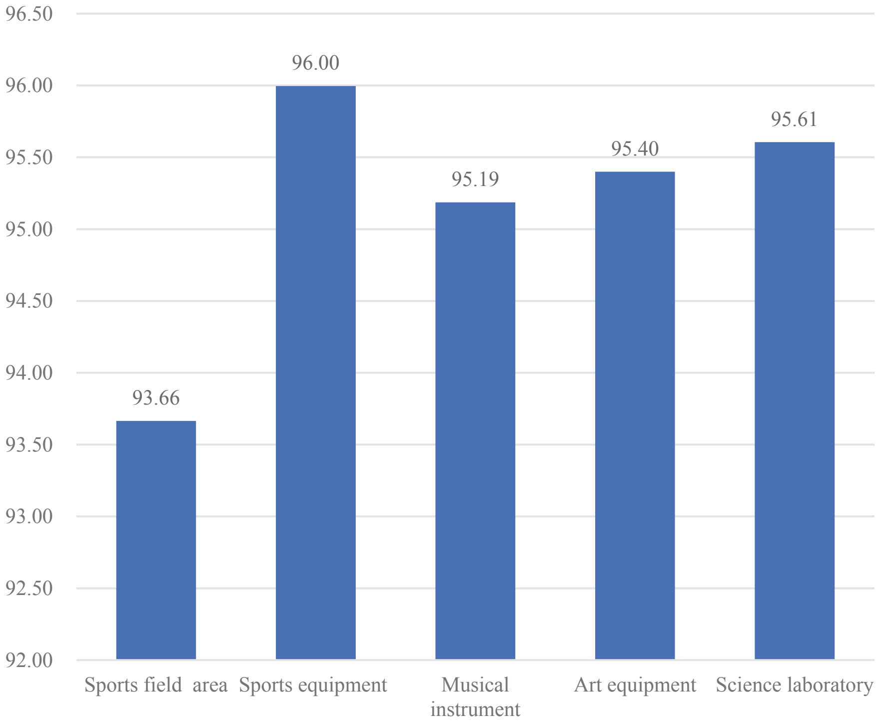


**Fig. 4.6** The percentage of high schools in China meeting the required standards for various facilities and equipment (2021) (%). *Source* MOE (2022b)

percentage of high schools in China meeting the required standards for various facilities and equipment is shown in Fig. 4.6 (Fig. 4.7).

In 2021, the overall compliance rate for facilities and equipment in Chinese high schools was high. The compliance rate across all categories exceeded 90% in 2021 (*ibid*). Specifically, the compliance rate for sports equipment was the highest at 96%, while the compliance rate for the sports field area was the lowest at 93.1%. This lower rate for sports fields could be attributed to the stringent area requirements and the high investment needed for their construction. This indicates a need for further improvement in the construction and development of sports facilities in Chinese high schools.

On the other hand, a longitudinal view from 2017 to 2021 shows that the overall compliance rate for facilities and equipment in Chinese high schools has increased. The trend in the facility and equipment compliance rates in China from 2017 to 2022 can be seen in Fig. 4.8. Starting from a baseline where all categories of facilities and equipment exceeded a 90% compliance rate in 2017, there has been a gradual and steady increase in the rates for each category. Notably, the rise in the compliance rate for musical instruments was the most significant, increasing from 91.5% in 2017 to 95.2% in 2021.

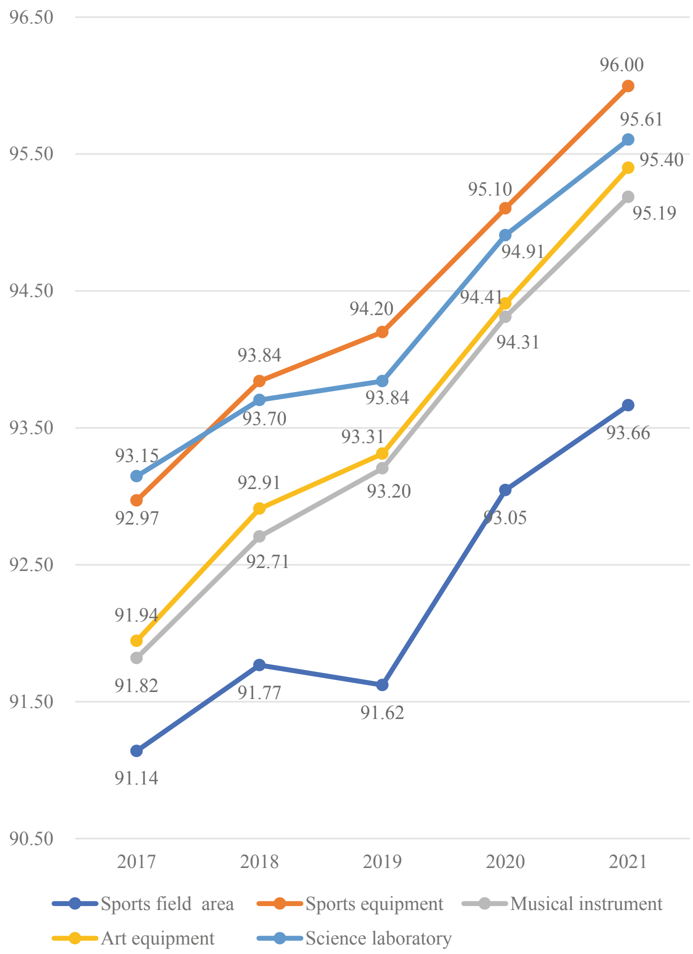


**Fig. 4.7** The percentage of high schools in China meeting the required standards for various facilities and equipment (2017–2021) (%). *Source* MOE (2018a, 2019a, 2020a, 2021a, 2022b)

It is important to highlight that science laboratory equipment was the only category to show a fluctuating increase over the past 5 years. After reaching 93% in 2018, there was a decrease to 91.8% in 2019, with no increase in 2020, before it finally rose to 93.1% in 2021. In conclusion, the trend in compliance rates for facilities and equipment in Chinese high schools from 2017 to 2021 overall shows a slow but steady increase, with room for improvement particularly in science laboratory equipment.

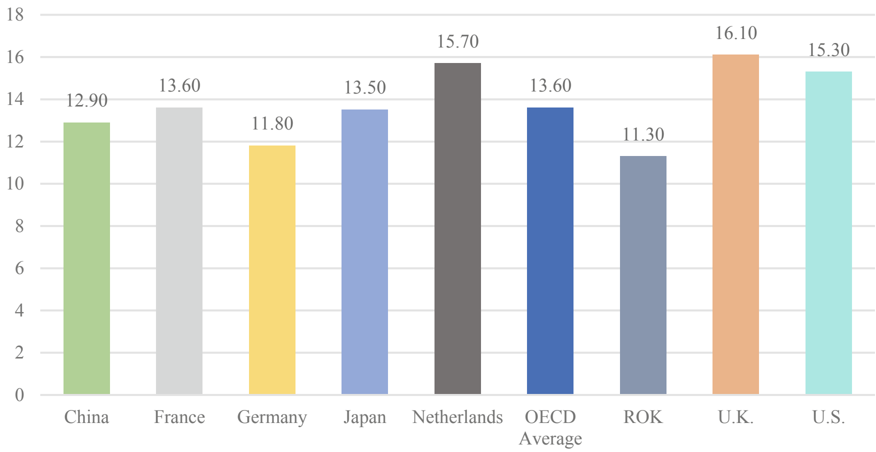


**Fig. 4.8** Student–teacher ratio of high school (2020). *Source* MOE (2022b); OECD (2023a); MEXT (2023b)

## 4.3 Excellent Index

The performance of Chinese high school education in terms of learning outcomes has been impressive. However, there currently exists a gap in the evaluation of high school excellence from an international perspective, particularly in considering indicators beyond academic performance. Therefore, establishing an excellence index for Chinese high school education within a global context is of significant importance.

Compared to the previous edition, the index design in this current book has made two significant adjustments. Firstly, in addition to providing indicators, we have also calculated corresponding indexes based on these indicators, providing a more intuitive understanding for the audience. This shift emphasizes a comprehensive and integrated view of the various factors that contribute to educational quality.

Secondly, there has been an adjustment in the sources of data. The revised data set allows for more thorough comparisons across multiple countries, raising the analysis from the school level to the national level. These modifications aim to enhance the utility and relevance of the analysis, offering broader insights into the excellence of high school education on an international scale. By focusing on globally comparative data, this new approach helps to contextualize China's position in terms of high school education quality relative to other leading nations, providing valuable perspectives for educational stakeholders and policymakers.

**Table 4.2** An overview of the excellence index

| Dimensions | Indicators | Data resources |
|---|---|---|
| Resources and scale | Student–teacher ratio<br>Per-student expenditure<br>Percentage of teachers with a master's degree or higher | OECD, MOE, MEXT<br>2018 PISA database |
| Performance | Cognitive performance<br>Non-cognitive performance | OECD, MOE, NBS |
| School climate | | OECD, MOE |
| Output | The proportion of students admitted to 4-year universities<br>The proportion of students admitted to leading universities | MOE<br>Korean Education Statistics Service<br>U.S. Bureau of Labor Statistics<br>MEXT<br>U.K. Parliament<br>OECD |

### *4.3.1 Design*

Four dimensions are chosen to examine high school excellence at the global level: Resources and Scale, Performance, School Climate, and Output (see Table 4.2). Within Resources and Scale, there are three indicators: student–teacher ratio, per-student expenditure, and the percentage of teachers with a master's degree or higher. Performance includes two indicators: cognitive performance and non-cognitive performance. The Output category consists of two indicators: university admission rate and leading university admission rate.

In terms of data comparability and availability, this analysis selected indexes that are internationally comparable, and the data for these indicators were sourced from the same OECD database, MOE, and official websites of education ministries from various countries, allowing for substantive comparisons. The consistency of the underlying definitions of these data is ensured when data for the same index are sourced from different databases. However, it must be acknowledged that for some indexes, data from certain countries may be insufficient. The upcoming sections will detail these specifics.

### *4.3.2 Data Sources*

The set of indexes for evaluating excellent high schools is listed in Table 4.2.

### *4.3.3 Resources and Scale*

There are three indicators under the resources and scale dimension: student–teacher ratio, expenditure on educational institutions per full-time equivalent student, and the percentage of teachers with a master's degree or higher. Table 4.3 shows the definitions of the index.

*Student–Teacher Ratio*. As China's student–teacher ratio was discussed in Sect. 2.4, this section focuses on the international comparison. The results of the student–teacher ratio across the eight core countries are shown in Fig. 4.8.

In terms of international comparison, China's student–teacher ratio is relatively low. In 2020, China's ratio was 12.9. Compared with the eight core countries, China ranked third, with the lowest being ROK at 11.3, and the highest being the United Kingdom (U.K) with a ratio of 16.1. This indicates that China's student–teacher ratio is in an ideal state.

*Per-student expenditure*. Per-student expenditure indicates the estimated absolute amount of financial support for education on a per-student basis. A large body of evidence suggests that financial resources play a significant role in determining education quality (UNESCO, 2016). Prior studies have reported associations between increased educational spending and better student outcomes, including test scores and graduation rates (Carter, 2014; Jackson et al., 2015). To facilitate accurate international comparisons, this index is expressed in USD adjusted for Purchasing Power Parity (PPP), which adjusts for differences in national currencies and cost of living. Figure 4.9 shows the total expenditure on educational institutions per full-time equivalent student.

According to Fig. 4.9, China's per-student expenditure is significantly lower, approximately one-third of that observed in other compared countries. In 2020, China's per-student expenditure amounted to USD4,468. In a comparison with eight countries, China ranks last, with a significant gap compared to the highest spender, the U.S., which invests USD16,775 per student, and an average expenditure of USD11,379.

Longitudinal data (see Fig. 4.10) show that China's per-student expenditure has consistently increased from 2017 to 2022. In 2017, the expenditure was USD3,618, surpassing USD4,000 in 2019, and achieving a substantial increase in 2022, reaching USD6,180. The data indicates a gradual rise in China's per-student spending from

**Table 4.3** Definitions of the resources and scale indicators

| Indicators | Definitions |
|---|---|
| Student–teacher ratio | The ratio of total student enrollment to the full-time equivalent teachers |
| Percentage of teachers with a master's degree or higher | The percentage of teachers that obtain a master's degree or higher |
| Per-student expenditure | Total expenditure on educational institutions per full-time equivalent student |

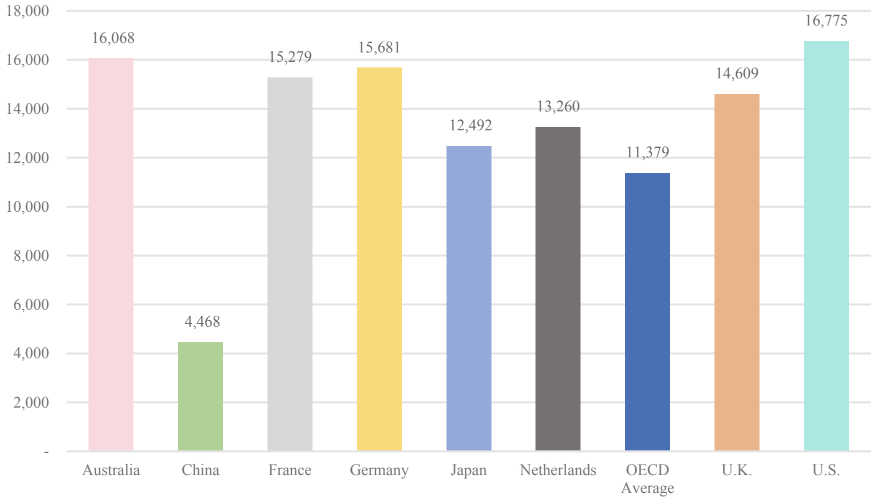


**Fig. 4.9** Per-student expenditure of high school education (2020) (USD adjusted for PPP). *Source* OECD (2021a); MOE (2021b)

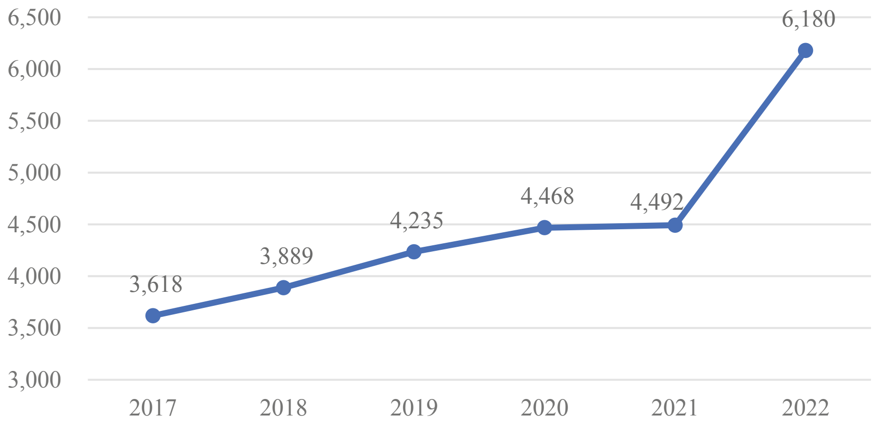


**Fig. 4.10** Per-student expenditure of high school education in China (2017–2022) (USD adjusted for PPP). *Source* MOE (2018a, 2019b, 2020b, 2021b, 2022c, 2023b)

2017 to 2020, with a significant leap in 2022–a 37.5% increase compared to 2021. This progression reflects China's growing investment in education per student, marking a notable shift toward enhancing educational resources and quality.

In summary, the year-over-year increase in per-student expenditure in China indicates the government's strong commitment to education, with continually growing investment in this sector in recent years. However, despite these efforts to increase educational funding, there remains a significant gap between China, a populous developing country, and developed nations in terms of per-student expenditure. Addressing this gap is crucial for China to further improve the quality of its educational system and align more closely with global standards.

*Percentage of Teachers with a Master's Degree or Higher.* The academic level of teachers is a critical factor that influences educational quality. Consequently, a significant number of teachers pursue advanced degrees such as a master's or higher. The proportion of high school teachers with a master's degree or higher is illustrated in Fig. 4.11. It is important to note that, except for China and Japan, the figures for other countries represent the proportion of upper secondary education teachers, encompassing both general and vocational secondary teachers. Additionally, the calculation of the percentage of teachers with a master's degree in China and Japan is done manually, by dividing the total number of teachers with a master's degree by the total number of employed teachers.

Based on Fig. 4.11, in 2020, the proportion of high school teachers in China with a master's degree or higher was relatively low, at 11.5%. Among the eight core countries analyzed, China ranked last. The highest was Germany, where 100% of high school teachers hold a master's degree or higher, while Japan, on the lower end, had a rate of 16.8%. This data indicates that the proportion of high school teachers in China with advanced degrees is comparatively low and there is a significant need for improvement in this area.

Although the proportion of high school teachers in China with master's degrees is relatively low on a global scale, longitudinal data (see Fig. 4.12) show a continuous increase over the past 5 years. The percentage of teachers in ordinary high schools in China with a master's degree or higher was 8.9% in 2017 and has been rising year by year, reaching 12.3% in 2021.

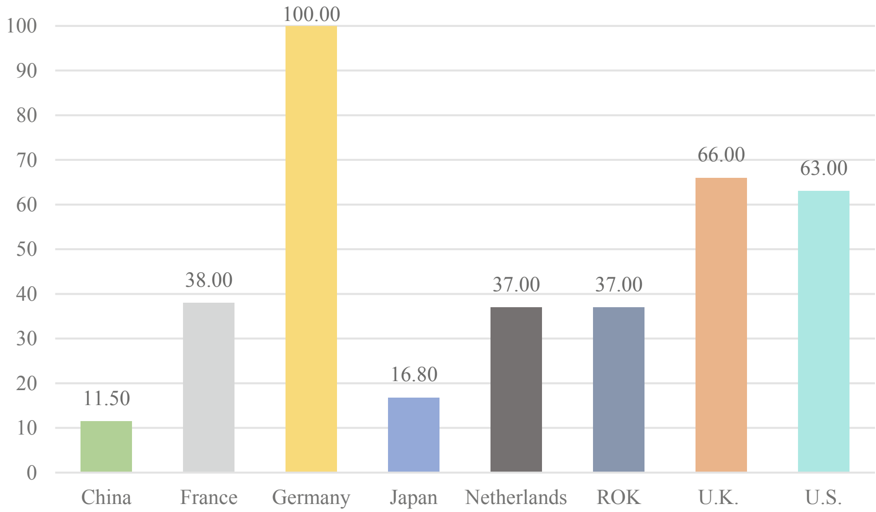


**Fig. 4.11** Percentage of high school teachers with a master's degree or above (2020) (%). *Source* MOE (2021a); OECD (2022); MEXT (2023c). *Notes* The data for Japan is from the year 2019

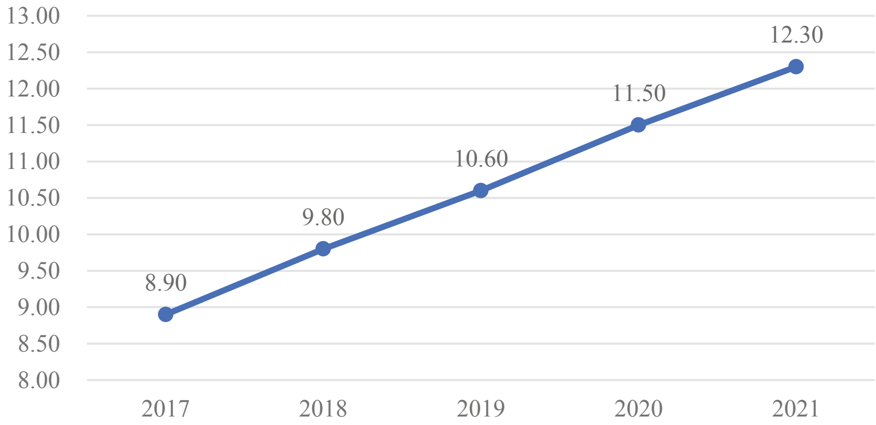


**Fig. 4.12** Percentage of high school teachers with a master's degree or above in China (2017–2021) (%). *Source* MOE (2018a, 2019a, 2020a, 2021a, 2022b)

This upward trend demonstrates China's efforts to enhance the qualifications of its high school teaching staff, a crucial step towards improving the overall quality of education. In recent years, the government has continuously implemented various policies to enhance the training and selection of high school teachers, encouraging outstanding young individuals to pursue teaching careers in high schools (refer to Sect. 4.6 for more details). In summary, there is considerable room for improvement in the proportion of teachers in China with master's degrees, and efforts will be focused on continuous advancement in the future.

### *4.3.4 Performance*

There are two indicators under the Performance dimension: cognitive performance and non-cognitive performance. Table 4.4 outlines the definitions of these indicators. It is important to note that the data for this index primarily comes from the PISA 2018 database. Upon review, it was noted that the sample sizes for Germany and the U.K. were relatively small (NGermany = 44, NUK = 160), and the data for the U.K. primarily represents England. Therefore, the data for these two countries are presented for reference only and are not included in the excellence indicators ranking or detailed analysis.

*Cognitive performance*. In this section, high school students' cognitive performance was assessed by the PISA 2018 assessments, including their performance in reading, mathematics, and science. High school students' performance is shown in Figs. 4.13, 4.14, 4.15 and 4.16.

In terms of reading performance, Chinese high school students achieve an average score of 598 points, making them the top performers among the countries compared.

**Table 4.4** Definitions of the performance indicators

| Indicators | Definitions |
|---|---|
| Cognitive performance | Students' academic performance, including their achievements in reading, mathematics, and science |
| Non-cognitive performance | Students' non-cognitive characteristics and abilities, such as a growth mindset and persistence |

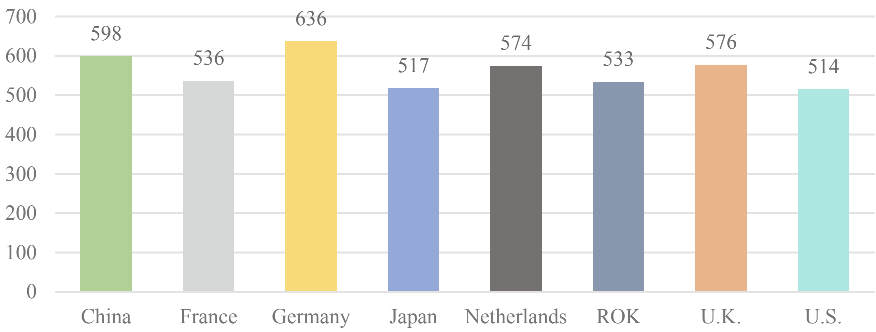


**Fig. 4.13** Cognitive performance of high school students in reading, as measured by PISA 2018. *Source* OECD (2019b)

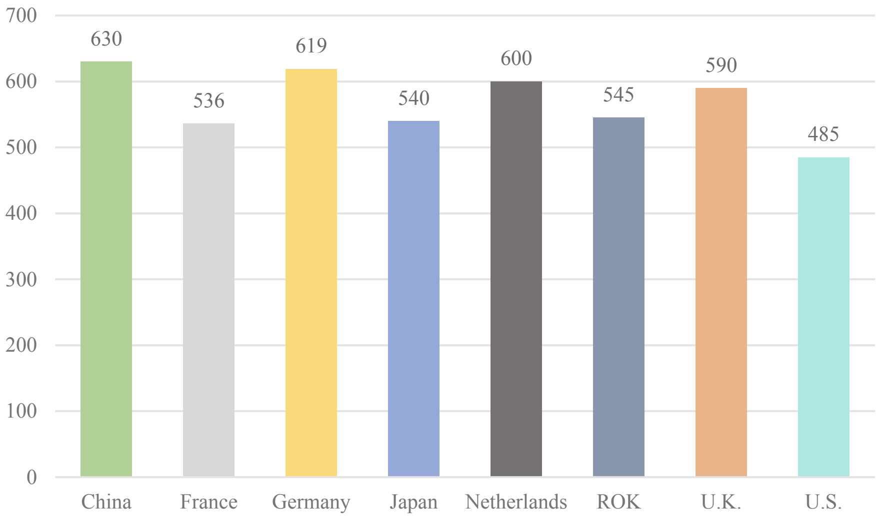


**Fig. 4.14** Cognitive performance of high school students in mathematics, as measured by PISA 2018. *Source* OECD (2019b)

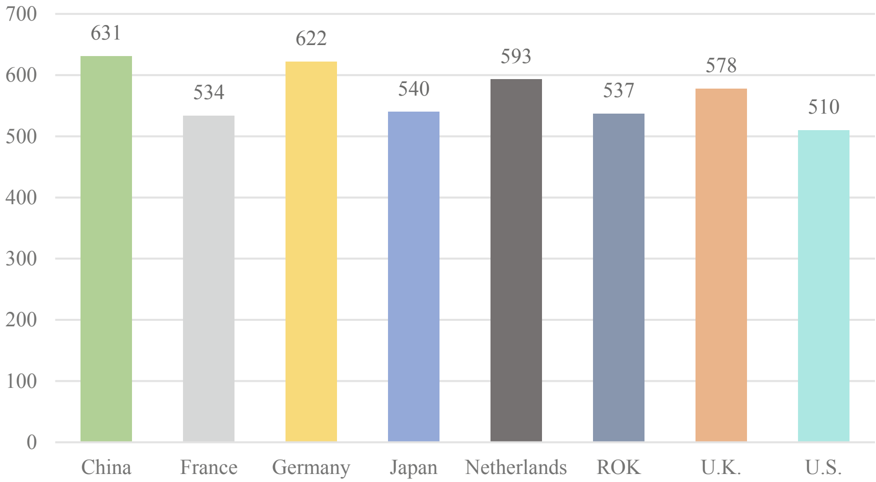


**Fig. 4.15** Cognitive performance of high school students in science, as measured by PISA 2018. *Source* OECD (2019b)

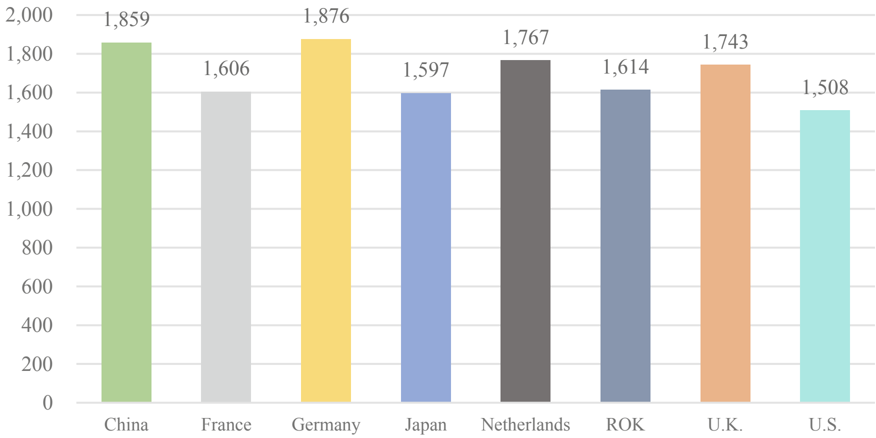


**Fig. 4.16** Cognitive performance of high school students (overall score), as measured by PISA 2018. *Source* OECD (2019b)

This ranking places China ahead of France (536 points), the U.S. (514 points), Japan (517 points), and the ROK (533 points). The results indicate that Chinese students excel in reading comprehension and interpretation skills, showcasing the strength of China's focus on language arts education and suggesting a robust foundation in critical thinking and analytical abilities.

Regarding mathematics, Chinese students are top performers with an average score of 630 points. This score positions China as the leading country in mathematics among the compared nations, significantly surpassing the ROK (545 points), Japan

(540 points), and notably higher than the U.S. (498 points). These results indicate a high proficiency in mathematical reasoning and problem-solving skills among Chinese students, highlighting the effectiveness of China's mathematics curriculum and its emphasis on developing quantitative and analytical competencies.

In science, Chinese students also demonstrate exceptional performance with an average score of 631 points. Among the compared countries, this score places China at the top, above Japan (540 points), and ROK (537 points), and notably higher than the U.S. (510 points). This leading position in science indicates that Chinese students possess a strong understanding of scientific principles and are adept at applying these concepts to complex scenarios.

When considering the combined scores across all three disciplines, China's total of 1,859 points solidifies its position as the top-ranked country among those compared. This score is higher than ROK (1,614 points), Japan (1,597 points), and notably higher than the U.S. (1,508 points).

In summary, the results indicate China's foremost position in high school education on the international stage. This comprehensive performance illustrates the overall effectiveness and quality of China's high school educational system in a global context. Moving forward, China aims to maintain its world-leading status while striving to further enhance the cognitive abilities of its high school students.

*Non-Cognitive Performance*. The evaluation of non-cognitive performance involves a variety of measures. In this section, three key scales were chosen to assess high school students' non-cognitive performance according to the PISA 2018 student questionnaire. These scales are growth mindset, resilience, and mastery goal orientation. The performance of high school students in these non-cognitive areas is displayed in Figs. 4.17, 4.18 and 4.19. It should be noted that the data has been adjusted for analytical clarity. The average score for each indicator was set as the baseline at zero, with other scores recalibrated relative to this average. This adjustment provides a more straightforward comparison of students' performance in non-cognitive aspects across different countries.

Regarding the growth mindset, defined as the belief in the developmental potential of one's abilities and intelligence over time (Dweck, 2006), a growth mindset is crucial in assessing student adaptability and learning attitudes. This index is particularly significant due to its strong correlation with various personal traits, such as motivation, self-efficacy, and fear of failure (OECD, 2019e). In the context of education post-pandemic, a growth mindset has gained increased relevance and is recognized as a key aspect of future education by the OECD (2018). In this study, the growth mindset is measured by responses to the statement: "Your intelligence is something about you that you can't change very much."

From Fig. 4.17, China's score of 0.29 on the growth mindset scale indicates a leaning towards a fixed mindset, with higher scores representing a lower presence of a growth mindset. Consequently, China ranks last among the six core countries analyzed. The U.S. leads with a score of −0.09, showing a significantly stronger belief in a growth mindset compared to other nations. Among Asian countries, Japan performs the best with a score of 0.04. China's standing is closer to that of countries like the Netherlands (0.23) and ROK (0.25). This data highlights the importance for

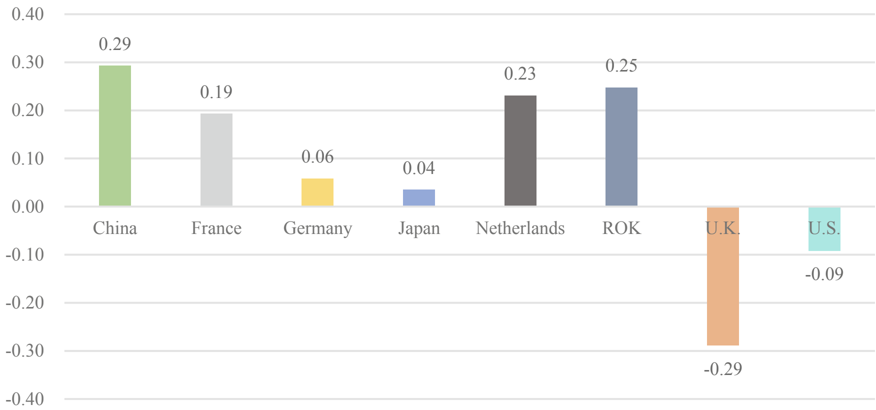


**Fig. 4.17** Non-cognitive performance of high school students in the growth mindset, as measured by PISA 2018. *Source* OECD (2019b)

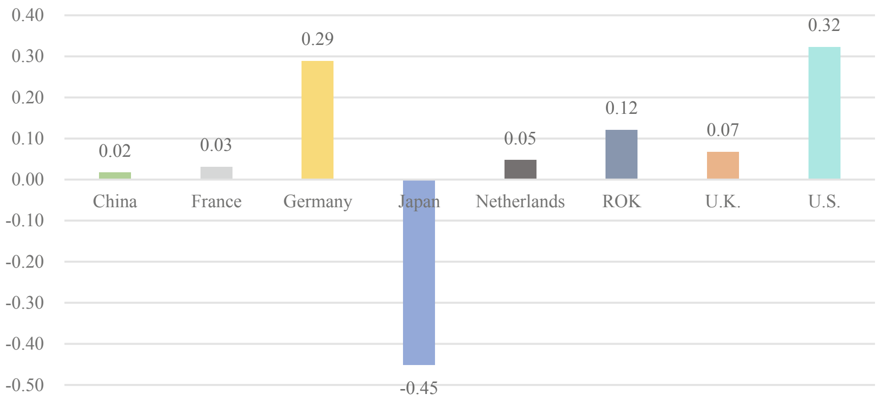


**Fig. 4.18** Non-cognitive performance of high school students in resilience, as measured by PISA 2018. *Source* OECD (2019b)

China to promote and cultivate a growth mindset in its students, focusing on the potential for personal development and learning.

In terms of resilience, defined as the ability of students to cope with adversity (OECD, 2019d), it is an index reflecting students' non-cognitive abilities. This index positively correlates with cognitive adaptability, the capacity to adjust one's thinking and behavior according to the current culture, new environments, or challenges (*ibid*). A strong resilience in students is indicative of a higher likelihood of developing adaptive cognition, creativity, and innovative thinking. Similar to the growth mindset, resilience is a crucial non-cognitive skill in the post-pandemic era. Focusing on building resilience is essential for students to effectively navigate challenges and adapt to changing circumstances in their academic and personal lives.

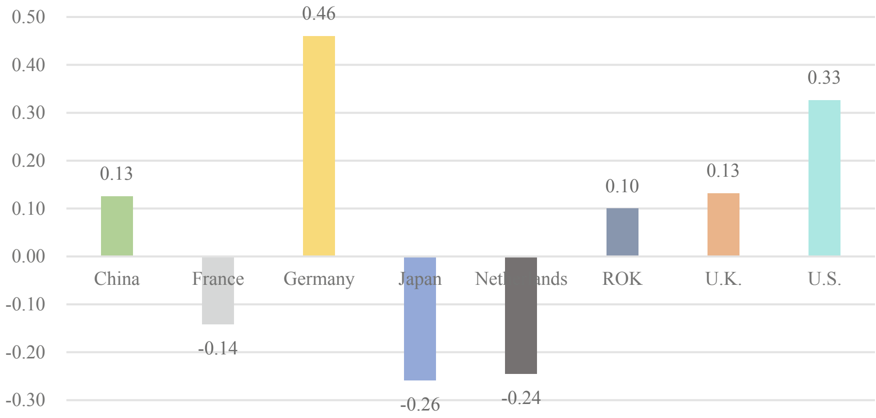


**Fig. 4.19** Non-cognitive performance of high school students in mastery goal of orientation, as measured by PISA 2018. *Source* OECD (2019b)

The results from Fig. 4.18 show that Chinese high school students' performance in resilience is relatively weaker compared to other countries. In 2018, Chinese students scored 0.02 in resilience. Among the six core countries, China ranks fifth, with the U.S. leading at 0.32, significantly higher than other nations. The lowest score is observed in Japan at −0.45. From a comparative perspective, the U.S., with the highest score, demonstrates a strong capacity for student resilience, which may reflect a more supportive environment or effective strategies for developing coping mechanisms. On the other hand, Japan's negative score indicates a potential area for improvement in fostering resilience among students. China's position, while not at the bottom, still shows room for development in enhancing resilience among its high school students.

In terms of mastery goal orientation, this indicator refers to students' learning objectives being more inclined towards mastering the subject matter and skills, as opposed to performance goal orientation, which focuses on achieving high academic performance, such as high grades (Elliot & Murayama, 2008). Mastery goal orientation is closely related to the ability of knowledge transfer: students with a strong mastery goal orientation are more likely to deeply understand and transfer their knowledge into new situations (Belenky & Nokes-Malach, 2012). Therefore, mastery goal orientation is a crucial trait for outstanding high school students.

From Fig. 4.19, Chinese high school students show a relative advantage in mastery goal orientation. In 2018, Chinese students scored 0.13 in mastery goal orientation, positioning them second among the six core countries. The U.S. leads with a score of 0.33, while Japan scores the lowest at −0.26, indicating a lesser focus on mastery goal orientation. Meanwhile, other countries also exhibit a lesser degree of mastery goal orientation, potentially indicating a greater emphasis on performance-oriented learning objectives. Overall, the data indicates that mastery goal orientation varies among countries, with China exhibiting a distinct strength in mastery learning, reflecting an educational emphasis on deep learning and comprehension.

In summary, regarding non-cognitive performance, Chinese high school students exhibit mixed results. While Chinese students show positive results in mastery goal orientation, there is a need for more focus on cultivating growth mindsets and resilience to prepare them for the challenges of the future.

### *4.3.5 School Climate*

School climate refers to the overall environment within a school. The state of the school's facilities, the tone of the conversations in corridors, the enthusiasm of the school staff, and the way students interact during breaks are some of the signs that visitors can read to quickly and broadly assess a school's climate (OECD, 2019e). High school climate is evaluated through three indicators: student cooperation, teacher support, and adaptive instruction. These scales collectively contribute to understanding the school climate from different perspectives. The definitions of these scales are summarized in Table 4.5. It should be noted that due to the limited sample size from Germany and the U.K. in the PISA 2018 database (see more details in Sect. 4.3.4), data from these two countries are only presented for reference and are not included in rankings or detailed analyses. Similar to the prior section, the values for the indicators have undergone a transformation for ease of comparison. The average score for each indicator has been established as the baseline, set at zero. Scores from various countries have been recalibrated relative to this average, allowing for a clearer comparative analysis of the school atmosphere across different nations. The school climate in high schools among the countries, as perceived through these scales, is presented in Figs. 4.20, 4.21 and 4.22.

*Student co-operation.* The significance of cooperative behaviors in educational settings is well-established. Cooperative learning environments are associated with better academic performance, positive relationships, and a stronger sense of belonging (*ibid*). From Fig. 4.20, Chinese high school students achieve a score of 0.19, which indicates a reasonably good level of collaboration among students. When compared with six core countries, China ranks third, with ROK and the Netherlands

**Table 4.5** Definitions of the school atmosphere indicators

| Scales | Definitions |
|---|---|
| Student co-operation | Students' perceptions of their peers' willingness to cooperate in a learning environment |
| Teacher support | The extent to which students feel supported by their teachers |
| Adaptive instruction | The adaptability of teaching methods to the needs and abilities of students, as perceived by the students themselves |

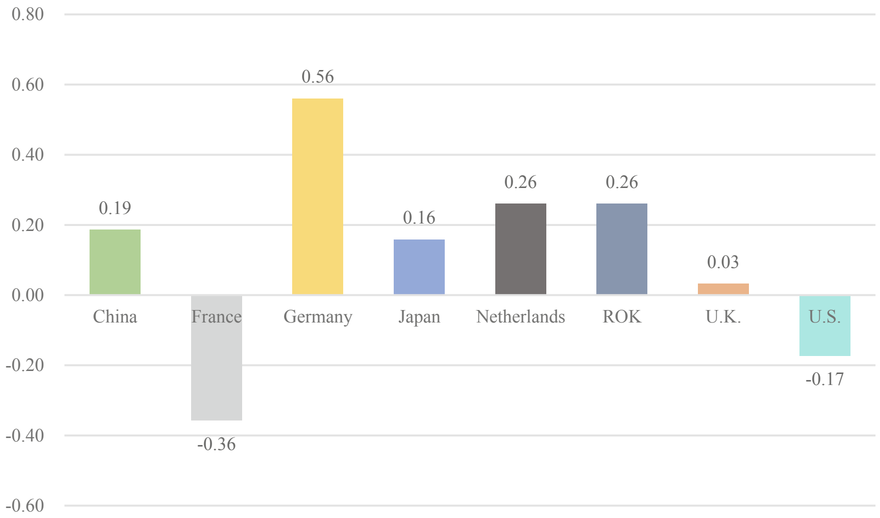


**Fig. 4.20** School atmosphere in high school based on student cooperation, as measured by PISA 2018. *Source* OECD (2019b)

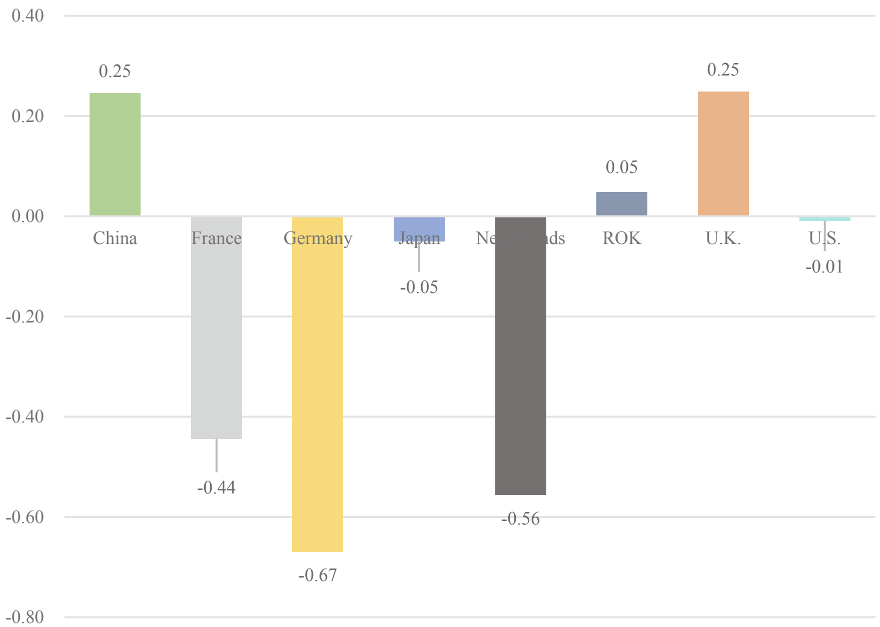


**Fig. 4.21** School atmosphere in high school based on teacher support, as measured by PISA 2018. *Source* OECD (2019b)

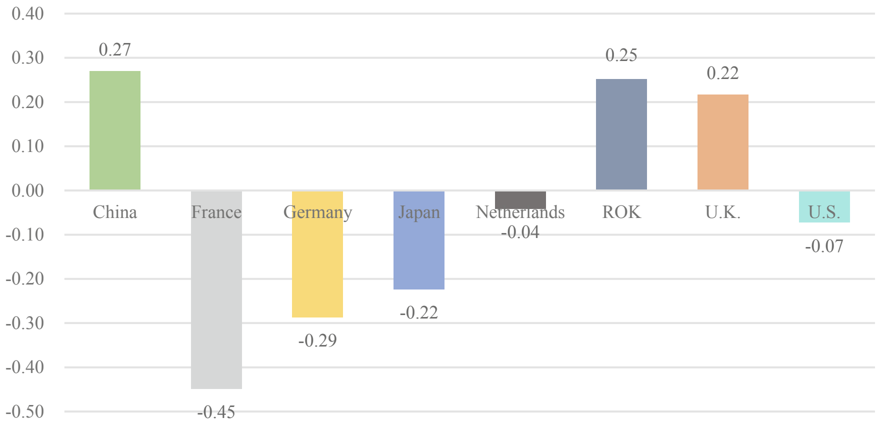


**Fig. 4.22** School atmosphere in high school based on adaptive instruction, as measured by PISA 2018. *Source* OECD (2019b)

leading at 0.26 and France at the lowest with -0.36. These results suggest that while students in China show a positive tendency to work together, there is still potential for further improvement in student cooperation.

*Teacher support*. The role of teacher support is critical in shaping students' learning experiences and attitudes toward school. Supportive teachers can significantly boost student motivation (OECD, 2019f). In Fig. 4.21, China leads among the six core countries in teacher support with a score of 0.25, indicating a strong perception of support from teachers among Chinese students. The Netherlands scores the lowest at -0.56. The results reveal that Chinese high school teachers provide a supportive and motivating environment for students, contributing positively to student engagement and achievement.

*Adaptive instruction*. Adaptive instruction refers to instructional approaches that cater to individual student needs, aiming to improve the overall quality of education (OECD, 2019e). This personalized approach to teaching enables educators to address the unique learning requirements of each student, thereby enhancing the effectiveness of the educational process. From Fig. 4.22, China ranks first in adaptive instruction with a score of 0.27, followed closely by ROK at 0.25, while France scores the lowest at −0.45. This leading position indicates that Chinese students perceive their teachers as highly adaptable and responsive, which is key for effective teaching and learning.

In summary, China demonstrates strengths in all three areas, particularly in teacher support and adaptive instruction, indicating a conducive learning environment. This environment, characterized by supportive teachers and personalized teaching methods, is likely to have a positive impact on student learning outcomes and overall school experience. While China excels in these aspects, continuous efforts to enhance student cooperation can further strengthen its school atmosphere.

### 4.3.6 Output

There are two indicators under the category of Output: the proportion of students admitted to-year universities and the proportion of students admitted to top universities (see Table 4.6).

*The Proportion of Students Admitted to 4-Year Universities.* The proportion of students admitted to 4-year universities is a significant indicator measuring the transition from high school to higher education. This indicator sheds light on the effectiveness of high schools in preparing students for undergraduate studies. Figure 4.23 presents the result for this indicator among various countries.

The methodology for calculating this rate varies by country. The proportion of students admitted to 4-year universities in China, ROK, the U.S., and Japan for the year 2020 was calculated by dividing the total number of high school graduates for the year by the number of admissions to general universities in the same year. For China and ROK, these ratios were calculated manually based on official data sourced from MOE (2021a) and the Korean Education Statistics Service (2023). The data for the U.S. and Japan were directly sourced from the National Center for Education Statistics (2021) and the (MEXT, 2023a), respectively. The U.K.'s data was obtained

**Table 4.6** Definitions of the output indicators

| Indicators | Definitions |
|---|---|
| University admission rate | The percentage of students admitted to the government-approved 4-year universities |
| Leading university admission rates | The proportions of high school graduates gaining admission to leading universities in each country. For China, this refers to the C9 league; in the U.S., it includes the top 24 universities; the U.K.'s G5 alliance; Japan's imperial seven; and ROK's SKY alliance |

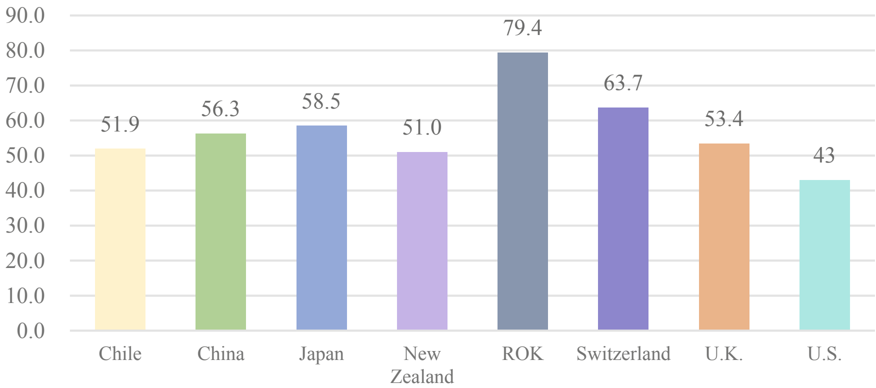


**Fig. 4.23** The proportion of students admitted to 4-year universities (2020) (%). *Source* The Department for Education UK (2021); National Center for Education Statistics (2021); MOE (2022b); Korean Education Statistics Service (2023); MEXT (2023a); OECD (2023a)

from the Department for Education UK (2021), while other countries' data were derived from OECD (2023a), which tracks the proportion of high school graduates entering 4-year universities in 2020.

According to Fig. 4.23, China's performance in this indicator is average. In 2020, 56.3% of Chinese high school students were admitted to undergraduate programs through the national college entrance examination (*Gaokao*). Among the eight countries analyzed, China ranks fourth. ROK leads with the highest rate of 79.4%, while the U.S. has the lowest rate at 43%. This data suggests that there is room for improvement in China's high school education system to better prepare students for admission to undergraduate programs.

*Proportion of Students Admitted to Leading Universities.* This is a key indicator of a high school's effectiveness in preparing students for academic excellence. Renowned universities offer superior educational opportunities and resources, and securing a place in these institutions is often highly competitive, requiring exceptional academic and extracurricular accomplishments. Thus, the percentage of students accepted into these top universities is a measure of a high school's success in developing student capabilities. The results of the proportion of students admitted to top universities are shown in Fig. 4.24.

The data are sourced from five countries: China, the U.S., the U.K., Japan, and ROK. The figures were estimated by dividing the enrollment numbers to top-tier universities by the number of high school graduates in 2021 in the same year. For the U.K., the calculation only includes upper secondary graduates with A-levels and International Baccalaureate qualifications, primarily from England, leading to a potentially smaller dataset.[1]

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[1] Here, leading universities refer to the most recognized and prestigious university groups in each country except the U.S. Below are the details of the universities included for each country:

China: The universities considered are those in the C9 League. The C9 League is an alliance of nine elite universities in China, known for their high academic standards and significant influence. The universities in the C9 League are: Peking University, Tsinghua University, Fudan University, University of Science and Technology of China, Nanjing University, Harbin Institute of Technology, Shanghai Jiao Tong University (SJTU), Xi'an Jiao Tong University, and Zhejiang University.

The U.S.: Due to the large number of prestigious universities in the U.S., the analysis includes 24 universities that consistently rank highly across the four major global rankings (QS, Times, ARWU, U.S. News). These selected universities are renowned for their academic excellence and consistently feature within the top 50 positions in these rankings. These universities are: Harvard University, Stanford University, Massachusetts Institute of Technology (MIT), University of California, Berkeley (UCB), Princeton University, Columbia University, California Institute of Technology, University of Chicago, Yale University, Cornell University, University of California, Los Angeles (UCLA), Johns Hopkins University, University of Pennsylvania, University of Washington, University of California, San Diego (UCSD), New York University, University of Michigan-Ann Arbor, University of North Carolina at Chapel Hill, Northwestern University, Duke University, University of Wisconsin-Madison, University of Texas at Austin, University of Illinois at Urbana-Champaign, and Brown University.

The U.K.: The analysis includes universities from the G5 Group. The G5 is a group of five leading U.K. universities with a strong emphasis on research and academic excellence. The G5 universities are: University of Oxford, University of Cambridge, Imperial College London (IC), The London School of Economics and Political Science (LSE), and University College London (UCL).

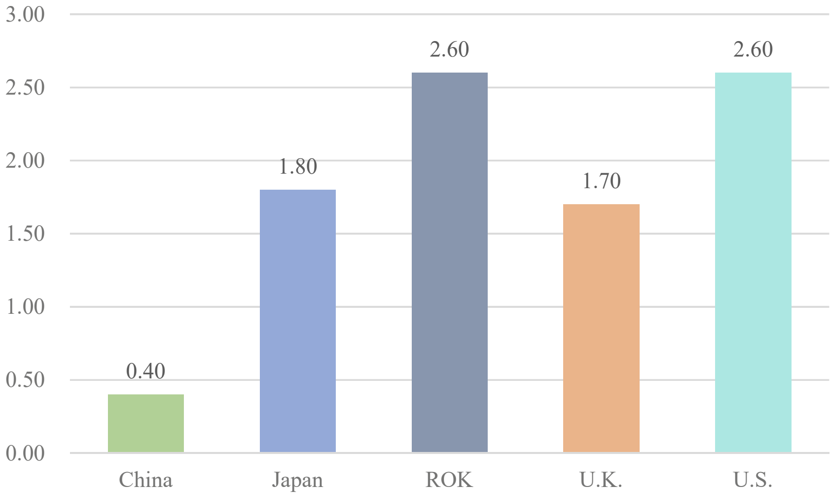


**Fig. 4.24** The proportion of students admitted to leading universities (%) (2021). *Sources* The admission rates for leading universities were calculated by dividing the total number of enrollments of domicile students in leading universities in each country by the total number of local high school graduates for that year. The total enrollment numbers for leading universities were primarily retrieved from the official websites of each university. For a few Chinese universities that did not publish their enrollment numbers, alternative non-official data sources were used. The number of high school graduates in each country was acquired from government or official databases. For specific details, please see the footnotes on this page[2]

[2] China C9 League: Fudan University (2022); MOE (2022a); Shanghai Jiao Tong University (2022); Sohu (2022); Harbin Institute of Technology. (2021); Nanjing University (2021); Peking University (2021); Tsinghua University. (2021); University of Science and Technology of China (2021); Xi'an Jiaotong University (2021); Zhejiang University (2020).

U.K. G5 League: Ofqual (2021); University of Cambridge (2021); Allan (2022); IC (2022); LSE (2022); UCL (2022); University of Oxford (2022). For UCL, the proportion of domicile students in 2021's new university entrants was not provided. Thus, the number of domicile enrollments was approximated by multiplying the proportion of domicile students in the entire undergraduate program by the total number of new entrants in 2021.

Imperial Universities of Japan: Hokkaido University (2021); Kyoto University (2021); Kyushu University (2021); MEXT (2023b); Nagoya University (2021); Osaka University (2021); Tohoku University (2021); University of Tokyo (2021).

ROK SKY University Alliance:; Korea Advanced Institute of Science and Technology (KAIST) (2021); Seoul National University (2021); Yonsei University (2021); Korean Education Statistics Service (2023).

Top 50 U.S. Universities in Global Rankings: Brown University (2022); California Institute of Technology (2022); Columbia University (2022); Cornell University (2022); Duke University (2022); Harvard University (2022); Johns Hopkins University (2022); Massachusetts Institute of Technology (MIT) (2022); New York University (2022); Northwestern University (2022); Princeton University (2022); Runco and Jaeger (2012); Stanford University (2022); National Center for Education Statistics (2021); UCB (2022); UCLA (2022); UCSD (2022); University of Chicago (2022); University of Illinois at Urbana-Champaign (2022); University of Michigan-Ann Arbor (2022); University of North Carolina, Chapel Hill (2022); University of Pennsylvania (2022); University of Texas at Austin (2022); University of Washington (2022); University of Wisconsin-Madison (2022); Yale University (2022).

Chinese high school students' admission rates to top-tier universities are relatively lower compared to other countries. In 2021, only 0.4% of Chinese high school graduates were admitted to the most prestigious universities. This ranks China at the lowest among the five countries analyzed, with the U.S. leading at 2.6%. This high rate in the U.S. can be attributed to the actual abundance of top-tier universities in the country, as opposed to an expansive definition of such institutions. In fact, other countries included in this study have significantly fewer institutions ranked within the top 50 in major global university rankings. Japan, the U.K., and ROK show similar rates, at 1.8%, 1.7%, and 1.5%, respectively.

The comparatively low rate of admissions to elite universities in China can be attributed to the large number of high school students competing for limited spots in these top institutions. This disparity indicates a potential imbalance between the vast number of high school graduates and the restricted capacities of elite universities in China. This scenario highlights the intense competition and the need for more opportunities at the top level of higher education in China. The results suggest that while China excels in many aspects of high school education, there remains a challenge in funneling a greater proportion of students into its most prestigious universities. In summary, China's high school education output, as measured by the rates of students admitted to 4-year universities and leading universities, presents a mixed picture. While a moderate percentage of students enter 4-year universities, the rate of students admitted into the most prestigious universities is significantly lower, compared to that of the developed countries. This disparity suggests a need for targeted improvements in China's high school education system, particularly in preparing students for the intense competition for limited spots in elite universities. The data suggests an opportunity for China to enhance its educational strategies, ensuring a greater proportion of high school graduates can access top-level higher education.

### *4.3.7 Findings*

The educational quality of high schools can be analyzed through the eight indicators that are analyzed and discussed above. In this section, we will present the performance of China's high school education and compare this performance to other countries through the excellence index.

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Japan: The data considers the Imperial Universities of Japan. These are a group of seven prestigious and historically significant universities in Japan, often regarded as the highest tier of higher education in the country. The Imperial Universities are: University of Tokyo, Kyoto University, Tohoku University, Kyushu University, Hokkaido University, Osaka University, and Nagoya University.

ROK: For ROK, the universities included are those in the SKY University Alliance. The SKY universities, comprising Seoul National University, Korea University, and Yonsei University, are known for their high educational standards and are among the most prestigious in ROK.

#### 4.3.7.1 Performance of China's High School Education in the Eight Indicators

Regarding the ranking of China's high school education across various indicators, the situation varies. Regarding Resources and Scales, China ranks third in the student–teacher ratio but falls to the bottom, ranking eighth in both per-student expenditure and the percentage of teachers with a master's degree or higher. For Performance, Chinese high schools excel in cognitive performance, leading in first place, and have a third-place ranking in non-cognitive performance. Regarding School Climate, China achieves the top rank, reflecting a highly positive educational environment. Regarding Output, there's a contrast with China ranking third in the proportion of students admitted to 4-year universities but coming in last, at fifth place, for admissions to leading universities.

Overall, while Chinese high schools demonstrate strong academic performance and a positive school climate, there are areas for improvement, particularly in resource allocation and non-cognitive skills development, as well as in increasing opportunities for students to gain admission to top-tier universities.

#### 4.3.7.2 Overall Performance of China's High School Education

The overall performance of high school education is shown in Table 4.7 and Fig. 4.25. Notably, Germany is not included in the overall index or rankings due to significant data gaps or small sample sizes in more than five indicators.

From Fig. 4.25, ROK leads the ranking with a perfect score of 100, indicating exceptional performance across various dimensions. Following closely is the U.S., with a score of 93.3, which also demonstrates robust performance, driven by its substantial investment in educational resources and a focus on diverse learning outcomes. The U.K. also has an impressive score of 82.2, underlining the strength of its education system. Other countries, each scoring above 70, demonstrate their education systems' continual progress with a commitment to high-quality education.

Although China's score is close to those of other countries, with a score of 69.4, it is observed to have the most room for improvement when compared to these countries. With a strong educational foundation, China still faces significant areas that need improvement.

Overall, this global snapshot underscores the varied educational landscapes across countries, each with its unique strengths and challenges. For China, there's a clear pathway to further enhance its high school education system, learning from the successes of other nations and addressing its specific areas of need.

**Table 4.7** The overall performance of high school education over countries

| Countries | Dimensions | | | | | | | | Total score | Transformed total mean score |
|---|---|---|---|---|---|---|---|---|---|---|
| | Resources and scale | | | Performance | | School climate | Output | | | |
| | Student–teacher ratio | Per-student expenditure | Percentage of teachers with a master's degree or higher | Cognitive performance | Non-cognitive performance | | University admission rate | Leading university admission rate | | |
| China | 88 | 27 | 12 | 100 | 41 | 100 | 71 | 15 | 454 | 69.4 |
| The U.S | 74 | 100 | 63 | 81 | 100 | 38 | 54 | 100 | 610 | 93.3 |
| Germany | 96 | 93 | 100 | NA | NA | NA | NA | NA | 289 | |
| France | 83 | 91 | 38 | 86 | 35 | 14 | NA | NA | 347 | 70.7 |
| The U.K | 70 | 87 | 66 | NA | NA | NA | 48 | 65 | 336 | 82.2 |
| Japan | 84 | 74 | 17 | 86 | 18 | 44 | 74 | 69 | 466 | 71.3 |
| ROK | 100 | 96 | 37 | 87 | 47 | 87 | 100 | 100 | 654 | 100.0 |
| The Netherlands | 72 | 79 | 37 | 95 | 31 | 35 | NA | NA | 349 | 71.2 |

*Notes* For the purpose of comparison, the scores for each indicator have been changed to fit a 100-point scale. This means the highest score from the original data is set to 100, and the other scores are adjusted based on this. The "Transformed total mean score" is the final score that comes from changing the average total score to the 100-point system

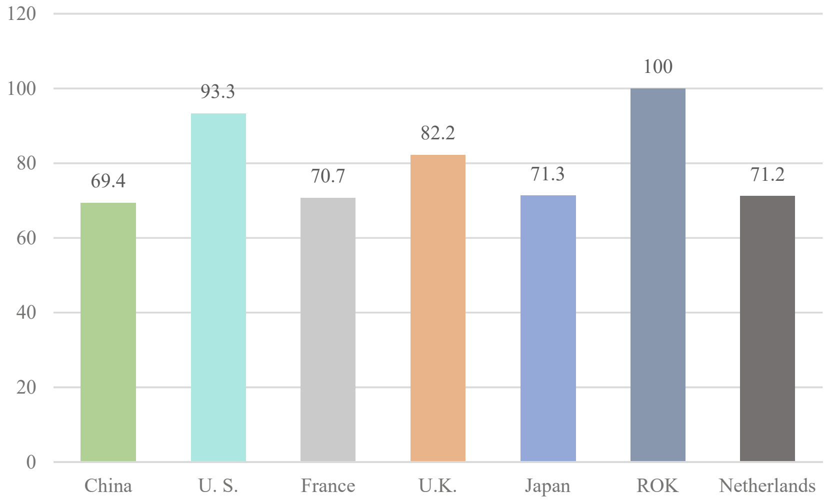


**Fig. 4.25** Overall performance of high school education

### *4.3.8 Discussion*

The current state of China's high school education presents a complex yet fascinating picture, showing significant strengths as well as areas in need of enhancement. The analysis reveals that China has managed to achieve impressive academic performance levels and provide a positive school climate, which is remarkable given the relatively limited expenditure per student and the low proportion of high school teachers with master's degrees. This indicates that high academic achievements in China's high schools are not solely dependent on financial and human resources, challenging traditional notions about the necessary features for educational success.

However, the analysis also points out critical areas for improvement. In terms of non-cognitive abilities, Chinese high school students lag behind their global counterparts, particularly in growth mindset and resilience. This gap suggests that China's high school education could benefit from putting greater emphasis on developing these skills, thus preparing students to face adversities more effectively and fostering their sustainable development.

Another area of concern is the proportion of high school graduates gaining admission to higher education institutions. While China has a high rate of high school graduation, less than 60% of these graduates can enter universities. This result reflects the intense competition in China's national college entrance examination (Gaokao) and underscores the need for broader access to undergraduate education in a highly competitive job market.

A key sign of the intense competition in China's high school education is the small number of students who are admitted to leading universities like the C9 League. Only 0.4% of high school graduates can enter these top institutions. This low percentage presents a significant challenge for students in the transition from high school to higher education. Despite high academic levels, many students cannot access these prestigious universities in China, demonstrating the need for more opportunities for students to enter top-tier universities.

In conclusion, while China's high school education system exhibits notable strengths, particularly in academic performance and school climate, there remains a clear need to focus on developing non-cognitive abilities, expanding access to higher education, and particularly enhancing opportunities to enter top-tier universities. Addressing these challenges will be crucial for ensuring that China's high school education not only maintains its current strengths but also improves China's high school education to cater to the diverse and evolving needs of its students.

## 4.4 Best Practices

### *4.4.1 Creating a Future Smart Campus*

Beijing 101 Middle School, often cited as a paragon of educational innovation, has embraced the construction of a comprehensive future smart campus ecosystem as one of the model schools for Beijing smart campuses (with a total number of 41) (Beijing Municipal Education Commission, 2023b). The school's efforts resonate with the strategic objectives outlined in *the Beijing Education Reform and Development Plan for the 14th Five-Year Plan Period (2021–2025)* for educational informatization, marking a pivotal transition from a solely tech-driven paradigm to an education-reform-driven one (The State Council, 2021). The leadership of Beijing 101 Middle School pursues a multifaceted approach to a future smart campus within the framework of the *Beijing Smart Education Master Plan (2022–2025),* which emphasizes which is "one foundation (a new foundation for digital education), six scenes (new scenes of digital education), and three spaces (new spaces for digital education)" (Beijing Municipal Education Commission, 2023a). Thus, the school's digital campus application scenario matrix includes eight application scenarios such as smart portal, after-school service, classroom innovation, live classroom, collaborative teaching and research, and smart management (Future Smart Campus Research Center, 2021). It promotes the application of digital technology scenarios around the developmental needs of teachers and students to form a complete construction structure and to promote the landing of the matrix of various application scenarios of digital technology. This is discernible in the institution's endeavors to create new digital education scenarios with a strong emphasis on integrating the campus management system, enhancing students' holistic growth and the full process of teacher instruction, and shows the school attaching great significance to propelling the smart education and digitization movement forward.

#### 4.4.1.1 Integrating Campus Management System

Building a campus-wide management system was a big problem for the school. In May 2019, when Beijing 101 Middle School Education Group was officially established, the group included a total of 15 campuses, with the Old Summer Palace campus as the school's main campus (*ibid*). Achieving integration across different campuses presents significant challenges in terms of management mechanisms, resource allocation, curriculum teaching, teacher training, quality assessment, and student cultivation. By coincidence, the COVID-19 soon hit the whole world, Beijing 101 Middle School then quickly responded to adopt an OMO (Offline Merge Online) learning mode and established a modern group management system to optimize the organizational structure of the education group. The school has set up six major administrative departments, focusing on leadership, school development, teacher development, student development, curriculum and instruction, international education, and logistics support, respectively (*ibid*). Correspondingly, the smart management platform was established as one of the eight school's digital campus application scenario matrix. Serving the purpose of efficient management, unified standards for the school's information technology, educational resources, teaching, courses, and management itself have been set up and implemented. These efforts aim to create a future school community ecosystem with a strong focus on effective management at the main campus, and then to replicate this model across other branch campuses.

With a similar way of thinking, the school also asks four leading academies to integrate into the smart management scenario. Yingcai Academy focuses on cultivating scientific literacy and innovation abilities; and Xiangyu Academy attaches great importance to humanistic literacy and the ability to transfer knowledge into practice. Hongru Academy is mainly responsible for better teacher development, and GITD Academy is about moral education and cultivating international vision. The future-oriented landscape of these academies takes a various of perspectives to serve the needs of students and teachers (*ibid*). More importantly, it allows school management personnel to collect and analyze data in terms of the various and most essential aspects for high school education to inform school decision-making processes. This integration of management facilities school management efficiency and reduces cost in the long term.

#### 4.4.1.2 Embracing Diverse Approaches for Students' Holistic Growth

In terms of education philosophy, Beijing 101 Middle School believes no matter what form of education is, the foundation of a good education is to foster a self-learning environment so as to let students freely explore and reach their great potential. Relying on information technologies such as the Internet of Things (IoT), cloud computing, big data, ubiquitous networks and artificial intelligence, the school has created an intelligent system of IoT, and ubiquitous education ecology to provide a digital education environment for the all-round and individual development of students. Besides, under the OMO learning mode, the school utilizes its resources to utmost and create a sharing education mode. Students can find, in their opinions, the best resources and teachers and use them for better academic achievements and their personal interests.

Apart from this, student learning style at Beijing 101 Middle School is also respected. The school has established individual growth profiles, which include process records that are enriched through various channels facilitated by information technology—such as implementing point-based rewards to encourage the development of students' unique personalities and strengths. Moreover, the results of the students' learning are visually presented, supported by relevant learning tools. Learning tasks are thoughtfully designed, and contextual learning environments are crafted to enhance the educational experience. In the school digital education scenario, students can find specific places and guidance in the following areas: future leaders' cultivation, innovative talent cultivation, technology education, Olympiads (i.e., mathematics, physics, chemistry, biology, and IT, respectively), scientific research, humanities and arts, social practice, aesthetic education, career planning, blended courses, and ethnic culture (Future Smart Campus Research Center, 2021).

Nurturing the multifaceted growth of students is at the forefront of Beijing 101 Middle School's philosophy. As the school principal Lu Yunquan stated the school pays special attention to cultivating students' essential literacy in terms of information and innovation, including critical thinking and problem-solving skills, communication and collaboration skills, and creativity and innovation skills, in addition to their digital and AI competencies (101 Future Smart Education, 2024). By building a future smart campus, a multitude of strategies are utilized to accommodate the individual developmental trajectories of students.

#### 4.4.1.3 Advancing Teachers' Instructional Methods and Development

The school's AI environment uses technology to recreate the six steps of teaching: lesson preparation, class, homework, tutoring, assessment, and self-reflection (Future Smart Campus Research Center, 2021). Normally, it is challenging for teachers to keep track of students' preparation before classes and reflection after learning, which plays indispensable parts of education and often influences student academic performances. Now, by integrating these six steps into teachers' terminals of management platform, teachers can gain a better understanding of students' obstacles in learning, give students timely feedback, master the learning process of each student and better adjust teaching styles, methods, and materials. Principal Lu said that the school also allow teachers to use a smart homework platform, which helps them realize the philosophy that has been praised thousands of years in China by the famous philosopher and politician Confucius, "teach in line with the students' abilities". Student assignments can be tiered, personalized, and designed according to the academic situation. Thus, the compilation of student learning data aids in crafting detailed "portraits" to enhance future personalized instruction (*ibid*). The pattern of students writing assignments remains the same, but data can be collected so that teachers can conduct accurate assessment of students. Subsequently, this visionary approach extends to smart campus management where a suite of digital applications has been actualized. Innovations such as smart homework platforms, blended teaching models, and real-time interactive collaborations exemplify the intelligent and pervasive educational ecosystem engineered by the school.

The direction that Beijing 101 Middle School has set signals a transformative chapter in the realm of educational informatization. Exhibiting utmost dedication to digital education, the school not only sets a precedent for others to follow but also vividly demonstrates the immense potential and future of smart campuses in Beijing. Each of these conceptual elements signifies Beijing 101 Middle School's commitment to harnessing digital advancements to mold a nurturing and intelligent educational landscape, one that faithfully serves every student's success in a rapidly evolving, interconnected world.

### *4.4.2 Advancing Career Planning and Guidance for High School Students*

The journey toward career fulfillment is a vital, ongoing process that begins well before students enter the workforce. Recognizing this, Shanghai's education system has been proactive in embedding career planning and guidance within the high school curriculum, an initiative aligned with the global emphasis on individual talent development. The *12th Five-Year Plan* launched by Shanghai has been a pivotal point for providing structured and systematic support to students, aiding them in the complex task of understanding and paving their professional paths (Shanghai Municipal Government, 2012). In 2018, Shanghai released the *Guidelines on Strengthening Career Education in Elementary and Middle Schools*, which ensures that all high schools will offer career courses and career planning guidance services (Shanghai Municipal Commission of Education, 2018). At the meantime, schools are required to explore innovative student development guidance models based on the "all-staff mentorship system", and actively guiding students to learn to make choices and develop independently (MOE, 2022a).

#### 4.4.2.1 Cultivating a Career-Oriented Mindset Through Innovative Curriculum

Rather than merely offering courses, Shanghai high schools are pioneering a transformative paradigm where education transcends traditional academics, imbuing a career-oriented mindset throughout its student body. This philosophy embeds career consciousness into the fabric of the high school experience. By integrating industry engagement and professional skill development into the curriculum, students are not only learning—they are preparing to excel at work. Beicai Senior High School

Affiliated to Shanghai Maritime University (SMU) becomes an exemplar in this regard (*ibid*). Since 2010, it has become one of Shanghai's 17 general high schools with special features and the school is known for its "nautical culture" (SMU, 2018). The school integrates the concepts of career guidance throughout the entire educational process, offers a diverse curriculum that includes nautical humanities, nautical science and technology, nautical engineering, nautical military, and nautical trade, catering to the different needs of students through elective classes (*ibid*). It demonstrates how aligning educational pursuits with maritime industry needs can result in a dynamic, symbiotic relationship between students and their future potential as industry professionals. Real-world application becomes a core tenet of this philosophy, ensuring students receive an education that is as enlightening as it is pragmatic.

#### 4.4.2.2 Empowering Individual Potential Through Mentorship

Instead of simply pairing students with career planning mentors, Shanghai high schools adopt a philosophy focused on unleashing individual potential. Mentorship becomes a relationship-driven journey, emphasizing personal growth, curiosity, and the exploration of one's strengths and passions. Mentors not only provide guidance but also facilitate students' self-discovery, encouraging students to craft a vision for their future that is uniquely their own, as seen in the tailor-made academic plans at Shanghai Shixi High School. Every new student at the school is assigned a "career mentor" upon enrollment. Since 2021, the school has created an academic high school development plan that guides students in discovering their interests in a particular field of specialization and promotes students' discovery of their life direction through academic forums, academic inquiry days, and academic festivals (MOE, 2022a).

#### 4.4.2.3 Encouraging Exploratory Learning in Career Development

Rather than treating career research projects as a part of the curriculum, they can be conceptualized as incubators for exploratory learning that cultivate a mindset of inquiry and innovation. This philosophy encourages students to step beyond the confines of the classroom, as exemplified by the Shanghai Foreign Language School Affiliated with SISU (Shanghai International Studies University) during the past 14 years (Guangming Daily, 2023a, 2023b). In addition to a career mentor group, experts, alumni, parents, and teachers are integrated. (with 41 parent career mentors and 38 alumni career mentors, the oldest graduated from the school in 1966) to help students dive into the complexities of the real world so as to form a meaningful understanding of various professions through firsthand experience. As a middle school having both secondary school students and high school ones, career education has been implemented from Grades 6–12 since 2009. Hence, students can seek who they truly want to become and what profession they are going to have throughout the 7 years. During the transition from junior high school to high school period, each student is given two weeks to do a real-life career development project, which helps them ignite their dreams (*ibid*).

#### 4.4.2.4 Fostering an Ecosystem for Career Education

Building an informational platform for career education is not just about technology; it is a commitment to creating a collaborative ecosystem. This philosophy values open communication and shared resources, aligning Minhang district's efforts with a vision of collective empowerment. By integrating the input of students, educators, and parents, the platform can grow to provide tailored support, guided by the needs and aspirations of each user. In the district, Shanghai Minhang High School is a typical example to better career education. The school sets its career planning goals into 3 parts: academic planning for helping students adapt to high school learning, self-cultivation for discovering students' self-realization and career exploration for helping students' major choices and career direction. Career planning courses are compulsory and students must take one per week. The school also invites professionals, celebrities, and alumni from all walks of life to give career talks to students through career and guides students to find their career goals. Then it helps students to try career simulation planning, helping them know what they should do from choosing their occupation and put the goal into specific plans (Wenhui Bao, 2021).

Over the years, Shanghai Minhang High School has developed a comprehensive career practice model that consists of five key components:

- Curriculum of community service: program provides students with their initial experiences of engaging with society.
- Taking career lecture series: a chance to help students gain insights into different industries.
- Personalized summer practice: an activity that encourages students to explore their fields of interest.
- Academic overseas classroom: an opportunity allows students to broaden their horizons by experiencing educational environments around the world.
- Science and technology practice: a hands-on approach to learning where students actively participate in scientific and technological projects, enhancing their practical skills and knowledge (China Education News, 2019)

Shanghai's initiative to nurture student development through comprehensive career planning and guidance is a testament to its forward-thinking educational policies. Such an encompassing system underlines the importance of preparing students for future challenges, and fostering adaptable, informed, and skilled individuals ready to contribute to society. As Shanghai continues to develop programs that bridge the gap between education and employment, it paves the way for its youth to not only anticipate but shape their futures with confidence and clarity.

### *4.4.3 Cultivating Digital Literacy Among High School Teachers*

Remarkable strides have been made by China in cultivating digital literacy among high school teachers. It examines the development of a comprehensive digital literacy framework based on general digital literacy guidelines, as well as the delivery of national training programs via intelligent education platforms. Additionally, this part delves into the strategic initiatives with national and Shenzhen's efforts as a beacon for fostering digital literacy among educators.

#### 4.4.3.1 Launching Strategic Initiatives

Digital literacy is imperative for equipping educators with the essential skills and knowledge to navigate the ever-evolving digital landscape in education. China's *Digital Literacy of Teachers*, introduced by MOE in 2022, acts as one of the cornerstones of educational development in the New Era (MOE, 2022d). The document provides a comprehensive framework with 5 primary dimensions, 13 secondary dimensions, and 33 tertiary dimensions, aligning closely with international standards while placing specific emphasis on social digital responsibility. It is tailored to ensure educators adhere to ethical and legal standards, protecting personal and work-related data, observing privacy rights, and promoting technology use in harmony with students' overall well-being.

Shenzhen, known as one of the most advanced urban metropolises and a hub of high-tech activities, is ambitiously striving to lead smart education and raising teachers' standards with digital literacy being a part of it. *Shenzhen's 14th Five-Year Plan on Basic Education Informatization* shows the aims to make the city a leading figure in smart and digital education, with special attention and efforts on Talent Advancement Project of Smart Education as one of the four major projects (the other three are Digital Foundation Construction Project, Smart Governance Further Development Project, and Upgradation Project of Application for Education Intelligence) (Shenzhen Municipal Education Bureau, 2022a).

In 2022, the city government released *The Implementation Plan for the Training of Leading Talents in Smart Education in Shenzhen (2022–2025)*, aiming to guide local schools to cultivate leading experts in smart education through a 2-to-3 year in-depth training program (Shenzhen Municipal Education Bureau, 2022b). This initiative envisions a long-term, ongoing project that will gradually progress from laying a solid foundation to grasp future opportunities. By training and evaluating teachers' digital literacy, it intends to construct a team of smart education professionals and emerging teacher with better innovative capabilities, and much more proactivity in adapting to new technological changes such as artificial intelligence. Through these general and specific measures, it seeks to effectively promote teaching practices.

#### 4.4.3.2 Conducting Comprehensive and Focused Training

In the *Digital Literacy of Teachers*, professional development is an essential part and extensive and intensive training of digital education has already been undergoing both nationally and locally. China has promoted a platform named Smart Education of China, on which Chinese teachers in elementary and secondary education are able to learn systematic courses to promote their digital literacy (MOE, 2022d). The Winter Vacation Workshop on the platform, which aims to equip secondary school teachers with up-to-date digital skills and knowledge, has attracted substantial participation from educators across China, culminating in a total of 13.72 million teachers participating (about 74.4 percent of China's full-time teachers) and 694 million views in 2023 (People's Education, 2024). This program has played a pivotal role in revolutionizing teacher learning methodologies and driving the digital literacy and competence of educators.

*Shenzhen's 14th Five-Year Plan on Basic Education Informatization* also discusses focused training of teachers at different levels so as to realize the vision that teachers' professional development catches up with the trend of digitalization (Shenzhen Municipal Education Bureau, 2022a). First, the city develops a special training program for principals of experimental schools in the city, including measures such as organizing experts to provide professional guidance to them, developing five to ten specialized courses on leadership in smart education, organize a special forum for principals every six months to promote the principals' ability in digital literacy. The city also carries out high-level training for hosts of experimental school workshops to cultivate a group of hosts capable of integrating information technology with new education and teaching concepts. Plus, in January 2021, Shenzhen's first "Innovation Classes for Pioneer Teachers" was launched, with 25 young teachers selected from across the city to participate in the training, exploring the new form of future teachers and empowering education innovation in the era of digitalization (Shenzhen News, 2023). Students in the class learned new ways of imparting knowledge to students with the help of virtual reality and other digital technology resources. Now the special training has become a norm for these experimental schools and the city hopes the participation rate for this project of lead teachers from these schools gradually reaches 100%. Through training of principals, workshop hosts and lead teachers, Shenzhen constructs a comprehensive training system for teachers' digital literacy with experimental schools as pioneers and then extend it to the whole city.

#### 4.4.3.3 Establishing a Collaborative and Hands-On Setting

In Shenzhen, 25 schools designated as model institutions for digital education by MOE have launched unique initiatives, to cultivate teacher digital literacy and practices introduced in this part all aimed to further teachers' digital literacy by collaboration that can be directly used in teaching (Shenzhen Municipal Education Bureau, 2023b). To raise digital awareness and enrich digital knowledge, Shenzhen Experimental School Group take the lead in initiating the city's first Inviting "Dual Hundred"

AI Experts into Schools Program, which introduces one hundred AI professors and one hundred AI doctorates into its primary and secondary schools to promote AI literacy, which allows teachers to get access to the cutting-edge theoretical and practical AI knowledge by cooperating with higher education institutions and help high school teachers relate their teaching concepts and practices to the advanced ideas in the field of AI (Shenzhen Experimental School, 2023).

Digital literacy involves many aspects and Shenzhen Senior High School's inter-school collaboration is at the benefits of teachers' digital competencies, especially in digital application skills. The school, in collaboration with Bao'an Middle School's Second Foreign Language School, enhances the IT application skills of their school teachers by integrating digital classroom technology resources, under the implementation of IT Skills Enhancement Project 2.0 conducted by Shenzhen Education Bureau's project, and conducts cross-school workshop exchange activities aligned with the requirements of the GLOBE Teaching Competition finals organized by Shenzhen Senior High School Group with a theme "Leading with Concepts, Empowering with Digital Intelligence" (Shenzhen Senior High School Group, 2023).

Luohu Senior High School in Shenzhen encourages its teachers to participate in practical activities aimed at improving digital teaching design and implementation, which has turned into fruitful results. Li Chun'e, one of its teachers, won a regional first-prize award for the school in "Efficient Smart Classroom Teaching Reform at the High School Level Based on Big Data" (Luohu Senior High School in Shenzhen, 2023). Zhou Chenglong received a second-place award in the micro-lecture project for senior high schools with one titled "The Principle and Use of Vernier Calipers" (*ibid*). In addition, they organize teaching and research activities on how to integrate and enable digitalization within various academic subjects in terms of teaching design and implementation (*ibid*).

Apart from school-wide efforts, the city also creates a digital-friendly ecosystem in high schools by setting up a Chief Data Officer system for education, so as to strengthen the implementation and application of digitalization across schools, as well as establish a data-driven educational evaluation system (Shenzhen Municipal Education Bureau, 2023a). Under this system, teachers with better digital literacy are selected and Chief Data Officers shoulder the responsibilities of helping others catch up with the trend and better cope with the digital challenges. Thus, a virtuous cycle is formed.

Through its comprehensive strategic initiatives, Shenzhen has prioritized the development of digital talents, ensuring the establishment of a well-versed leadership team capable of navigating the complexities of digital education. By focusing on in-depth middle- and long-term professional development and a collaborative eco-system, the city is at the forefront of nurturing talented individuals with better digital literacy to lead the nation towards a digitalized educational landscape.

China's unwavering commitment to cultivating digital literacy among high school teachers is underscored by the intricate development of a specialized framework based on international standards, coupled with robust national training programs via smart education platforms. Vanguards like Shenzhen provide more detail- and target-oriented practices with a down-to-earth pragmatic attitude to enhance digital literacy, not a mare's nest. These initiatives collectively envision a future where educators are equipped with the necessary digital competencies to navigate the digital terrain and effectively prepare students for formidable challenges brought by AI and related fields.

## 4.5 Inspiring Stories

### *4.5.1 Tang Jiangpeng: A Gatekeeper of Quality Education*

Tang Jiangpeng is known as the "Internet Celebrity Principal" with many honorary titles including Vice President of the China Education Association, Chief Principal of Jiangsu Xizhong Education Group, Director of the Institute of Contemporary Education of The Chinese University of Hong Kong (Shenzhen), Professor of SJTU, and Chief Inspector of Experimental School Affiliated to Jiao Tong University (SJTU, 2023). He has made great achievements in promoting quality education by developing Xishan Senior High School into one of the best middle schools in Jiangsu Province.

#### 4.5.1.1 Striving for Self-Improvement

In 1963, Tang Jiangpeng was born in Luonan, Shaanxi Province. In 1979, he took the college entrance examination and scored among the best in the region, but was not admitted to the university due to his physical condition (The Paper, 2023). However, his commitment to continuous self-improvement and his dedication to education led to a transformative career path. The major turning point in Tang's life came when he inadvertently tutored a few of his classmates. He introduced them to the review method, and those he tutored were admitted to the university. Tang attracted the attention of the education department and was arranged to be a private middle school teacher at Luonan Middle School. After that, Tang studied the courses after work and obtained a degree in Chinese literature (*ibid*). Later, he went to Shaanxi Education Institute for further study and obtained a bachelor's degree in Chinese. In December 1993, Tang decided to go to the south, and in January 1994, he became a language teacher at Xishan Senior High School in Jiangsu Province. From there, he worked his way up from a Chinese language teacher to the director of the teaching and research department, to assistant principal and vice principal, and in August 2006, he was appointed principal of Xishan Senior High School in Jiangsu Province (Shanghai Observer, 2023b). His progression from a private middle school teacher to the principal of Xishan Senior High School stands as a testament to his unwavering determination to overcome obstacles and inspire others with his exemplary journey.

#### 4.5.1.2 Reaching the Balance of Exam-Oriented and Quality Education

In August 2023, Tang Jiangpeng formally retired from the position of principal of Jiangsu Xishan Senior High School after 17 years. His tenure can be summed up in one sentence—"adhere to the essence of education is the direction and ultimate value of education, which is to take out the strength and wisdom, in order to make education closer to the people, away from utilitarianism" (*ibid*). Throughout his 17-year leadership at Jiangsu Xishan Higher Secondary School, Tang's steadfast commitment to the essence of education reshaped the institution's educational landscape and fostered an environment to help students flourish. Under Tang's leadership, Jiangsu Xishan Senior High School has pursued a path of quality education that goes beyond mere focus on college entrance examinations to achieving success in them. The campus features a student social street, an Internet of Things farm, and various innovative laboratories. The amount of activity space per student is comparable to that of education powerhouses in the world. Volunteer service has become a way of life for the students at this school. The ingredients in the school cafeteria are tested by students every day and announced in real time. Even with a reading volume of 6 million words, students still have time to make their own snacks and drinks (The Paper, 2023). Tang's leadership saw the establishment of innovative facilities, a strong emphasis on volunteerism, and a dedication to nurturing well-rounded individuals (*ibid*). His unwavering stance on prioritizing students' well-being, including ensuring adequate sleep, set a new standard in educational leadership.

Tang believes in the reality of the educational environment, people are always in contradiction and entanglement: on the one hand, the essence of education points to the growth of human beings, the education of human beings; on the other hand, the "points" of education is pulling towards utilitarianism. But Tang insisted education should not develop at the expense of students' sleep, and required his school must ensure that students sleep eight hours a day, which became an unshakeable requirement (Jiefang Daily, 2023a, 2023b). This is also the predecessor of Xishan Senior High School—Kuangcun Middle School. "Good education, should be to cultivate lifelong athletes, responsibility bearers, problem solvers, elegant life", Tang's words attracted the attention and resonance of the whole country (*ibid*). To grasp the balance, the principal must have higher wisdom. Tang's experience is to recognize the direction first, then set limited goals, find a professional path, and make real changes little by little in a step-by-step manner.

#### 4.5.1.3 Fostering Lifelong Learners and Creating a Unique Teaching Method

At Xishan Senior High School, education is to cultivate individuals who are not only lifelong learners and athletes but also responsible citizens and problem-solvers, fostering robust and outstanding character (*ibid*). This, the school trusts, sets the foundation for future happiness and social contribution. To achieve this vision, the school has reviewed the purpose of subject education and created "subject declarations" for each discipline to reinforce teachers' professional convictions. In a significant reform in 2006, Xishan Senior High School moved away from the traditional grade-based management system that segmented students by their year in high school to a model inspired by college administration (*ibid*). Tang required teachers to implement an individualized "3-year development plan", marking a new chapter in the school's academic journey.

Previously, the efficiency of the grade-based system was uncontested, designed to prepare students for college entrance exams without foresight or long-term strategic planning. However, when tasked with devising a development plan for its subjects, Tang raised several thought-provoking questions, which were seldom considered by high-school teachers. For instance, what was the true aim of teaching languages? As said, Tang believed defining educational objectives solely by the pursuit of high test scores would narrow the educational path and lead to teaching only to the test. He summarized his own unique views on the purpose of language education, teachers and students, curriculum and teaching materials, and has formed a more complete system of classroom teaching strategies and named it "embodied teaching" in Chinese language (*ibid*). This teaching method stresses students can really experience, feel, and understand the process of language teaching and learning, and can combine their own experience with the current learning activities, to produce a deep understanding of the text, a deep feeling of the image, and a practical understanding of the methodology and skills. This method has become influential nationwide and has won awards (*ibid*).

Tang's exceptional contributions to the educational landscape demonstrate a visionary blend of conviction, innovation, and a compassionate commitment to nurturing the potential of every student. His work continues to serve as a guiding light, signaling the decisive significance of quality education in shaping a better future for individuals and society at large.

### *4.5.2 Lu Zhaohua: A Pioneer in Technology Education and Discipline Integration Innovation*

Lu Zhaohua has been a beacon of innovation in tech-infused pedagogy at Nanyang Middle School in Shanghai, distinguishing himself as a leading physics teacher and the head of the school's science and technology information center. Holding a senior teaching position and honored in 2023 as a Shanghai Prominent Teacher, Lu has dedicated himself to blending technology education seamlessly into his classroom teachings (Shanghai Municipal Human Resources & Social Security Bureau, 2023). He has masterfully crafted an educational philosophy centered around "situation-led learning", nurturing students' autonomy, observational prowess, hands-on abilities, and innovative thinking. His distinct teaching flair has been recognized with numerous accolades, including Shanghai's Youth Science and Technology Advancement Award (nomination category) and top prizes in national competitions for youth technology innovation and homemade teaching aids (Nanyang Middle School, 2023). Lu is also known for securing 13 individual patents, which include nine inventions, and for participating in nationally and regionally significant scientific research projects, earning him a second-class award for municipal teaching achievements (*ibid*).

#### 4.5.2.1 Motivating Students' Learning by Teaching and Experiment Innovation

Central to Lu's success in efficient and effective education is his integration of innovation with classroom and laboratory instruction, demonstrated using the school's scientific landmarks as interactive teaching tools. These unique methods have sparked students' enthusiasm for physics, a subject often viewed with trepidation, transforming it into a realm of curiosity and exploration. Recognizing the impact of physics experiments derived from day-to-day life, Lu encourages learning through active engagement and genuine experience with science activities. His inventions, like the "Mini Intelligent Wind Power Generation Experimental Platform", secured a first-place award at the National Science and Technology Education Innovation Works Exhibition (*ibid*). Moreover, locally developed teaching tools, such as the conductor tensile resistance demonstrator, received top honors in various contests, exemplifying Lu's innovative approach to teaching physics with an emphasis on "interest, thinking, and ability".

Lu's forward-thinking educational strategies also reach beyond the classroom walls. In the laboratory setting, he has championed specialized courses and has been a driving force behind physics education competitions that emphasize experimental skills and originality. Lu utilizes Nanyang Middle School's strong technological educational characteristics to advance curriculum development. His teaching strategy incorporates new energy features and comprehensive research, such as studying the relationship between light intensity and the output of solar panels. These initiatives have not only inspired specialized course development like "Innovative Utilization of New Energy" but have also made Nanyang Middle School a pacesetter in conducting physics teacher competitions focused on experimental skills and innovation (*ibid*). Such competitions have substantially contributed to the professional development of physical science educators in the Xuhui District and beyond.

#### 4.5.2.2 Integrating Learning with Cutting-Edge High-Tech

Typically, teachers pay attention to students to explore the fundamental principles governing matter, energy, and the forces that interact within the universe in physics. However, Lu seeks to understand the behaviors of objects and the interactions that define the physical world by employing high-tech resources to enrich physics lessons. For example, Lu uses multimedia and digital information systems to enhance understanding and engagement. Students, under his mentorship, are empowered to conduct complex experiments, fostering a culture of cooperation, analytical thinking, and innovation. In search of a high-tech inclusive learning environment, Lu has adopted high-speed cameras and other high-tech lessons about the pendulum, highlighting scientific principles in an engaging fashion. He has also led research involving digital information systems such as DAS and DIS for innovative physics experiments in high school (*ibid*). These tools have enabled students to undertake complex experiments and fostered their cooperative and investigative spirits, analytical abilities, and innovative thinking, receiving recognition and accolades at the municipal level for modern educational technology applications.

#### 4.5.2.3 Promoting Scientific Education Nationwide

Lu, in his role as the school's Science and Technology Information officer, has helped to continue cultivating a pedagogical brand (Shanghai Observer, 2023a). This journey has evolved from the "Experimental Teaching, Situation-led Learning" philosophy to the integration and innovative development of tech education, emphasizing the cultivation of scientific literacy. Lu explores unique teaching paradigms that include cross-disciplinary elective courses like structural engineering courses and, together with other colleagues, combining biology and geography and show the public the course "Rice Breeding and Cultivation in China" (*ibid*). These courses have been well-received by educational authorities for breaking down subject barriers and fostering an inquisitive and evidence-based approach to teaching.

Moreover, due to his successful experience in the interdisciplinary integration of classroom teaching, Lu attracts numerous delegations of educators from across China each year. These delegations include school administrators, teachers, and governmental officials who come to visit and learn from Lu and the school's work. Some have traveled from as far as Haxu of Xinjiang, Panzhihua of Sichuan, and the Hulunbeier City of Inner Mongolia to Shanghai for a visit. These school visits showcase Lu's significant influence in the field of science and technology education (Nanyang Middle School, 2013). With his work, the school has contributed hundreds of inventions and utility model patent applications, positioning Nanyang Middle School at the forefront of national youth technology activities. What is more, aligning with higher education institutions, Lu's initiative has led to the establishment of cooperative ventures like the "Tongji–Nanyang Innovation Laboratory" (*ibid*).

In summary, Lu is selfless, hardworking, and pioneering, driven by a strong sense of enterprise. Although the work he engages in may not be sensational, he never slacks off, instead tirelessly laboring in his modest role to advance the cause of popular science education year after year. Furthermore, he is proactive in ideating and reflecting, persistently pursuing and exerting unremitting efforts in innovative approaches to science popularization activities, thereby significantly contributing to cultivating a new generation of learners equipped for a future woven with scientific inquiry and innovation.

## 4.6 Latest Research

### *4.6.1 General Overview*

High school education in China is a critical part of the nation's educational framework. This analysis focuses on examining the research trends within Chinese high school education by reviewing articles from the China National Knowledge Infrastructure (CNKI), the largest Chinese journal database in the world. The search, spanning from January 01, 2013, to January 01, 2023, using the keyword "high school," yielded a total of 539,133 articles, including 70,202 journal papers, 30 books, and 86,185 theses. The distribution of major research topics within the realm of high school subject education is shown in Fig. 4.26. In searching each subject, terms like "high school + subject name" were used, for example, "high school Chinese" or "high school mathematics".

As shown in Fig. 4.26, the most heavily researched subjects in high school education are English, followed by mathematics and Chinese. In terms of science education, physics is the most studied, while biology is less researched, indicating a need for increased focus in this area. It is also observed that subjects not involved in the college entrance examination, such as music, art, physical education, and information technology, have considerably fewer research articles. Notably, there is a significant dearth of research in science and innovation education, which requires future research and attention.

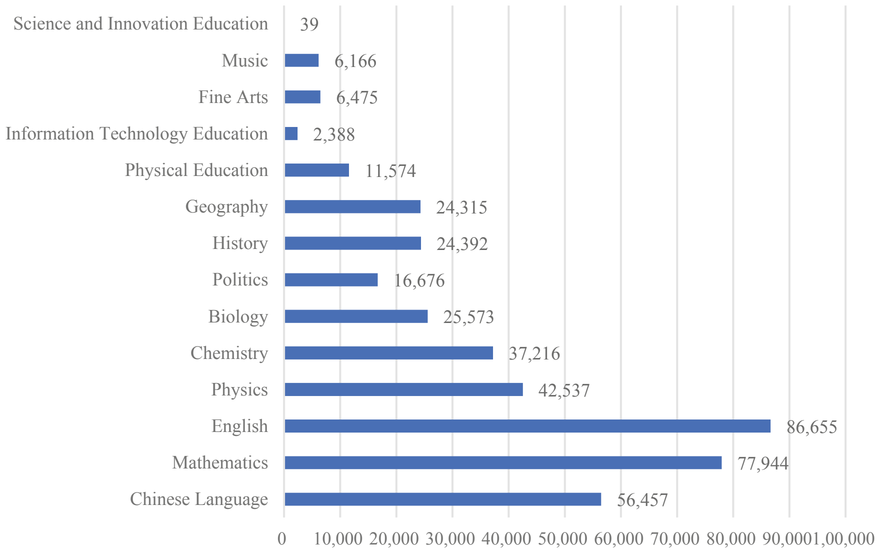


**Fig. 4.26** Major research topics in high school subject education from 2013 to 2023, sourced from CNKI

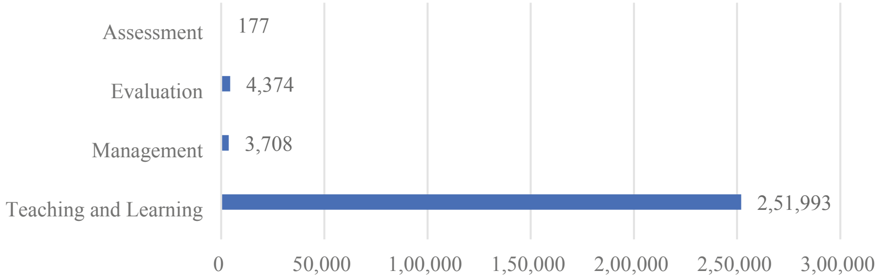


**Fig. 4.27** Key areas of research in high school education: teaching and learning, management, evaluation, and measurement from 2013 to 2023, sourced from CNKI

Further analysis is conducted on the important topics of "teaching and learning, management, evaluation, and measurement" in high school education. The search, covering publications from January 01, 2013, to January 01, 2023, included keywords like "high school teaching," "high school management," "high school evaluation," and "high school measurement." The findings are presented in Fig. 4.27.

According to Fig. 4.27, the topic of high school teaching has the highest number of publications, indicating a strong focus on pedagogy, learning and instruction, and practices in the high school context. In contrast, high school management, evaluation, and measurement are under-researched, particularly in the field of assessment and measurement. This disparity suggests a potential area for further research and development, particularly in understanding and enhancing the administrative and evaluative aspects of high school education in China.

In summary, while certain subjects like English and mathematics are extensively researched in Chinese high school education, there is a noticeable gap in studies focusing on less traditional and innovative subjects, as well as in administrative and evaluative aspects of education. This highlights the need for a more balanced and comprehensive approach to research in high school education, encompassing both academic subjects and the broader aspects of educational management and evaluation.

### *4.6.2 Research Topics*

This section introduces some key research topics in Chinese high school education. The topics involve four aspects: creativity, creative thinking, innovative literacy, career education, technology-supported education, and AI education.

#### 4.6.2.1 Creativity, Creative Thinking, and Innovative Literacy

In response to China's increasing demand for cultivating innovative talents, the cultivation of creativity, innovative thinking, and innovative literacy at the high school level has been an important point of attention. Creativity, defined as the generation of ideas or products that are both original and useful (Runco & Jaeger, 2012), is a critical aspect of educational development. Originality implies novelty and uniqueness, while usefulness refers to utility and appropriateness in a given cultural or societal context. Creative thinking, as defined by MOE (2022e), is a higher-order thinking process that generates novel and valuable ideas. Innovative literacy, on the other hand, involves using various materials to make accurate conclusions and deductions for creating novel and original products (Erdogan et al., 2013). Here is an overview of some recent research on creativity and innovation in Chinese high school education.

Regarding curriculum and instructional design, recent research in Chinese high schools focuses on reimagining teaching and curriculum design to foster creative and innovative thinking. For example, Zhang et al. (2024) examined concept-based instructional design in physics to encourage creative thinking. Similarly, Qin and Jiang (2023) analyzed mathematics textbooks for their representation of creative thinking, emphasizing the need for logical and progressive approaches. Additionally, He et al. (2017) show a practical implementation of a curriculum specifically designed to cultivate innovative literacy among high school students.

In terms of cultivating creativity in different disciplines, Dai and Yin (2019) from an aesthetic perspective, and Ye et al. (2019) in physics, explored fostering creative thinking in subject-specific contexts. Similarly, Hou et al. (2022) analyzed the role of educational robots in enhancing student creativity through experimental studies. Additionally, Xu et al. (2020) discussed the preparation and properties of magnetic fluids in chemistry as part of STEAM-based innovative experiments.

This interdisciplinary approach reflects a broader trend in integrating creativity into diverse subject areas. However, current research seems to be predominantly focused on science education. There is a need to expand high-quality research on fostering creativity and innovative literacy across a broader spectrum of subjects, particularly in the arts and humanities, such as Chinese Language and English.

Research has also delved into the current state and developmental strategies of creativity in high schools. Qi and Hu (2016) investigated the development of creative tendencies among high school students, suggesting strategies for improvement. Li et al. (2014) provided empirical insights into factors affecting creative problem-posing abilities in physics classrooms, highlighting the need for targeted educational interventions.

Finally, the integration of technology in teaching has been shown to be a significant driver for enhancing creativity and innovative literacy. For instance, a study by Wang (2022) explored the role of educational robots in cultivating innovative thinking.

Overall, these studies collectively underscore the cultivation of creativity and innovative literacy in Chinese high schools. From curriculum design to the use of technology, the focus is on creating an environment that encourages originality, problem-solving, and value creation among students. As Chinese high school education continues to improve its educational quality, these aspects will play a crucial role in shaping a generation of creative and innovative individuals.

#### 4.6.2.2 Career Education in High Schools

Career education in Chinese high schools, a critical component for assisting students in making informed decisions about their future professions, has garnered significant research attention in recent years. This section provides an analysis of recent high school career education research in China: Regarding international perspectives on career education, studies have delved into the curriculum reforms in Japanese elementary and high schools, shedding light on the approaches and methodologies applied in different countries. This includes analyses of Japanese general high school career education policies (Ren & Ou, 2022), initiatives in high school career education in Ontario, Canada (Li & Zhu, 2023), and comparative studies of top U.S. high schools' practices in career education (He et al., 2021).

In the context of China's new Gaokao system, researchers have focused on the recent comprehensive reforms of the college entrance examination system. These reforms, involving changes in subject selection and exam processes, have significant implications for career education. Researchers continue to explore the status and policy expectations of career education in this new examination context. Scholars like Wang and Yang (2023) have been analyzing the status and policy expectations in this context, highlighting its challenges and evolving nature. Wang and Zeng (2021) further explored the career cognition characteristics of high school students and the pathways for improvement under this new examination landscape. Their research highlights the necessity of a combined effort from both schools and families to enhance various aspects of students' career cognition in the context of the new Gaokao reforms. This includes improving their self-awareness, academic understanding, professional knowledge, occupational awareness, and meta-cognition of career planning.

Regarding the impact and effectiveness of high school career education, the focus has been on how it influences students' future planning. Cui et al. (2022) found that participation in career education activities significantly enhances students' career planning, especially when activities involve rich self-exploration. Ma et al.'s (2019) research in Anhui province and Deng et al.'s (2020) study on the effectiveness of career curriculum systems based on school-family cooperation reveal gaps in the current career guidance offered in Chinese high schools. These studies highlight areas such as insufficient recognition of the importance of career planning guidance and the monotony of career courses in Chinese high schools.

In terms of curriculum implementation in career education, researchers have been examining the construction and optimization of career education systems. This includes building career education systems (Wan & Wang, 2021), developing competency assessment systems for teachers in career guidance (Suo, 2022), and innovating paths for career education through seminar-style classrooms (Wang, 2018). Additionally, research on the implementation and optimization of high school career planning courses offers innovative approaches for enhancing the effectiveness of career education in high schools (Nie, 2018).

In summary, these studies highlight the growing importance of career education in Chinese high schools, emphasizing the need for adaptable career education strategies under the new Gaokao system, tailored career education for diverse student needs, and optimized curriculum and instructional implementation in career education.

#### 4.6.2.3 Technology-Supported Education

Another topic gaining increasing attention is the adoption of digital technologies in Chinese high school education, a critical part of the country's vision for 2035. The integration of technology in classrooms is seen as an essential step to align high school education with the development of the digital era. The following sections highlight some key areas of recent research on technology-enhanced high school education in China:

After the COVID-19 pandemic, online learning has become prevalent in Chinese high schools. For example, a study by Guo and Xu (2023) looked at how teacher-student interactions in online classes affect students' learning. They found that such interactions are generally positive across the country, with teachers being more active participants. Ding and Du (2021) analyzed comments on high school physics teaching videos on the Bilibili website, a popular Chinese video-sharing website that features a wide range of content, including music, animation, gaming, and education. Their research sheds light on the unique aspects of online learning interactions.

Regarding simulation, this technology is increasingly recognized for its educational value. For instance, Song (2023) investigated the use of virtual simulations in chemistry education, demonstrating their potential to enhance teaching and learning. Zhou and Chen (2019) studied high school chemistry teachers' views on virtual simulation labs, revealing a high interest in using these tools in teaching, although they also pointed out some quality issues with current software.

Data literacy, defined as the ability to understand, gather, analyze, and use data to solve problems, is emphasized as a critical skill for students in the information age (OECD, 2019a). It is seen not just as an interdisciplinary ability but also as a way of thinking about and solving problems. Yu et al. (2023) explored the role of information technology in fostering high school students' data literacy, arguing that its integration into the curriculum could boost students' interest and habit of thinking analytically with data.

Virtual Reality (VR), an immersive technology, is gaining ground in high schools for its teaching advantages. Mao et al. (2023) conducted a meta-analysis of VR's impact on student learning performance, indicating VR's potential to enhance learning outcomes in various subjects. Research by Ye et al. (2019) looked into the application of VR technology in high school biology classes, providing examples of its effective use in teaching and learning.

In summary, these studies underline the increasing focus on using technology to enhance high school education in China. From online learning and virtual simulations to data literacy and VR, technology is reshaping the educational landscape, offering innovative ways to engage and educate high school students.

#### 4.6.2.4 AI Education

With the rapid development of generative artificial intelligence in recent years, high school education in China has increasingly focused on AI education, particularly on integrating AI into the high school curriculum. Here is an overview of some recent research in high school AI education:

In the field of top-level design for AI education, Zhong and Zhan explored the overarching design of AI education. Their analysis, based on representative top-level AI education documents, revealed that these designs encompass themes such as "AI and Social Development", "AI and Human Intelligence", and "AI Technology". However, they noted variations in the focus on educational objectives and requirements across different documents.

Regarding the development of the AI curriculum, Artificial Intelligence Curriculum Guidelines for Primary and Secondary Schools Research Group (2023) proposed comprehensive guidelines for AI curriculum in primary and secondary schools. These guidelines cover aspects such as the nature and philosophy of the curriculum, core competencies and objectives, curriculum structure, content and requirements, standards for academic quality evaluation, and implementation recommendations, providing a reference for the construction of the AI education system in Chinese schools.

In terms of using AI technologies to support authentic classrooms, Zhao and Liu's (2022) research integrated high school mathematics with AI, offering an innovative approach. An (2022) examined ROK's "AI Mathematics" course in high schools, offering valuable insights into the integration of mathematics and AI education. Zhang et al. (2022) focus on game-based learning in AI courses to enhance computational thinking, underlining the importance of interactive teaching strategies in AI education. Additionally, a study by (Bian, 2023) investigated the evolving role of high school teachers in political education within the AI context. These studies demonstrate Chinese scholars' exploratory efforts in the use of AI to support high school classrooms.

Overall, these initiatives reflect China's efforts to incorporate AI into the Chinese high school curriculum, despite the challenges of developing effective teaching methods and course materials. This direction emphasizes the need to prepare students with AI-related skills and knowledge for the future.

## 4.7 National Policies

This section introduces the evolution of policies regarding high school education in China, including its main development stages, national policy promulgation, and the primary policies as shown in Table 4.8. This table indicates that China's policies for high school education have consistently sought development and universalization, efficiency and equity, adjustment and reform, and the balance between quantity and quality. Initially, the Elite Education Stage (1950–1993) focused on enhancing the quality and management of key schools, with efforts from 1978 to 1984 aiming at education standards improvement and local governments' involvement in basic education. This period laid the groundwork for a government-led schooling system, with the goal of expanding high school education in developed areas. Following this, the Universal Development Stage (1993–2019) marked China's endeavor to achieve universal access to high school education and enhance quality, starting with urban and economically developed regions and then extending to rural education, significantly raising the gross enrollment rate. Entering the Balancing Universal Access with the High-Quality Development Stage (2019–2023), the focus pivoted towards refining educational methods and enhancing quality. Policies targeted establishing a comprehensive education system that advances both virtues and talents, aiming to elevate the gross enrollment rate above 92% by 2025.

### *4.7.1 The Evolution of Policies Regarding High School Education in China*

This section introduces the policy evolution process for each stage, which are: elite education stage, universal development stage, and balancing universal access with high-quality development stage.

#### 4.7.1.1 High School Education as Elite Education

In the early years after the establishment of the People's Republic of China, the national illiteracy rate was high. Eradicating illiteracy and establishing spare-time schools for workers and farmers became top educational priorities. However, the government still placed great emphasis on the development of high schools, and policies were introduced for the construction and enhancement of key high schools. In the context of limited resources, the emphasis was strategically shifted toward developing these key high schools with a priority on efficiency.

In 1985, the policy explicitly made local governments primarily responsible for the development of basic education. Under the circumstances at that time, focusing on compulsory education and the construction of key junior secondary schools became an inevitable choice. Consequently, the number of general high schools nationwide

**Table 4.8** Primary policies regarding high school education in China

| Main development stages | Key policies [year] | Main contents |
|---|---|---|
| Elite education stage | *Trial plan for the effective management of a group of key primary and secondary schools* [1978] | Proposes the effective management of a group of key primary and secondary schools to enhance the quality of education in these institutions |
| | *Regarding the phased and batched development of key high schools* [1980] | Strengthen the construction of key high schools in phases and batches, initially focusing efforts on successfully managing a group of key high schools with better conditions |
| | *Decision on the reform of the educational system* [1985] | Local governments are primarily responsible for the development of basic education |
| Universal development stage | *Outline of China's educational reform and development decision* [1993] | Gradually establish a system where government-led schooling is the main approach, complemented by contributions from various sectors of society. Set development goals for actively universalizing high school education in large urban areas and economically developed coastal regions |
| | *Outline of China's educational reform and development decision* [1994] | Gradually establish a system where government-led schooling is the main approach, complemented by contributions from various sectors of society. Set development goals for actively universalizing high school education in large urban areas and economically developed coastal regions |
| | *Opinions on vigorously developing general high schools* [1995] | By the year 2000, the development goal is for ordinary high schools to have approximately 8.5 million students enrolled |
| | *Educational revitalization action plan for the 21st Century* [1998] | By 2010, the goal is to progressively universalize high school education in urban and economically developed areas |
| | *Decision on the reform and development of basic education* [2001] | Overall policy for the universalization of high school education |

(continued)

**Table 4.8** (continued)

| Main development stages | Key policies [year] | Main contents |
|---|---|---|
| | *State council decision on further strengthening rural education work* [2003] | Elaborates on the strategic position and role of rural education, clarifies the goals and tasks of rural education development and reform, and proposes a series of significant policy measures for strengthening rural education |
| | *State council decision on further strengthening rural education work* [2003] | Elaborates on the strategic position and role of rural education, clarifies the goals and tasks of rural education development and reform, and proposes a series of significant policy measures for strengthening rural education |
| | *State council decision on further strengthening rural education work* [2003] | Elaborates on the strategic position and role of rural education, clarifies the goals and tasks of rural education development and reform, and proposes a series of significant policy measures for strengthening rural education |
| | *National education development planning* [2006] [2011] [2016] | Enhances the gross enrollment rate in high school education as the core objective of high school educational reform. During the *eleventh five-year plan* to *thirteenth five-year plan* periods, the planned gross enrollment rates are approximately 80, 87, and 90%. This enrollment rate includes both general and vocational upper secondary education |
| Balancing universal access with high-quality development stage | *Guiding opinions on advancing the reform of educational methods in general high schools in the new era* [2019] | By 2022, the comprehensive education system encompassing moral, intellectual, physical, aesthetic, and labor education will be further perfected, and the mechanism for fostering virtues and talents will be further strengthened. A scientific educational evaluation and examination enrollment system will be fundamentally established. The provision of teaching staff and school conditions will be effectively guaranteed, and a pattern of diverse and distinctive development in ordinary high schools will be basically formed |

(continued)

**Table 4.8** (continued)

| Main development stages | Key policies [year] | Main contents |
|---|---|---|
| | *"The 14th five-year plan" for the development and improvement of general high schools at the county level* [2021] | By 2025, the overall quality of education in county-level schools will have significantly improved. A basic coordination mechanism for the development of county-level schools and urban ordinary high schools within the same city will be established. The development of general high school education and upper secondary vocational education will be integrated, aiming to push the gross enrollment rate in high school education to over 92% |
| | *Opinions on implementing the action plan for expanding excellence and enhancing quality in basic education in the New Era* [2023] | Further to optimize the supply and allocation of resources for general high school education, expand the provision of high-quality resources, and promote the intrinsic development of general high schools |

dropped from 49,215 in 1978 to 14,850 in 1992, reaching its lowest point in over a decade (Qi & Chen, 2018). At the same time, the enrollment numbers in general high schools also declined annually, from 6.929 million in 1978 to nearly half in 1980, and continued to decrease over the next 12 years, reaching the lowest of 2.347 million in 1992 (*ibid*). During this period, only a few people had the opportunity to receive high school education.

#### 4.7.1.2 Universal Development of High School Education

Since 1993, the development of high school education has highlighted key policies of prioritized development, scale expansion, and structural reforms. In 1993 and 1995, the policy such as *Outline of China's Educational Reform and Development* and *Opinions on Vigorously Developing General High Schools* shifted the focus toward expanding the scale of high school education. This included the evaluation and acceptance of about 1,000 existing demonstrative high schools in three batches. At this stage, the term "key high schools" was changed to "demonstrative high schools", a term still in use today. Policies issued from 1999 to 2016 all revolved around accelerating the development and construction of high schools.

#### 4.7.1.3 Balancing Universal Access with High-Quality Development in High School Education

The *Guiding Opinions on Advancing the Reform of Educational Methods in General High Schools in the New Era*, issued in 2019, provided a policy basis and guidance for the high-quality development of general high school education. The *2023 Opinions on Implementing the Action Plan for Expanding Excellence and Enhancing Quality in Basic Education in the New Era* further promoted the intrinsic development of general high schools. In 2022, the gross enrollment rate for high school education, including both general and vocational education in China reached 91.6%, and the average educational attainment of the new labor force was 14 years (MOE, 2023a). This indicates that the educational level of the new labor force has reached the high school stage.

### *4.7.2 Key Policies*

The following sections review the key policies in Chinese high school education from three important aspects, including the universalization of high school education, the enhancement of high school quality, and the development of suburban and county high schools.

#### 4.7.2.1 The Universalization of High School Education

In the mid-to-late twentieth century, as the 9-year compulsory education gradually achieved its universalization goals, there was an increased demand for high school education among junior high school graduates. The sustained and rapid economic growth also required more skilled professionals.

In 1993, the State Council issued the *Outline of China's Educational Reform and Development*, which reflected two major aspects: the reform of the high school education system and the development goals for universalizing high school education in large urban areas and economically developed coastal regions. The 1995 *Opinions on Vigorously Developing General High Schools* set a target of about 8.5 million students enrolled in general high schools by the year 2000. The *Educational Revitalization Action Plan for the 21st Century* issued in 1998 specified the goal of gradually universalizing high school education in urban and economically developed areas by 2010. In the education development plans from the "Tenth Five-Year Plan" to the "Thirteenth Five-Year Plan" issued by the State Council, the gross enrollment rate in high school education, with both general and vocational education included, was explicitly planned to increase from around 60, 80, 87, to 90%, progressively moving towards comprehensive universalization.

Data show that compared to 1995, by 2001, the number of students enrolled in and attending general high schools had doubled, with an average annual growth rate of 12%. The number of enrollees increased from approximately 2.3 million in 1993 to 8.777 million in 2005, nearly tripling. The number of students attending these schools also grew year by year, reaching a peak of 25.2 million in 2007 (Qi & Chen, 2018).

#### 4.7.2.2 The Enhancement of High School Quality

Further universalizing high school education, optimizing the allocation of educational resources, and enhancing the quality of high school education have always been strategic priorities in China's efforts to facilitate the construction of a high-quality education system.

Beginning in 1978, under the low universalization of high school education, China actively explored the operational mechanisms and systems for the development of key high schools. Policies such as *Trial Plan for Successfully Running a Group of Key Primary and Secondary Schools* and *Regarding the Phased and Batched Development of Key High Schools* were come out, marking the initial steps in improving the quality of high school education. In 1995, the Notice on the Evaluation and Acceptance of About 1,000 Model Ordinary Senior High Schools was issued. This policy aimed at evaluating and accepting around 1,000 model high schools over 3 years to summarize experiences.

Since the 18th National Congress, China has specifically issued documents related to general high school education. In the redefinition of the nature of high school education, it has been distinguished from junior middle school and vocational education, thereby highlighting the unique status and important role of general high schools. In 2019, the *Guiding Opinions on Advancing the Reform of Educational Methods in General High Schools in the New Era* were issued. This document proposed deepening reforms in key aspects and critical areas of education, providing a policy basis and guidance for the high-quality development of general high school education.

In 2023*, the Opinions on Implementing the Action Plan for Expanding Excellence and Enhancing Quality in Basic Education in the New Era* were issued, further optimizing the supply and allocation of resources for general high school education, expanding the provision of high-quality resources, and promoting the intrinsic development of general high schools. The government continuously improves the funding mechanisms for high schools and actively promotes the standardization of high school construction, considering the promotion of diverse and distinctive development as a fundamental policy of high school education.

During the *14th Five-Year Plan* period and looking toward 2035, higher requirements have been set for the reform and development of high school education. Adhering to the focus on intrinsic development and quality improvement, implementing comprehensive education for all students throughout the entire process and in all aspects, and promoting the well-rounded development of general high school students in moral, intellectual, physical, aesthetic, and labor education.

#### 4.7.2.3 The Development of Suburban and County High Schools

In 2020, there were a total of 14,200 high schools nationwide, among which 7,243 were operated by counties and county-level cities, accounting for 51% of the total, with 14.684 million students, making up 59% of the total high school student population (MOE, 2021a). In 2021, the scale of high schools in county areas exceeded half of the total number of general high schools nationwide and represented the forefront of county-level basic education (MOE, 2022b). Effectively managing county high schools is of great significance for consolidating and improving the level of high school education universalization, driving the high-quality and balanced development of compulsory education at the county level, and serving the national rural revitalization and talent development strategies.

In 1953, the central government proposed the establishment of key high schools and identified 194 key high schools nationwide, creating the first batch of key high schools in New China. In 1978, 1980, and 1994, the state successively introduced policies emphasizing developing a group of key high schools. A few county high schools emerged with the support of these policies. After years of development, nearly every county town in the country has built one or two demonstrative high schools representing the highest educational level in the county area (Lei, 2021).

In recent years, in response to the era's demands for high-quality educational development and the challenges faced by county high schools, the 2021 Government Work Report proposed strengthening the construction of high schools in county areas. In the same year, the government formulated the *14th Five-Year Plan for the Development and Improvement of General High Schools at the County Level*, guiding all high schools in county areas towards distinctive management and coordinated development, and promoting a significant improvement in the overall standard of education. In 2023, the *Opinions on Implementing the Action Plan for Expanding Excellence and Enhancing Quality in Basic Education in the New Era* proposed "strengthening the standardization of county high schools" to ensure that every general high school in county areas meets construction standards. The focus is on improving educational conditions, addressing the weaknesses in the development of rural and suburban general high schools, and overall enhancing the quality of education in county high schools. The policy also highlights the importance of creating a system where new teachers in county high schools can undertake internships at higher-quality institutions. This approach aims to facilitate their rapid professional development and prepare teachers to meet the standards of high-quality education. In summary, with the government's increasing focus and supportive policies for suburban and rural high school education, the future quality of these schools in China is expected to see further advancement and improvement.

## 4.8 Summary

This chapter provides a comprehensive review of the advancements and achievements of China's high school education in recent years. Through a combination of data analysis, index development, case studies, research reviews, and policy introduction, it becomes clear that the Chinese high school education system has undergone significant transformations. These changes have resulted in three distinct characteristics, shaping the current state of high school education in China.

Historically, Chinese high school education has evolved remarkably over the past eight decades. Initially, it served as an elite education system in the 1950s and gradually transitioned to universal education in 2010. In recent years, the focus has been on pursuing high-quality development. This journey from elite to widespread education demonstrates China's efforts at educational reform and the impressive progress made.

The analysis of the data shows several strengths of Chinese high school education in several aspects. These strengths include student academic performance, high school gross enrollment and graduation rates, and infrastructural development, including physical and digital facilities, as well as a positive school climate. These areas not only show China's educational progress but also position its high school system favorably on the global stage.

However, there are noticeable gaps in the system. Regarding recourses, there are significant deficiencies in per-student spending and teacher's education background. Additionally, in terms of student performance, non-cognitive abilities like growth mindset and resilience, and leading university admission rates are lagging globally. This indicates that while China has excelled in many areas, there is a need for further improvement in resource allocation and student skill development.

Research in Chinese high school education covers various domains, with a focus on core subjects like Chinese, Mathematics, and English, alongside critical areas such as teaching and learning. Research involves key areas such as the cultivation of creativity and creative thinking, career education, and technology-supported education. Recent trends show an increasing interest in integrating AI into high school curriculums and using AI to support classrooms. Nonetheless, there is room for improvement, particularly in areas like science and innovation education and evaluation and assessment research in high school education.

Regarding policies, the rapid development of Chinese high school education can be largely attributed to strong governmental support. The focus has shifted from elite education to universal education and now to a balance between universal access and quality enhancement. In recent decades, significant resources have been allocated to high school education to improve the minimum educational level of the workforce. Looking forward, the government is expected to further enhance the quality of high school education and foster comprehensive development among students to better prepare them for higher education.

In conclusion, the chapter illustrates the comprehensive overview of China's high school education, highlighting its historical evolution, current achievements, areas for improvement, research diversity, and the critical role of policy in shaping educational outcomes. In the future, high school education in China will prioritize quality enhancement and comprehensive student development to tackle the complexities of contemporary global challenges.

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# Chapter 5
# Undergraduate (*Benke*) Education of China

**Liu Li, Li Yujie, Hong Yingshan, and Zhao Yiwei**

**Abstract** Undergraduate education has played a fundamental role in China's higher education reform over the past four decades. Great progress has been made in undergraduate enrollment, quality, and effectiveness. Most recently, Chinese higher educational reforms have focused on developing world-class undergraduate education with Chinese characteristics. This chapter presents an overall picture of the Chinese undergraduate education sector and analyzes its development and performance through an international comparative lens. It then provides case studies of best practices and inspiring stories of teaching excellence. This chapter also reviews national policies and existing literature on undergraduate education by Chinese scholars.

**Keywords** World-class undergraduate education · Quality and performance · Undergraduate teaching and learning · Teaching excellence · Policy highlights on undergraduate education

## 5.1 Introduction

The modern concept of undergraduate education first appeared in the *University Ordinance* (*Daxueling*) issued by the Ministry of Education of the Republic of China in 1912, "once completing the foundation year and passing all the examinations, students will be granted graduation certificates and will be admitted to undergraduate

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studies" (Zhu & Yao, 1993). In 1985, Ma Jixiong, a well-known expert on comparative and international education in China, used a Chinese perspective to analyze undergraduate programs relative to and beyond pre-college preparatory programs, and the specialized courses offered to students (Ma, 1983). According to the International Standard Classification of Education (ISCED) published by UNESCO, undergraduate programs are the first stage of tertiary education, and entry into these programs normally requires successful completion of senior secondary school or equivalent programs. These programs, traditionally offered by universities or equivalent tertiary education institutions, provide students with intermediate academic and/or professional knowledge, skills, and competencies with a duration of four or more years. Higher education in China consists of undergraduate and postgraduate education. Undergraduate education includes education in both academic and vocational routes and is considered the major sector in Chinese higher education (Huang, 2017). Traditional higher education is the academic route and offers a 4-year program leading to bachelor's degree. Tertiary vocational education consists of both 4-year bachelor's degree programs and 3-year associate degree programs. This chapter's analysis of undergraduate education mainly focuses on the academic route programs offered through traditional higher education.

## *5.1.1 History and Status of Undergraduate Education in China*

### 5.1.1.1 History of Undergraduate Education in China

The modern Chinese undergraduate education has a history of more than 100 years, including three stages, that is, forming, rapid development and quality-driven development stages.

*Forming Stage.* Modern undergraduate education in China began in the late Qing Dynasty and early Republican era. Upon abolishing the civil service examination system (also called *keju zhidu* or imperial examination), the Qing government issued *the Memorial School Regulations* (*Zouding Xuetang Zhangcheng*) in 1904. The Regulations defined undergraduate education as the second of three-level university education (Qu, 1993). In 1912, the Ministry of Education of the Republican government announced the *University Ordinance*, which established seven undergraduate education subject areas (i.e., arts, science, law, commerce, medicine, agriculture and engineering) and furthered its duration and required courses in 1913 (Li, 1997). The *Dictionary of Chinese Education* (*Zhonghua Jiaoyu Cidian*) issued in 1928 explained that undergraduate education and its courses were designed by grades, and its content was beyond preparatory programs, so that graduates completing preparatory programs would be able to enter the specialized professional learning, e.g., teacher education and university degrees (Qu & Wang, 2015). Ever since, undergraduate education has been officially regarded as the primary level of university education.

*Rapid Development Stage.* Undergraduate education underwent a series of changes since the founding of the People's Republic of China. After the opening-up in 1978, with the deepening of the ideological emancipation movement and the continuous socio-economic recovery, undergraduate education was fully restored. It has been experiencing rapid development, especially since the national economic structural reform (Yang, 2004). In 1978, the Ministry of Education (MOE) reaffirmed that the objective of higher education institutions (HEIs) was to cultivate "specialized personnel" (*Zhuanmen Rencai*) rather than general workers (National Institute of Education Sciences [NCES], 1984). In 1985, *Decision on the Reform of the Educational System* pointed out that HEIs should be provided with more autonomy. As such, universities should have the right to adjust educational programs, formulate teaching plans and syllabi, and prepare and select teaching materials (Central Committee of the Communist Party of China [CPC], 1985). In another policy document from 1992, the then National Education Commission (now MOE) explicitly proposed to expand subject areas and develop quality and capable undergraduate students (National Education Commission, 1993). In 1998, MOE issued *Action Plan for Education Revitalization in the 21st Century* and proposed that by 2010 the gross enrollment ratio (GER) of higher education in China would reach 15% of students at school age (MOE, 1998). Since then, the scale of undergraduate education has witnessed a rapid growth.

*Quality-Driven Development Stage.* In the early twenty-first century, the implementation of excellence initiatives such as Projects 211 and 985 marked a significant transition for undergraduate education in China, ushering in a phase focused on quality-driven advancement within the higher education sector. In 2006, the government launched a series of policy documents emphasizing the importance of cultivating top talent, developing quality assurance, building world-class undergraduate curricula and programs, and encouraging innovation and entrepreneurship, to enhance quality and standards of undergraduate education and move focus from quantity to quality in higher education expansion. The Double World-Class Project was implemented in 2015.

Along with the *Guidelines on Accelerating the Development of High-Quality Undergraduate Education and Comprehensively Improving the Capacity of Talent Training* (hereafter *the 40 Guidelines on Higher Education Development in the New Era*), a macro guidance document on developing undergraduate education in 2018, the project reiterates the importance to form high-standard undergraduate education with Chinese characteristics and world-class standards by 2035. The project aims to provide strong support to develop a strong nation through higher education (MOE, 2018a). In 2018, MOE, Ministry of Finance (MOF), and National Development and Reform Commission (NDRC) jointly issued *Guidelines on Accelerating the Development of the Double World-Class Project in Higher Education Institutions*. The guidelines clearly defined the goal of developing world-class undergraduate education, emphasized the fundamental role and status of undergraduate education, made the development of world-class undergraduate education the essential task of the Double World-Class Project, etc. (MOE *et al.*, 2018a). Ever since, undergraduate education in China has been marching toward the goal of achieving "world-class" status.

#### 5.1.1.2 The Status of Undergraduate Education in China

From a global perspective, world-class universities tend to place undergraduate education at an important strategic position and make developing world-class graduates an unchangeable goal of the universities. The 1000-year history of universities in the world also shows that undergraduate education lays the foundation for higher education development and to some extent decides the progress of countries (Chen, 2018a). Since the beginning of the twenty-first century, refocusing on undergraduate education and launching teaching reforms have become common agendas for leading universities around the world, including Harvard, Stanford, and MIT (*ibid*).

In June 2018 at a national convention, MOE stressed that undergraduate education should be placed "at the center of workforce development, as the groundwork of university education, and at the forefront of education development in the new era" (Chen, 2018b). The term "undergraduate education as the foundation" (*Yiben Weiben*) summarizes its significant status in Chinese higher education and its pursuit of academic excellence (MOE, 2018b). According to statistics on the 1,200 undergraduate institutions, the ratio of undergraduates to graduate students nationwide is 8:1, and 87% of students graduating are undergraduates (Chen, 2018b).

### *5.1.2 The Notion of World-Class Undergraduate Education*

In the 2016 working meeting on teaching reform, MOE explicitly stated that world-class undergraduate education is the foundation and basic feature of world-class universities and that developing world-class undergraduate education be included in the Double World-Class Project action plan (Ma, 2016). Further, 150 universities jointly issued *World-Class Undergraduate Education Statement* (also called *Chengdu Statement*) (MOE, 2018b) that advocated for nurturing top talent and developing excellence in undergraduate education. Arguably, the notion of "world-class undergraduate education" is derived from the Double World-Class Project context and has experienced a transformation from a top-down policy to intrinsic motivation within universities (Yang, 2021). While this term originates from the integral role of undergraduate education in promoting academic excellence, it is rooted in the fundamental problem that Chinese universities lag the world's leading universities in terms of cultivating high-quality workforce (Zhou, 2019). To cater to the changing context of universities and their own development needs, various ideological transformation are taking place throughout undergraduate education, including making interdisciplinary programs mainstream, emphasizing student-centered ideology, and confirming the strategic importance of developing excellence.

The goal of world-class undergraduate education is to pursue excellence in teaching and learning (Zhang, 2019). It means high standards and high-quality educational activities with specific goals, promoting quality culture, and enhancing overall quality in undergraduate education and workforce development (Yang, 2021). In the Chinese context, world-class undergraduate education should align with the following four principles: "return to common sense, return to the essence, return to the original heart, and return to the dream", build a general pattern of "three-holistic education" (*sanquan yuren*)[1], and understand rationales of higher education development and talent growth. Within such a system, students are encouraged to study hard, and teachers are inspired to teach and nurture well-round graduates for nation building (MOE, 2018a).

Based on the above context, this chapter first depicts the development of China's undergraduate education and analyzes its performance through key indicators from an international comparative perspective. It then provides case studies to illustrate the exploratory paths of Chinese universities and share inspiring stories of teaching excellence, particularly on the aspects of talent development, quality assurance, and innovation and entrepreneurship. The chapter lastly reviews policies on Chinese undergraduate education and related research by Chinese scholars, to reflect its policy trends and theoretical thinking.

## 5.2 Highlighting Data

### *5.2.1 Size and Scales*

In the past decade, the Chinese higher education system has been continuously and rapidly expanding its undergraduate sector, providing strong intellectual support for its socioeconomic development. Since the economic reform and opening-up, China has trained more than 60 million undergraduate students, who have become central to China's socio-economic development (Shi, 2018).

The total number of undergraduate students reached 19.89 million in 2022, an increase of more than 40% from 2012. Total undergraduate admission has also grown steadily, with an additional 4.76 million students admitted in 2022, aligning with the increasing demand for university education (Fig. 5.1).

[1] "Three-holistic education" means education provided by "whole" community, through "whole" process and with "well-round" focus. In other words, everyone in the community engage in teaching and learning, including students themselves, teachers, school staff, and other community members; teaching and learning happens any time (throughout the school years) and any place (all aspects of school life, including teaching, management, and financial support to students); and teaching

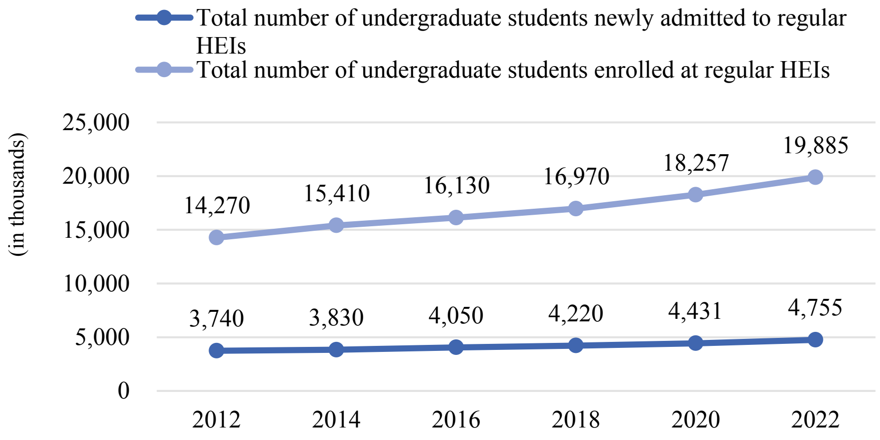


**Fig. 5.1** Number of undergraduate students at regular HEIs (2012-2022). *Source* Adapted from MOE (2023a)

A comparison with the world's major developed countries shows that, from 2015 to 2021, despite a slow decline each year, the total number of newly admitted undergraduates in the United States (U.S.) far exceeded those in other countries; China's undergraduate admission increased steadily and exceeded those in many developed countries; and the admission number in Japan and the Republic of Korea (ROK) exceed those in Germany, the United Kingdom (U.K.), France, Australia and the Netherlands (Fig. 5.2).

In terms of institutional layout, there are five different types of undergraduate institutions in China, namely, universities pursuing world-class status, universities developing world-class disciplines, regular undergraduate universities, newly established universities and colleges, and independent colleges (Fan et al., 2021). Among them, ordinary undergraduate colleges and universities had the largest enrollment volume, accounting for more than 40% of the total undergraduate enrollment in 2022, which was closely related to the enrollment plan for college entrance examinations. In the past decade, the number of institutions training undergraduates in China have steadily grown, reaching 1,271 in 2022 (Fig. 5.3).

### 5.2.2 *Outline of Academic Disciplines*

In terms of academic disciplines at the undergraduate level, engineering science has the largest student enrollments, which advances the national strategy to develop manufacturing power. The overall enrollment and graduation of engineering majors

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and learning should focus on comprehensive effectiveness and include moral education, intellectual education, physical education, aesthetic education, labor education, and other comprehensive education.

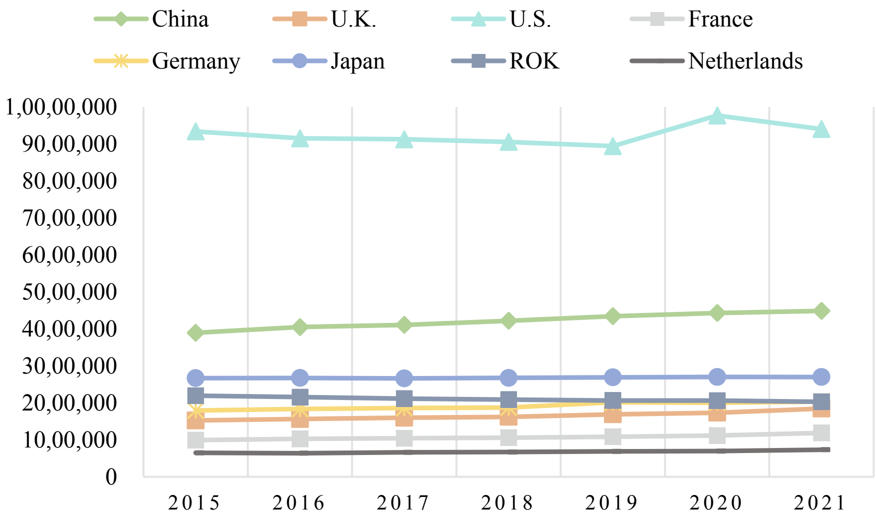



**Fig. 5.2** Undergraduate admission in China and some developed countries (2015-2021). *Source* MOE (2023a).

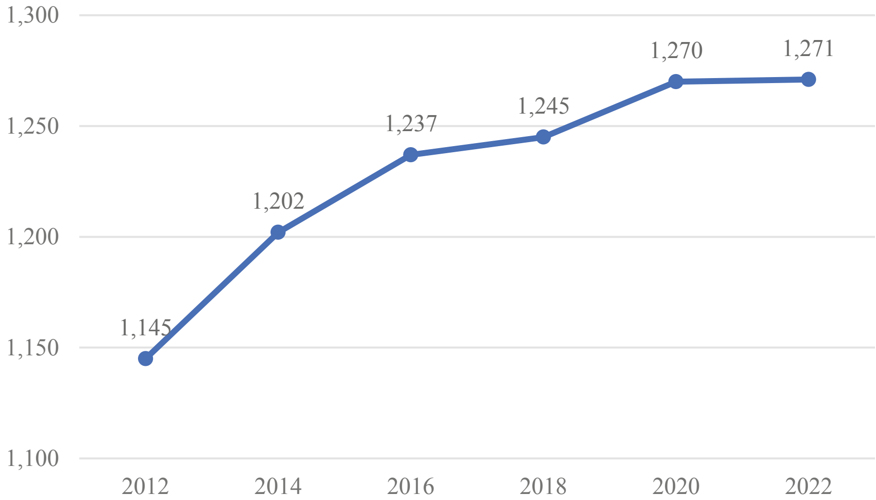



**Fig. 5.3** Numbers of HEIs in China (2012-2022). *Source* Adapted from MOE (2023a). *Source* OECD (2023a)

in regular HEIs in China are much higher than those of other countries in the world and are three to five times higher than those of Russia and the U.S. following closely behind (Ding & Zhao, 2018). According to data from MOE, China boasted the world's largest scale of engineering education, welcoming approximately 1.56 million freshmen and graduating 1.40 million students in 2021 (*ibid*). The above values represented one-third of the overall national undergraduate volume. Meanwhile, China continues to make great efforts to improve the quality of undergraduate engineering education. In hopes of joining the Washington Accord, China has been promoting program accreditation exercises and strengthening comprehensive reform in engineering education (MOE, 2018c). As of 2022, 2,385 engineering degree programs in 257 regular HEIs in China have been accredited and recognized, which cover 24 specialized engineering majors including machinery and instrumentation (MOE, 2023b). According to the Director of the Department of Higher Education at MOE, Chinese engineering education is expected to leverage its expertise to the global stage and play a leading role in the development of engineering education in the world (Li, 2018).

Chinese student enrollments by academic discipline vary greatly from EU students. In 2021, over one-fifth (22%) of university students studied business, administration, or law. The second most common field of study was engineering, manufacturing, and architecture-related areas, accounting for about 15.5% of total higher education students (Eurostat, 2023). Similar to EU countries, around one-fifth (19%) of bachelor's degrees were conferred in the fields of business in 2020-21 in the U.S. (NCES, 2023).

### *5.2.3 Faculty Development*

Despite having the largest number of full-time faculty in the world, student-teacher ratios are still high. By 2021, the number of full-time faculty at HEIs offering degree programs will reach 1.30 million, with a growth rate of 1.8% from the previous year. However, when taking into consideration the large student body at Chinese universities, the student-teacher ratio is rather high. In 2021, the student-teacher ratio at regular HEIs in China was 18.6:1, among which the ratio is 18.1:1 at regular undergraduate institutions, and 19.1:1 at newly established institutions (MOE, 2022). This contrasts with the OECD average of 17:1 at bachelor's, master's and doctoral or equivalent level in 2021 (OECD, 2024), the US's more favorable ratios of full-time-equivalent (FTE) students to FTE faculty at degree-granting postsecondary institutions in 2021 (13:1), particularly at private nonprofit 4-year institutions (10:1) (NCES, 2023), and world-leading universities, where it's below 10 (Fan & Wu, 2019).

In recent years, three main trends have emerged in terms of faculty preparation and demographics: the number of faculty holding advanced degrees has gradually increased; a growing number of professors are teaching undergraduates; and young faculty members are a major force in Chinese higher education. As of 2021, 43.2% of the full-time faculty held a doctoral degree, a 1.4% increase from 2020. Of universities pursuing world-class status funded by the Double World-Class Project, 75.3% of their full-time faculty with doctoral degrees; this number rises to 94.8% for universities aspiring to be world-class (Fan et al., 2023). In 2021, more than 80.7% of professors teach undergraduates, ensuring the use of high-quality resources in undergraduate teaching. In terms of age, nearly 70% of the full-time faculty are junior (under 35) and young (between 36 and 45) faculty in 2021 (MOE, 2022). This shows junior and young faculty members are now the major force in Chinese higher education, and it also suggests a favorable growth trend and huge potential in terms of faculty development.

### 5.2.4 Educational Expenditure

The expenditure on undergraduate education continues to increase, at a higher growth rate than that of other developed countries. Educational expenditures represent a fundamental and strategic investment that underpins a country's long-term development and forms the cornerstone of its educational infrastructure (Fan & Wu, 2019). China's overall expenditure on higher education increased from RMB1,012.5 billion to RMB1,383.0 billion, with an average annual growth rate of 8.1% (Figure 5.4). When compared with developed countries' expenditures in 2016 and 2020 (2.9% increase rate for OECD countries and 3.4% for EU countries), China's expenditures on higher education increased much faster.

Comparing data in Figure 5.4 and Table 5.1, it is clear that government spending on higher education in recent years has slowed down in developed countries. Average educational expenditure in OECD countries is slightly higher than that of EU countries.

Funding for undergraduate education in China primarily comes from the national government, and efforts have been made to further diversify its funding structure.

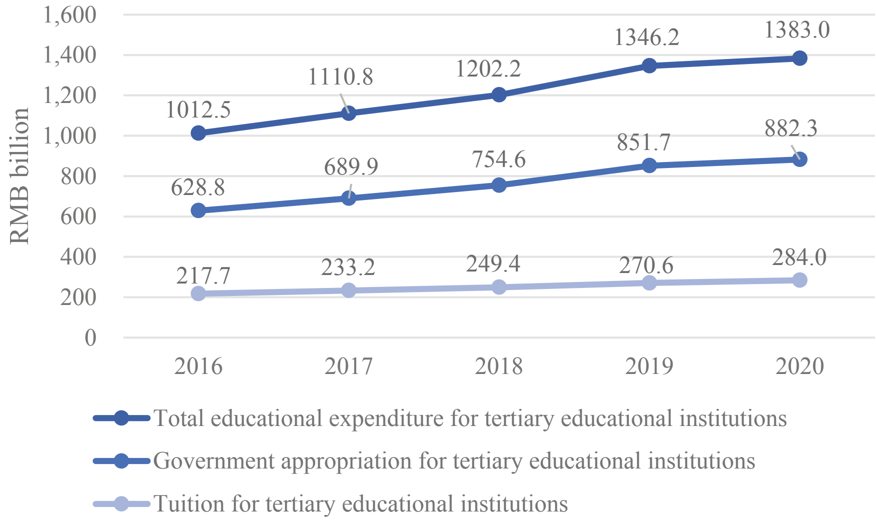



**Fig. 5.4** Educational expenditure in Chinese higher education (2016-2020) (in RMB billion). *Source* MOE (2017; 2018d; 2019a; 2020a; 2022).

**Table 5.1** Higher education expenditure in developed countries (in USD million)

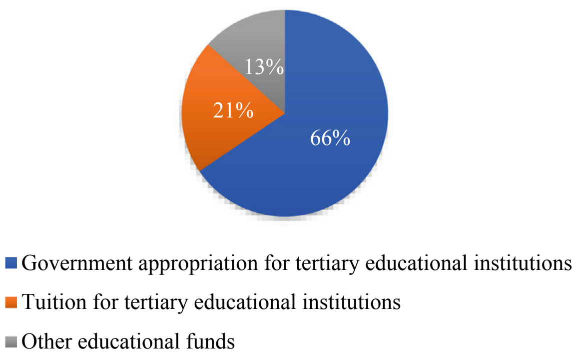
| Year | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|
| Average UN 20 countries | 9,382 | 9,608 | 9,950 | 10,278 | 10,715 |
| Average OECD 29 countries | 12,493 | 12,866 | 13,234 | 13,546 | 14,003 |

*Notes*

1. To ensure year-to-year comparability, all spending measured in monetary terms (e.g., total expenditure) is adjusted by the Consumer Price Index (CPI) and measured in 2015 Constant Prices. All increase rate in this chapter is measured in Constant Prices.
2. This table is compiled based on data from the OECD Dataset: Educational expenditure by Source and destination. Some countries' data are missing, including Bulgaria, Croatia, Cyprus, Colombia, Costa Rica, Denmark, Ireland, Korea, Malta, Mexico, Romania, Switzerland, Turkey, and the United States

In terms of funding sources, national expenditure on higher education (equivalent to public expenditure in the OECD documents) is the main source of overall educational funding in China, accounting for more than 60%; while tuition fees (equivalent to household expenditure in the OECD documents) only account for 20% of the overall educational funding (Figure 5.5). Based on Figure 5.4, it can be argued that tuition fees have been increasing slowly, and the increase in national financial expenditure on education has led to an overall increase in educational investment. In contrast, the funding landscape for tertiary education in OECD and partner countries in 2020 shows a different pattern. In most OECD and partner countries with available data in 2020, the central government directly provides more than 60% of government funds in tertiary education; in 37 out of 41 countries with data, the central government is the main source of both initial and final funding. In contrast, in Spain, as well as in federal countries such as Belgium, Germany, and Switzerland, over 65% of tertiary-level funding comes from regional governments with little or nothing transferred down to local governments. Local authorities typically do not have an important role in financing tertiary education, representing only 1% of both initial and final government funds on average, with the exception of the U.S. where local governments provide 9% of total expenditure at this level (OECD, 2023b).

**Fig. 5.5** Chinese higher education expenditure structure in 2020. *Source* MOE (2022).



### 5.2.5 Infrastructure

Infrastructure is fundamental to support teaching and research activities in undergraduate education. Figure 5.6 demonstrates that, in 2020, space utilization with laboratory facilities accounted for the largest space utilization with 5m$^2$ per student, followed by classroom facilities (4.5m$^2$ per student) and office and library facilities (about 2m$^2$ per student). The space for special use facilities and general use was relatively small: 1.5m$^2$ per student for specialized research rooms, 0.9m$^2$ per student for gymnasiums, and 0.3m$^2$ per student for assembly halls and meeting rooms (Fan et al., 2021). This suggests that the infrastructure at Chinese HEIs can meet the demand for teaching and research, but improvement is needed to expand general and athletic facilities.

As shown in Figure 5.6, independent colleges and newly-established universities provide the largest classroom space per student in 2020, followed by regular undergraduate universities, universities pursuing world-class status, and universities developing world-class disciplines. Conversely, in terms of laboratory facilities and special research rooms, universities pursuing world-class status enjoyed the largest space, followed by universities developing world-class disciplines, regular undergraduate universities, newly established universities, and independent colleges.

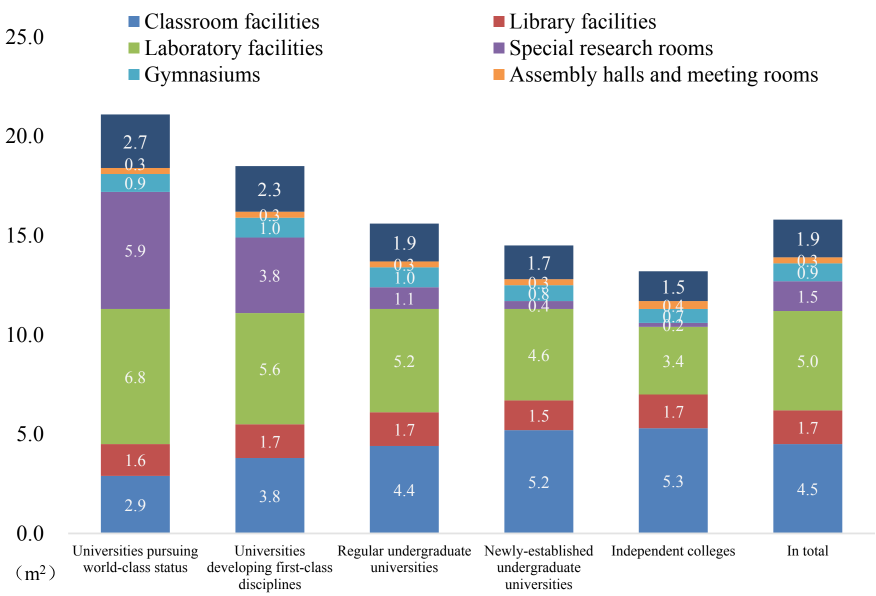



**Fig. 5.6** Average space utilization (teaching, research, and auxiliary rooms) per student in 2020 (m$^2$). *Source* Adapted from Fan et al. (2021)

### 5.2.6 Online Teaching and Learning

The robust advancement of massive open online courses is one of the significant trends in higher education in the modern world. In addition to the larger MOOC providers are the American platforms Coursera, edX, and Udacity, as well as the British FutureLearn, national online platforms have emerged in many countries: XuetangX in China; MiriadaX in Latin America; France Université Numérique (FUN) in France; EduOpen in Italy; SWAYAM in India; the National Platform for Open Education (NPOO) in Russia (N et al., 2023). In recent years, Chinese HEIs have strengthened online teaching platforms and vigorously developed online teaching resources. Massive Open Online Courses (MOOCs) represent a pivotal advancement in the realm of online education. In 2019 and 2020, China held China MOOC and Global MOOC Conferences and published the *Beijing Declaration* (Wu, 2020). Presently, China stands at the forefront of global MOOC development, both in terms of its sheer number and the extent of their application. As of February 2022, China had launched over 52,500 MOOCs, with registered users reaching 370 million. More than 330 million university students have earned academic credits through MOOCs (Fan et al., 2023). Online teaching and learning also play an important role in undergraduate education development and reform. During the COVID-19 pandemic, online teaching has expanded tremendously and reached a historic high in terms of the number of teachers, students, and courses. A national survey on teaching in HEIs (Fan et al., 2021) shows that online teaching and learning was offered on a large scale at undergraduate colleges and universities nationwide, with 1.08 million teachers offering 1.1 million courses, totaling 17.19 million courses, and a total of 3.5 billion course registration by students. The online course offering rate at Chinese HEIs was 91%; 80% of teachers acknowledged the importance of online teaching; and students' satisfaction with online teaching reached 85%. Online teaching and learning have presented opportunities for student learning and have helped to mitigate challenges and disruptions caused by the pandemic (*ibid*). In the post-COVID era, a hybrid model integrating both online and in-person teaching continues to develop, and significant changes are taking place in terms of curriculum design, teaching and learning styles, roles of professors and students, and classroom management (*ibid*).

### 5.2.7 Public and Private Funding Resources

In terms of funding resources, the community input has become an increasingly important force in higher education governance and management. A structure of "government funding as the main financial resource with support from various societal forces" has been formed (*ibid*). Implemented in 2012 and further amended in 2016, the *Private Education Promotion Law of the People's Republic of China* has "supported the development of private education" and "reassure the autonomy of private-run schools". These policies have strongly inspired the development of

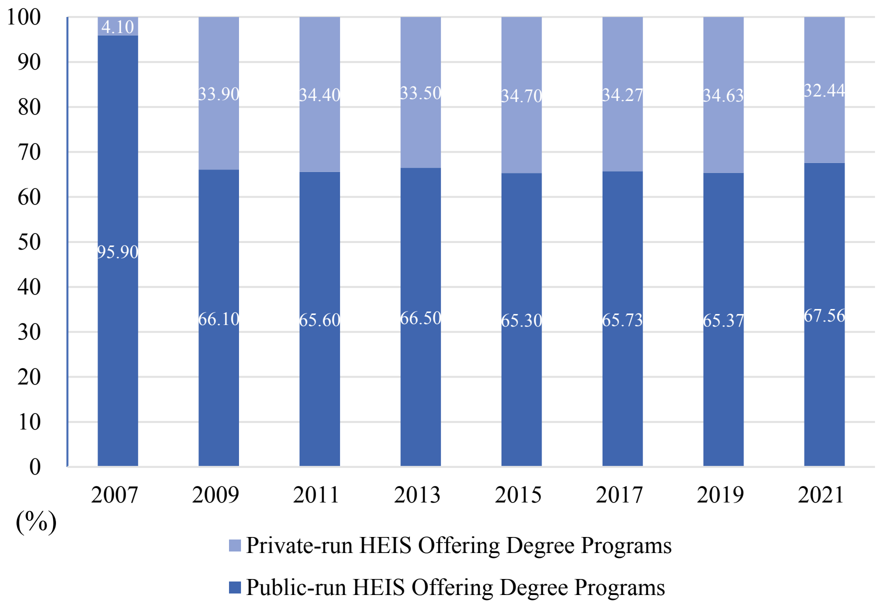



**Fig. 5.7** The percentages of public- and private-run HEIs in China (2007-2021) (%). *Source*: Compiled from National Bureau of Statistics (MOE 2007-2021)

private education. Figure 5.7 shows that the proportion of private HEIs in China, which mainly focuses on training a technically skilled workforce, increased from 4.1% in 2007 to 32.4% in 2021 with the number of private HEIs also increasing each year. There were 412 private regular undergraduate institutions in 2021, accounting for 30% of the overall regular HEIs nationwide (*ibid*). In contrast, as of the 2020-2021 academic year, the U.S. had 5,916 Title IV postsecondary institutions. Among these, 1,892 were public institutions, 1,754 were private nonprofit institutions, and 2,270 were private for-profit institutions, showing a significant presence of both private nonprofit and for-profit educational institutions (NCES, 2023).

## 5.3 Excellence Index

### *5.3.1 Design*

The quality of undergraduate education not only influences the quality of postgraduate (master's and doctoral) programs, but also directly affects a society's science and technology advancement, productivity higher education funding, and development momentum (Weng, 1999). This section intends to develop an excellence index with a set of excellence indicators, to analyze and evaluate undergraduate education in China through a global comparison.

#### 5.3.1.1 Indicators to Evaluate Undergraduate Education

Various research has attempted to evaluate undergraduate education quality in the past few decades. Chickering and Gamson (1987) explored "seven principles for good practices in undergraduate education". Ewell and Jones (1996) based on their empirical studies and designed "indicators of good practice", covering the four domains of institutional requirements, instructional "good practice", student behavior, and self-reported cognitive development. Since 2019, the China Association of Higher Education (CAHE) has published the first national "Teaching Development Index" to measure teaching quality at regular HEIs in China. This index focuses on six dimensions, including teaching forces, teaching reform projects, teaching material reform, research papers on teaching, teaching achievement awards and teacher training centers, and one special dimension of teaching competition, which is also called a "6+1" model (CAHE, 2019).

In recent years, Chinese scholars have been actively exploring an evaluation system to measure the comprehensive capacity of higher education in China. Zhang et al. (2014) constructed an evaluation system to measure regional higher education capacity in China from seven dimensions, including regional higher education scale, faculty development, internationalization, informatization and digitalization, social services, funding from local government, and funding from private resources. This evaluation system is applied to evaluate higher education capacity in each province with data from 2010. Relevant analysis shows that higher education evaluation usually adopts a grand framework of "scale, structure, quality, and efficacy", a process framework of "input, process, and output", a function framework of "workforce development, research, social services, and culture heritage", and a supply-demand framework of "supply, demand, engagement, performances, and productivity" (Huang & Sun, 2018). However, there is little country-specific studies on undergraduate education evaluation and comparison.

Thus, this chapter seeks to construct an evaluation system to measure undergraduate education in three dimensions of scale, resources, and performance. Indicators were selected based on the following principles: to adopt objective statistical data; to select indicators from public statistic databases; to select core indicators; and to examine the development of undergraduate education within the past 5 years. In addition, some specific indicators were employed, including the average growth rates of undergraduate student enrolment and graduates with a bachelor's or equivalent degree within the past 5 years (Table 5.2).

**Table 5.2** Excellence indicators of undergraduate education.

| Dimensions | Indicators | Data sources |
|---|---|---|
| Scale | 1. Undergraduate enrollment<br>2. Graduates with a bachelor's or equivalent degree | OECD, and national statistic agencies |
| Resources | 3. Percentage of world-class universities among quality undergraduate institutions<br>4. Percentage of quality undergraduate institutions per one million population | ARWU，QS |
| Performance | 5. Percentage of labor force at 25-64 year-olds with a bachelor's or equivalent degree<br>6. Number of graduates with a bachelor's or equivalent degree per one million population<br>7. Average annual growth rate of undergraduate enrollment<br>8. Average annual growth rate of graduates with a bachelor's or equivalent degree<br>9. Percentage of international students | OECD, and national statistic agencies |

*Source* Compiled from ARWU, OECD, and several national statistic agencies.

#### 5.3.1.2 Sample

To analyze undergraduate education in China in a global context, this chapter selected 11 countries with relatively developed undergraduate education systems, including the U.S., the U.K., Germany, France, the Netherlands, Japan, the Republic of Korea (ROK), Australia, Canada, Singapore, and New Zealand, mainly involving countries in North America, Europe, Asia, and Oceania.

#### 5.3.1.3 Data Collection and Analysis

This study collected data from OECD websites. If the data of individual countries were missing from OECD, it was then collected from its national statistics agency and sometimes from the official websites of Academic Ranking of World Universities (ARWU). The majority of the data collected pertains to 2021, supplemented by select data from 2020 or 2022.

When analyzing, data for the eight indicators were firstly standardized; then the scores of each indicator for each sample country were added for the initial value of its undergraduate education index; and last, the initial values were further standardized for comparison.

## 5.3.2 *Definitions*

### 5.3.2.1 Enrollment by Age—Overall Undergraduate Enrollment

The data on overall undergraduate enrollments were mainly collected from the OECD website. The OECD's definition is the number of students enrolled in bachelor's or equivalent level programs". Data for China are from MOE, and that of Singapore were from the website of Singapore Department of Statistics.

### 5.3.2.2 Graduates at Bachelor's or Equivalent Level

The data on graduates at bachelor's or equivalent level were mostly from the OECD website. The OECD's definition is the number of people who graduated from an education program at bachelor's or equivalent level. Data for China were from MOE, and that of Singapore were from the website of Singapore Department of Statistics.

### 5.3.2.3 Percentage of World-Class Universities among Quality Undergraduate Institutions

This indicator measures performance of quality undergraduate education programs in the sample countries. Based on the existing literature on world-class universities, this study defines those institutions entering the top 200 in ARWU as "world-class universities", and those institutions entering the top 1000 in ARWU as "quality undergraduate institutions". Data were collected from ARWU websites, using the latest year's results available.

### 5.3.2.4 Percentage of Quality Undergraduate Institutions Per One Million Population

This indicator measures the relationship between population and quality undergraduate education. Data on the sample countries' population were from the OECD website and the data on quality undergraduate education were collected same way as the previous indicators.

### 5.3.2.5 Percentage of 25-64 Year-Olds with Bachelor's or Equivalent Degrees

Data for this indicator mainly came from the OECD statistics. This indicator presents internationally comparable data regarding the labor force status and the educational attainment level by the National Educational Attainment Categories (NEAC) as reported by the labor force survey (LFS) and published in OECD *Education at a Glance 2023*. For trend data, the *Education at a Glance* Database included data from 1981 to 2022 (or years with available data).

Nevertheless, some data were missing, for example, Singapore; and there were also inconsistencies in the year of data, for example, the latest data for China was for 2020, while other countries' 2022 data.

#### 5.3.2.6 Number of Graduates with a Bachelor's or Equivalent Degree Per One Million Population

This indicator measures the relationship between population and graduates with a bachelor's or equivalent degree. The data for this indicator came from the OECD statistics.

#### 5.3.2.7 Average Annual Growth Rate of Undergraduate Enrollment

This indicator measures the average annual growth rate of undergraduate enrollment for each country over the period of 2016-2021. Data for the sample countries were mainly collected from the OECD, while data for China were obtained from MOE and Singapore from its Department of Statistics.

#### 5.3.2.8 Average Annual Growth Rate of Graduates with a Bachelor's or Equivalent Degree

This indicator measures the average annual growth rate of graduates with a bachelor's or equivalent degree in the period of 2016-2021. Data for the sample countries were mainly collected from the OECD, while data for China were obtained from MOE and Singapore from its Department of Statistics. In addition, the data for Japan were collected from, and that of France were from its National Institute for Statistics and Economic Studies.

#### 5.3.2.9 Share of International Students Among All Students–Bachelor's or Equivalent Level

Data for this indicator mainly came from the OECD statistics. This indicator presents the percentage of international students among the overall undergraduate enrollment of a country. It reflects to what extent a country's undergraduate education is internationalized.

### 5.3.3 Findings

To establish a comparable and standardized excellence index for each country based on the nine excellence indicators, three steps were followed. First, the raw data of the nine excellence indicators were retrieved from sources outlined in the previous section. Second, standardization was conducted to ensure uniformity in the unit and scale of the nine indicators. This involved assigning a score of 100 to the country with the highest value (considered the most optimal and the benchmark) for each indicator. For other countries, the standardized score was determined by calculating the proportion of its raw score relative to the benchmark, then multiplying by 100. Third, the excellence index for each country was calculated by averaging its standardized scores across all indicators. The resulting excellence index and corresponding ranks are presented in Table 5.3.

**Table 5.3** Excellence index and rank based on averaging standardized scores across indicators

| | Scale | | Sources | | Performance | | | | | Excellence Index | Rank |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | I1 | I2 | I3 | I4 | I5 | I6 | I7 | I8 | I9 | | |
| The U.S. | 100.0 | 48.3 | 47.1 | 37.4 | 71.6 | 63.3 | 8.1 | 32.6 | 25.0 | 79.3 | 3 |
| China | 47.3 | 100.0 | 21.2 | 8.5 | 22.3 | 30.5 | 27.7 | 61.1 | NA | 58.3 | 8 |
| Japan | 28.7 | 13.5 | 22.6 | 33.1 | 100.0 | 47.0 | 2.8 | 12.0 | 18.8 | 50.9 | 10 |
| ROK | 21.6 | 8.3 | 9.6 | 31.4 | 96.0 | 69.9 | (18.0) | (5.0) | 18.8 | 42.5 | 11 |
| Germany | 21.6 | 9.1 | 28.9 | 23.4 | 52.4 | 47.5 | 31.1 | 82.9 | 43.8 | 62.3 | 7 |
| The U.K. | 12.6 | 7.1 | 42.8 | 43.1 | 34.4 | 45.8 | 43.8 | 8.9 | 43.8 | 51.6 | 9 |
| France | 19.6 | 10.5 | 45.1 | 31.0 | 75.6 | 68.0 | 49.9 | 51.6 | 100.0 | 82.6 | 2 |
| Canada | 11.8 | 5.1 | 40.4 | 57.8 | 69.3 | 58.3 | 23.1 | 28.3 | 87.5 | 69.8 | 6 |
| Australia | 7.8 | 2.7 | 34.0 | 32.9 | 69.1 | 66.2 | 41.9 | 62.6 | 75.0 | 71.7 | 5 |
| The Netherlands | 10.9 | 5.9 | 100.0 | 100.0 | 81.9 | 100.0 | 12.7 | 54.1 | 81.3 | 100.0 | 1 |
| New Zealand | 1.9 | 1.0 | 0.0 | 50.8 | 84.5 | 85.4 | (18.0) | (59.6) | 56.3 | 37.0 | 12 |
| Singapore | 1.0 | 0.5 | 72.2 | 95.3 | NA | 36.9 | 100.0 | 100.0 | NA | 74.2 | 4 |

*Notes* NA means the data for the specific country are not available.
I1 = Undergraduate enrollment I2 = Graduates with a bachelor's or equivalent degree
I3 = Percentage of world-class universities among quality undergraduate institutions
I4 = Percentage of quality undergraduate institutions per one million population
I5 = Percentage of labor force at 25-64 year-olds with a bachelor's or equivalent degree
I6 = Number of Graduates with a Bachelor's or Equivalent Degree per One Million Population
I7 = Average annual growth rate of undergraduate enrollment
I8 = Average annual growth rate of graduates with a bachelor's or equivalent degree
I9 = Percentage of international students

**Table 5.4** Comparing Chinese undergraduate education's development with the 11 selected countries

| Dimension | Indicators of undergraduate education | Ranks of China's undergraduate education over all the 12 countries |
|---|---|---|
| Scale | 1. Undergraduate enrollment | 2 |
| | 2. Graduates with a bachelor's or equivalent degree | 1 |
| Sources | 3. Percentage of world-class universities among quality undergraduate institutions | 9 |
| | 4. Percentage of quality undergraduate institutions per one million population | 11 |
| Performance | 5. Percentage of labor force at 25-64 year-olds with a bachelor's or equivalent degree | 11 |
| | 6. number of graduates with a bachelor's or equivalent degree per one million population | 11 |
| | 7. Average annual growth rate of undergraduate enrollment | 6 |
| | 8. Average annual growth rate of graduates with a bachelor's or equivalent degree | 4 |
| | 9. Percentage of international students | / |

#### 5.3.3.1 Performance of China's Undergraduate Education in the Eight Indicators

The development of Chinese undergraduate education can be analyzed through the above-mentioned nine indicators and can also be reflected through a comparison with that of the other sample countries. Quantitative analysis of the nine indicators finds that China's undergraduate education ranks among the top in the two indicators of the number of graduates with a bachelor's or equivalent degree and overall undergraduate enrollment and ranks at an intermediate level in terms of average annual growth rate of undergraduate enrollment and average annual growth rate of graduates with a bachelor's or equivalent degree. However, its performance on the percentage of world-class universities among quality undergraduate institutions, the percentage of quality undergraduate institutions per one million population, and the percentage of labor force at 25-64 year-olds with a bachelor's or equivalent degree is not satisfactory. (Table 5.4)

#### 5.3.3.2 Overall Performance of China's Undergraduate Education

The comparative analysis shows that the Australia' undergraduate education has the best overall performance, stemming from its leads in terms of percentage of world-class universities among quality undergraduate institutions and number of graduates with a bachelor's or equivalent degree per one million population as well as its performance in terms of percentage of labor force at 25-64 year-olds with a bachelor's or equivalent degree, percentage of international students. China's overall performance in undergraduate education is relatively strong among Asian countries, mainly due to its performance on overall undergraduate enrollment, average annual growth rate of undergraduate enrollment, and average annual growth rate of graduates with a bachelor's or equivalent degree are not only higher than most of the Asian countries, but also higher than U.S. and U.K.

### *5.3.4 Discussion*

Since the socioeconomic reforms of the 1980s, undergraduate education in China has achieved remarkable progress, particularly over the past two decades, thanks to strong governmental support and advocacy. In recent years, the undergraduate education sector in China continues to emphasize quality transformation with the policy goal of building world-class undergraduate education. Focuses have been laid on student-centered teaching and learning, actively implementing teaching and curriculum reform, and aspiring to promote world-class undergraduate programs. Simultaneously, significant attention is given to the dissemination of Chinese traditional culture and values, ensuring the delivery of quality education with distinct Chinese characteristics.

The comparative analysis in this chapter suggests that the most obvious problem of China's undergraduate education is its limited number of world-class universities. It is true that China has made tremendous progress in the past two decades to develop academic excellence through the government funded excellence initiatives, such as Projects 211 and 985 as well as the Double World-Class Project, however, compared with the other sample countries, China still has a lower percentage of world-class universities among quality undergraduate institutions and efforts to build world-class universities are still to be strengthened. While the indicators need further elaboration due to limitations related to data availability, these findings are of practical significance for informing the future development of China's undergraduate education.

## 5.4 Best Practices

### *5.4.1 Exploring "Scientific Research + Practice" Education and Promoting the All-Round Development of Undergraduates*

#### 5.4.1.1 Focusing on Promoting Experiential Learning

Practice leads to true knowledge. The Renmin University of China has conducted the "Thousands of Educators, Hundreds of Villages" survey since 2012. Every year, it organizes more than a thousand teachers and students to go to rural areas to conduct systematic and normative practical research based on in-depth interviews and questionnaires. It also encourages students to engage in volunteer services in these areas, such as helping the elderly and the disabled, popularizing the law in rural areas, peer education, and caring support education. The university continues to promote the transformation of practical results, allowing students to temper their will and quality in practice and comprehensively improve their research-based learning and practical skills. At present, the project has reached more than 12,000 people, collected more than 9 million pieces of data, and generated more than 6 million words of primary materials (Renmin University of China, 2023).

Zhejiang University (ZJU), in addition to classroom teaching, has established the Second Classroom, Third Classroom and Fourth Classroom, to create an integrated training system. The Second Classroom is the training and exercising students receive on campus outside the regular class hours, including innovation and entrepreneurship competitions, quality training, academic competitions, academic research, club work, student-related work, cultural and sports activities, etc. The Third Classroom includes students' practical training off campus within the country, including entrepreneurial practices, employment internship, social and volunteer service. The Fourth Classroom includes students' overseas exchange experiences, including summer courses, short-term exchanges, overseas internships, exchange and visiting programs (ZJU, 2020).

#### 5.4.1.2 Fostering Academic Environments to Enhance Undergraduate Research Motivations

World-class universities generally regard cultivating outstanding academic talents as one of the goals of their undergraduate education reform and strive to create excellent academic environment to encourage undergraduate students to actively participate in scientific research activities (Shen et al., 2022). Shanghai Jiao Tong University (SJTU) launched the "Future Scholars Program" for second- and third-year undergraduate science and engineering students since 2022. It not only opens 20 top laboratories and scientific research platforms on campus to provide them with a series of resource support, but also gives students full identity and gave them the honor status of "Future Scholar" (Global Institute of Future Technology of SJTU, 2022). Similar programs can also be found in other countries. For example, in the U.S., the University of Pennsylvania's Undergraduate Research Mentoring Program (PURM) is committed to helping junior undergraduates join faculty research projects as research assistants, jointly explore the frontiers of science and technology, and provide certain assistant allowances to promote undergraduates from academic novices to future scholars, whose identity is constantly changing (University of Pennsylvania, 2022).

#### 5.4.1.3 Strengthening Scientific Education to Ignite Students' Interests in Science

The scientific spirit serves as the driving force behind the advancement of scientific endeavors, aligning with universities' core mission of fostering excellence in scientific research and education (Liu & Tan, 2020). Nanjing University (NJU) offers a series of 1+N+L "Light of Science" general courses for freshmen. Led by an academician or a "Changjiang Scholar" distinguished professor (1) in the field of science and technology, along with a team of high-level researchers and academics (N), the courses focus on cutting-edge interdisciplinary areas such as artificial intelligence and big data, new energy, optoelectronic information, astronomy, and Earth resources.

Drawing from recent participation in significant scientific research projects, noteworthy contributions to scientific inquiry, publications in reputable journals, and the latest research findings, NJU (2023a) conducts teaching activities comprising "Lab visits + Lectures + Discussions." By showcasing the journey of scientists in pursuit of truth, proposing novel theories, and navigating new studies, students' scientific spirit and literacy are nurtured, establishing a solid groundwork for their future academic pursuits and research endeavors.

### *5.4.2 Innovating Talent Development Models to Enhance Undergraduate Education Effectiveness*

#### 5.4.2.1 Promoting Residential Colleges and Creating New Learning and Living Communities

As early as 2015, Fudan University (FDU) took the lead in exploring a residential undergraduate college system. In this model, the colleges are divided based on the university's accommodation areas, with relatively independent physical spaces, including dormitories and public spaces within an area. The living arrangements are designed based on the principles of interdisciplinary studies and subject integration, allowing for extensive communication among students from different disciplines. Each college also implements enrichment opportunities, such as academic seminars and workshops, reading groups, and science and technology projects. It serves as the extracurricular activities for comprehensive student development, a residential campus for cultural education, a public space shared by teachers and students, and an educational platform for students to manage themselves (FDU, 2023a). Taking Fudan College as an example, its public spaces have diverse functions and are well-equipped, including reading rooms, gyms, yoga rooms, classic study rooms, free discussion rooms and other special spaces, as well as Fudan English Corner, Guqin Club, Calligraphy and Painting Club, Printmaking and Genealogy Production Center, Ancient Poetry Association, and other organizations and societies to cooperate with the community space (FDU, 2023b). Similarly, the college system of the University of Cambridge in the U.K. brings together undergraduates from different departments, different majors, and different backgrounds. With its unique community life model, it provides students with a diverse environment for communication, sharing, and service, and promotes the growth of students' sound personalities (University of Cambridge, 2024).

#### 5.4.2.2 Integrating Undergraduate, Master's, and Doctoral Education and Cultivating Elite Undergraduate Students

Chu Kochen Honors College at ZJU strives to create an integrated training program for bachelor's, master's, and doctoral degrees. Relying on basic disciplines, National Key Laboratories and the 2030 Discipline Convergence Research Plan, etc., ZJU adopts a "3+1+X" academic model for four-year majors. The "3" represents the undergraduate stage, "X" for the direct doctorate stage, and the "1" in the middle for the transition stage. An undergraduate degree will be awarded after the completion of the "3+1" training plan, and a doctorate will be awarded after the completion of the "1+X" training plan. In addition, based on the results of full discussions between teachers and students, the project formulates a high-quality personalized long-term training plan for each student during the undergraduate comprehensive training period and adopts a dynamic exit mechanism. It is committed to cultivating a group of students who focus on basic disciplines and national key urgently needed fields of top innovative talents (ZJU, 2023). FDU has comprehensively launched the "Excellent Doctoral Program", based on the basic principle of "excellent students, excellent teachers, excellent training". Every year, a group of students who are interested in academic research are selected from among the best undergraduates to directly pursue doctoral degrees and are equipped with the best mentors to provide personalized international training programs and generous scholarship support, striving to cultivate outstanding young scholars who will lead the future (FDU, 2022). Similar practice can also be observed in other countries. For example, Nanyang Technological University in Singapore launched the "CN Yang Elites Program" and actively built a direct "undergraduate-PhD" platform, requiring undergraduate students to prepare for doctoral studies upon admission, allowing students with excellent academic performance and enthusiasm for scientific research to directly pursue their doctoral degrees (Nanyang Technological University, 2023).

#### 5.4.2.3 Advancing Interdisciplinary Integration and Cultivating Comprehensive Innovative Talents

Relying on the Pilot Reform Program of Enrollment for Basic Subject, Tsinghua University (THU) has set up 22 science and engineering dual degree training programs such as "Basic Mathematical Sciences + Environmental Engineering" and one engineering-economics dual degree program in Computer Science and Finance and has 41 programs for full-time undergraduates. There are 13 optional minor degrees and 13 undergraduate course certificate projects such as Industrial Engineering and Data Science, forming a multi-level and three-dimensional compound talent training system of "double degree + minor degree + course certificate project" (THU, 2023a). In addition, THU has established seven interdisciplinary research institutes, including the Intelligent Unmanned Systems Research Center, the Intelligent Connected Vehicles and Transportation Research Center, and the Flexible Electronics Technology Research Center, as well as two physical laboratories like the Future Laboratory and the Brain and Intelligence Laboratory so build a platform for cultivating innovative talents. Likewise, Stanford University in the U.S. has established interdisciplinary science and technology research centers and laboratories to cultivate interdisciplinary talents. The students there can take interdisciplinary courses or participate in interdisciplinary research in addition to their majors, or they can directly apply for interdisciplinary degrees established by these research centers (Stanford University, 2024).

### *5.4.3 Enhancing Teaching Evaluation System to Ensure Quality Undergraduate Education*

#### 5.4.3.1 Reinforcing Student-Centered Teaching Evaluation

In terms of student evaluation, Nankai University focuses on "student-centered" approaches. It has shifted its previously teacher-centric evaluations to student-centered evaluation models: these questions, such as "Can you complete the course content teaching?" and "Can you interact with students", have been replaced with questions as "Can you gain something from the teacher's teaching?" and "Can you participate in the teacher's classroom interaction?" (China Education News, 2019). In this way, students are allowed to evaluate and provide feedback on class teaching based on their individual learning outcomes and gains. In addition, it combines school-level supervision evaluation and peer evaluation to effectively ensure that undergraduates education quality (Nankai University, 2023). The same approach can also be observed at universities in other countries. For example, the student evaluation at the University of California, San Diego is divided into three parts: teacher evaluation, course evaluation and general questions. It also evaluates what has been learned from course teaching, and what gains and progress have been made from the perspective of students (Course & Professor Evaluations, 2023).

#### 5.4.3.2 Implementing Teaching Portfolio Evaluation to Improve Teaching Capabilities

Peking University (PKU) has vigorously promoted the construction of teaching portfolios, including teachers' basic teaching information, personal reflections on teaching, teaching outputs and results, and external teaching evaluations into teachers' teaching portfolios, and has supported teachers to flexibly add relevant content, focusing on a combination of objectivity data and subjective elaboration (Yu & Feng, 2020). In addition, PKU has also developed a Teaching Portfolio Platform to collect teachers' teaching-related data and process data on participating in teachers' teaching development-related projects through the platform system, helping teachers quickly organize their own teaching resources and conveniently form the prototype of electronic teaching portfolios. As of December 2023, the platform has attracted 2,586 teachers to join and has generated 5,549 electronic teaching files (PKU, 2023).

THU has also implemented the teaching portfolio system to incorporate the investment and effectiveness in teaching and educating people into the teacher evaluation system. There are a total of 18 items in six modules in the teaching portfolio list. Among them, the four modules of teaching resume, teaching data, teaching statement, and teaching process record are required content, and the two modules of teaching development and research, teaching results and rewards are optional. The required modules involve not only rigid content such as teaching workload and student performance, but also process recording requirements such as student evaluation, peer evaluation, and self-evaluation. As of December 2023, more than 900 teachers have established teaching portfolios, which have exerted the function of promoting improvement and growth through evaluation, and the sense of teaching gain and happiness of teachers and students has been greatly improved (THU, 2023b).

#### 5.4.3.3 Enhancing Comprehensive Student Evaluation Systems

In response to the relatively one-dimensional student evaluation, NJU has gradually implemented a comprehensive evaluation system, including a transcript for reinforcement learning (i.e. academic transcript), a transcript for encouragement (i.e. the "Five Disciplines" transcript), and a transcript for honest and sincerity (i.e., the integrity transcript), starting with the undergraduate students during the 2021 academic year. The comprehensive evaluation transcript system includes academic development, practical experience, and ideological and moral character. It establishes a multi-evaluation mechanism for students, striving to evaluate every student comprehensively and objectively. Among them, a transcript for encouragement records students' participation in non-curricular studies such as the Five Disciplines Project, aiming to improve undergraduates' social cognition, learning understanding, practical practice, communication and leadership, etc. It is currently available in May 2023 (NJU, 2023b).

## 5.5 Inspiring Stories

### *5.5.1 Sun Qilin: Emphasizing Teaching as the Most Important in Talent Cultivation*

Sun Qilin, a professor of the Department of Physical Education at SJTU, is the first National Teaching Master recognized in the field of sports science. Sun has always kept in mind that "lessons are the most important". He has been teaching for 50 years and has compiled many high-quality textbooks. He has always been at the forefront of teaching and is committed to making every student experience the infinite fun of sports.

#### 5.5.1.1 Caring for Students like his Own Child and Always Staying on the Teaching Frontline

The responsibility and mission of teachers is to teach. Sun Qilin always believes that classes are the core and giving good classes is the basic skill of teachers. It is necessary to use teachers' passion to drive students' passion, and teachers' investment to drive students' investment. Since he started teaching in 1973, Sun Qilin has been responsible for teaching a table tennis special course for undergraduates every year. He has never tired of teaching table tennis to undergraduates in 50 years.

Sun Qilin loves students and is close to them. In the first lesson of every new semester, he bows deeply to the students standing in front of him and says to them: "Thank you for choosing my class and trusting me." (SJTU, 2017). It is challenging to deliver table tennis class at the undergraduate level, as each students' skills varies. However, Sun Qilin always gives each student individual attention, carefully prepares lessons, teaches scientifically, and teaches students in accordance with their aptitude, so that students can not only improve their skills, but also experience the infinite fun of sports. In each of his class, his requirement for students is very simple, that is, if they are not sweating profusely, it does not account as a physical education class. Moreover, Sun ensures both the students and the teacher himself are covered with sweat and pumped up with energy (Xinhua News Agency, 2019). No matter how busy Sun is at work, he turns up at the tennis table in the gym every Thursday. He always tries his best to free up the day for his students (SJTU, 2017).

#### 5.5.1.2 Innovating Teaching and Devoted to Student Development

Sun believes that physical education classes should not only improve physical fitness and skills, but also promote personality development, awaken students' understanding of the meaning of life, and improve the quality of life and life of college students.

Sun diligently studies teaching materials and methods, focuses on introducing scientific knowledge to students, incorporates the latest research results into teaching, emphasizing innovative interactions between in-class and extra-curricular, teaching and scientific research (*ibid*), committed to providing students with quality teaching in each class. In addition, he is also actively editing teaching materials. The "Sports and Health Course" he edited and published has a cumulative circulation of 1 million copies since its first edition was launched in 1995, making it the most widely used, influential and popular public physical education teaching in colleges and universities across the country. It serves as a representative university physical education textbook, and the textbook "Table Tennis" edited by him has also been rated as a national quality textbook (*ibid*).

### *5.5.2 Su Dekuang: A Calculus Teacher Who Sparks Joy and Inspires Hope in Students*

Su Dekuang, a professor of Mathematics at the School of Science, ZJU, has over 30 years of teaching experience. He has transformed what could be perceived as dull and boring calculus into engaging life lessons. He is known as the students' favorite teacher and the most interesting college calculus course professor. He has won the Yongping Outstanding Teaching Contribution Award and won a million-dollar teaching grant (ZJU, 2014).

#### 5.5.2.1 Developing a Gold Medal Calculus Course

Su Dekuang teaches calculus, which is an introductory undergraduate course. For many students, calculus is obscure and difficult to learn. However, Su Dekuang's calculus course is rated as one of the most difficult courses to register for a spot. For a course with a capacity of 150 students, there will be more than 3,000 people "vying" for it on the course registration system (CCTV.com, 2015). Students even wrote in their self-made handbook for freshmen, "You must attend Su Dekuang's class" (The Paper, 2017).

Su always employs various lively and interesting life philosophies and creates his own “jokes” to make abstract mathematical concept tangible and deeply ingrained in students’ minds. For example, when talking about partial derivative functions, Su compares it with the philosophy of love, “when you like someone, you can see every change in him/her, and everyone else remains a constant. He is the only variable. Falling in love with her, such preference becomes a deviation (People’s Daily, 2014a)”. In addition, Su pays great attention to teaching details and aim for optimal classroom effectiveness. He always uses two microphones in class, one hung around his neck and one placed on the podium to ensure that students can hear clearly no matter where they sit. He also orchestrates the classroom like a “stage manager”, requiring that the curtains in the first row of the classroom must be closed to prevent screen glare and using oil-based pens to write slides on paper, ensuring the clearest projection onto the screen (Zhejiang Online, 2014).

Su believes that excelling in teaching is challenging. It requires intensive research and innovative methods to enhance students’ interest in learning. It is a complex discipline that demands continuous exploration and refinement. Over the years, Su has diligently studied various teaching methodologies, including image-based teaching, exploration and discovery-based teaching, and collaborative pre-teaching practice and learning, etc., to effectively mobilize students’ enthusiasm and enthusiasm for learning, and he has summarized the “six-word teaching method”—understanding, thoroughness, essence, interest, emotion and virtue ( People’s Daily, 2017).

#### 5.5.2.2 Both a Mentor and a Friend, Being a Good Guide for Students’ Growth

Su Dekuang believes that only by being close to their teacher can students believe in the teacher’s teachings. He is a mentor and friend to his students both inside and outside the classroom, and often helps students solve problems and difficulties. Students like to get close to him, seeking his guidance not only for academic mathematics problems but also for advice on choosing majors and future planning. In addition, to benefit more students, Su has developed a second classroom through Microblog and used every moment to answer questions. Currently, the number of Microblog fans has exceeded 1.6 million ( People’s Daily, 2014b).

Su Dekuang believes that nurturing virtue is even more important than nurturing talent. He guides students to strive for excellence and to be ambitious individuals with ideals. He believes that the purpose of teaching is not just to let students remember boring formulas. The real meaning of university is to cultivate outstanding talents and leave students with beautiful memories of their youth (CCTV.com, 2015). While teaching knowledge, Su Dekuang also emphasizes guiding students to pay attention to the development of the country and teaches the principles of life and work. He will also mention Liu Qiangdong’s ups and downs in starting a business in Zhongguancun; Jack Ma’s search for a job has been blocked; Zhejiang’s “most beautiful doctor” is still treating illnesses and saving lives in his 80s. He hopes that these positive stories can turn into spring breeze, allowing students to learn knowledge and ignite their dreams (Zhejiang Daily, 2016). Su Dekuang strives to button up the first button of life for young people (ZJU, 2021), influencing every student he teaches with his words and deeds, and taking all means to let the students reach higher, fly farther, and live better.

## 5.6 Latest Research

### *5.6.1 An Overview of Research on Undergraduate Education in China*

With the rapid development of undergraduate education in China, increasing research on relevant topics has emerged in academia. Simultaneously, research on undergraduate education plays a pivotal role in guiding the reform and development of undergraduate education. Through a literature search, this chapter adopts a quantitative analysis to provide an overview of undergraduate education research in China.

This study selected core journals in the field of higher education indexed in the databases of the Chinese Social Sciences Citation Index (CSSCI) as sampling criteria. Through an advanced search in the higher education journals indexed in the database, this study retrieved 1,470 journal papers focusing on undergraduate education and published from 2013 to 2023.

Using undergraduate education as the keyword, the latest 10-year CSSCI journal papers (2013-2023) were searched on the China National Knowledge Infrastructure (CNKI) website. The distribution of the most studied topics related to undergraduate education is presented in Fig. 5.9.

As seen in Fig. 5.9, the most studied topic is world-class undergraduate education (with 61 journal papers), followed by undergraduate major (with 38 journal papers), talent cultivation (with 34 journal papers), undergraduate students (with 30 journal papers), research universities (with 29 journal papers), undergraduate talent cultivation (with 25 journal papers), Double World-Class Project (with 24 journal papers), vocational undergraduate education (with 24 journal papers), general education (with 24 journal papers), undergraduate teaching (with 22 journal papers), undergraduate education reform (with 21 journal papers), applied undergraduate education (with 20 journal papers), local undergraduate institutions (with 19 journal papers), undergraduate institutions (with 18 journal papers), world-class universities (with 18 journal papers), undergraduate major construction (with 18 journal papers), applied undergraduate education (with 17 journal papers), talent cultivation models (with 17 journal papers), and world-class undergraduate (with 16 journal papers).

These topics can roughly be summarized into four broad categories, which will be explored in the subsequent section: world-class undergraduate education (i.e., Double World-Class Project, undergraduate major construction), talent cultivation (i.e., undergraduate talent cultivation, talent cultivation model), general education,

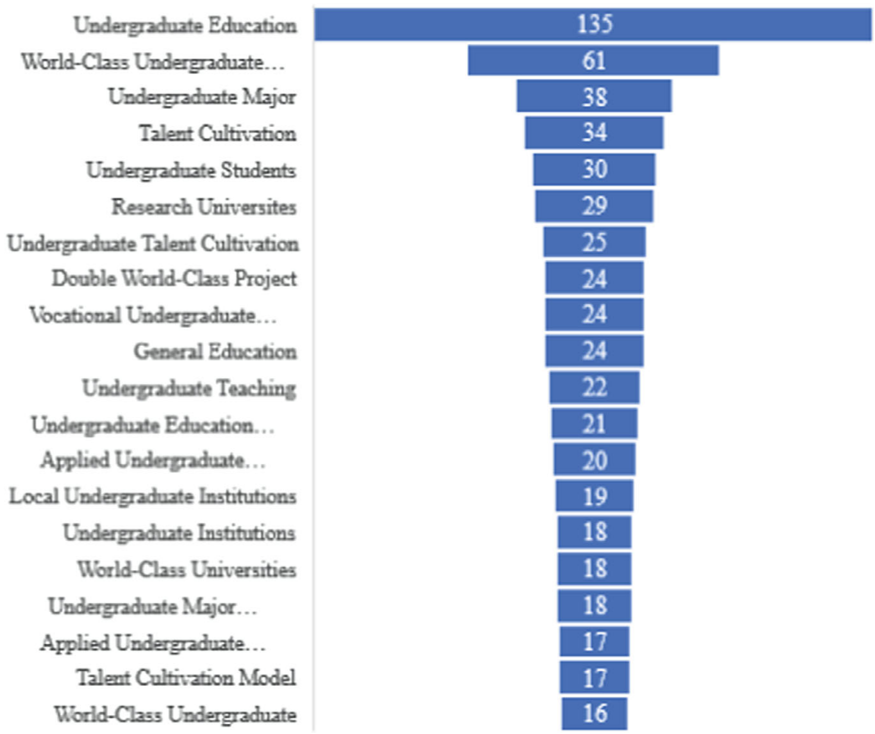



**Fig. 5.9** Top 20 topics in the undergraduate education literature**.** *Source* Compiled from search results from CNKI

and vocational undergraduate education. This thematic approach aids in understanding the areas of research focus and the evolving trends within undergraduate education.

Source journals serve as a central hub for the aggregation of research outcomes in undergraduate education, reflecting not only the journals' preferences for research in this field but also the quality of the published research. As depicted in Table 5.4, the majority of the 1,470 documents in the selected research sample originate from core journals in higher education. Among these, *China University Teaching* accounts for 114 papers, representing 7.8% of the total; *China Higher Education Research* contributes 109 papers, or 7.4%; *China Higher Education* has 91 papers, making up 6.2%; *Research in Higher Education of Engineering* includes 78 papers, comprising 5.3%; and *Jiangsu Higher Education* adds 61 papers, or 4.1% of the total. The top 5 journals, each with over 50 published papers, collectively contribute to approximately 30% of the total publications. This indicates that the dissemination of research findings in undergraduate education is relatively concentrated, with a significant portion of the research outcomes being published in academically recognized and authoritative journals (Table 5.5).

**Table 5.5** The top five journals by publication volume in undergraduate education

| Journal | Paper volume (in 2013-2023) |
|---|---|
| *China University Teaching* | 114 |
| *China Higher Education Research* | 109 |
| *China Higher Education* | 91 |
| *Research in Higher Education of Engineering* | 78 |
| *Jiangsu Higher Education* | 61 |

*Source* Compiled from search results from CNKI.

## *5.6.2 Research Focus and Trends*

The primary research focus underscores the essential elements and central tendencies within the subject matter of these research papers. Over the past decade, the research topics focused on undergraduate education can be distilled into four primary areas.

### 5.6.2.1 Research on Undergraduate Talent Cultivation

Talent cultivation is one of the essential functions of universities, and undergraduate education is the root and foundation of higher education (Chen, 2018b). This review indicates that the existing research explores modes of undergraduate talent cultivation in terms of goals, plans, and approaches.

Pan Maoyuan (2005), a renowned Chinese educator and academic master of higher education research, pointed out that, since higher education is diversified and HEIs are of diversified types, goals for talent cultivation must also be diversified. In terms of the goals, undergraduate education at practical and profession-oriented universities should set up their goals as serving local socio-economic development, meeting skill demands of industries and enterprises, ensuring curriculum content connected and relevant to real world experience, and enhancing students' employability (Wu & Huang, 2014); research universities, on the other hand should focus on training elite undergraduate students with both discipline-specific knowledge and comprehensive abilities (Li, 2012). In terms of student training plans, practical and profession-oriented universities should ensure their programs are closely connected and relevant to local workforce development needs and specialized industries (Xue & Wang, 2016); while research universities should stress education and training of top innovative talents, develop specialized disciplines to cultivate students' professional knowledge, expertise, innovative awareness and creativity and to design interdisciplinary courses to train multidisciplinary and comprehensive skill force (Li, 2022).

HEIs with different goals adopt different training approaches toward teaching and learning. University-industry research collaboration and university-enterprise cooperation are essential to train technical talent (Wu & Huang, 2014); while research universities should develop disciplines to support subjects and transform disciplinary advantages to that of talent training (Lu, 2018).

#### 5.6.2.2 Research on General Education

Over the past decade, general education within undergraduate programs has garnered substantial scholarly interest, although this focus has seen a slight decline recently. Cai Yuanpei, Pan Guangdan, Zhu Guangqian and other famous educators have introduced general education into Chinese universities and put it into practice (Yang, 2000). Research on general education focuses on exploration at the theoretical level and promotion at the practical level. At the theoretical level, the discourse has intensely focused on elucidating the concept of general education and delineating its relationship with allied educational philosophies. Chen (2006) critically reviewed its definition and its differences from professional learning, liberal education, liberal arts education, quality education, specialized education, as well as general elective and commonly required courses. Li and Wang (1999) analyzed the definition and nature of general education, and Liu (2012) proposed that general education carries the basic goal of university education, that is to develop students as a whole person. At the practical level, scholars investigate the opportunities and challenges to develop general education. Su and Li (2018) analyzed the challenges and implications to reform general education at THU and discuss the logical relationship between general education curriculum and its goals in terms of competence; Yu (2016) adopted a case study of China University of Political Science and Law to examine the status quo of general education in the Chinese higher education context and proposes recommendations to further promote such programs. Looking ahead, the field is poised for in-depth empirical studies examining the efficacy and quality of general education implementation, alongside explorations into innovative, localized models.

#### 5.6.2.3 Research on World-Class Undergraduate Education

World-class undergraduate education has seen a significant increase in research outputs since the National Conference on Undergraduate Education in Universities in The New Era in 2018. In this area, studies cover a range of topics, including the essence and fundamental characteristics of world-class undergraduate education, strategies for its development, and critical analyses of associated policies (Liu, 2016; Zhu & Ge, 2019). In discussing world-class undergraduate education within the Chinese context, scholars present varied perspectives, highlighting the complexity and multifaceted nature of this concept. Some studies, examining the practices and talent cultivation processes of top universities, have explored these connotations and characteristics. Illustratively, Zhou (2019) analyzed the Double

World-Class Project at C9 universities[2] and reveals that world-class undergraduate education in China is characterized by its elitism, criticality, foundational nature, and academic focus, as evidenced by high-quality student intake, top-tier faculty, small seminar classes, research-oriented teaching, undergraduate research opportunities, residential colleges, and international talent cultivation. Research on how to construct world-class undergraduate education primarily discusses essential factors, developmental paths, and lessons from international experiences. Specifically, some studies have examined the gaps between Chinese universities and world-class institutions in undergraduate education, such as Xie and Zhang (2019) discussing the issue of incomplete reform in undergraduate course curriculums. Other studies have focused on key areas like classroom teaching reform, institutional support, and policy implementation (Wang H.C., 2019; Wang K., 2019b; Zhang, 2019). Contrasting with certain international higher education reforms initiated predominantly at the university level, the legitimacy of educational reforms in China heavily depends on policy endorsement. Ever since policies on world-class undergraduate education were introduced, research focus shifted to policy objectives and implementation results. For example, some studies have studied top-level design issues and policy implementation of the Double Ten-Thousand project[3] for developing world developing-class undergraduate disciplines (Wang J.H., 2019; Ma, 2019). While these studies employ various research methodologies, descriptive, conceptual, and case analysis approaches are most common, with fewer empirical studies. Future research endeavors could focus on refining policy objectives pertaining to world-class undergraduate education, devising strategic implementation plans, and unravelling the complexities of talent cultivation process (Zhou & Xian, 2021).

### *5.6.3 Research Originality*

Academics play a primary role in developing scientific research in China. Research results in the field of education are mainly published in the form of papers and books (Gong, 2009). A review of the existing research literature on undergraduate education in China in recent years reveals that academics' original research not only enriches related theories but also makes a positive impact on policymaking and practices of undergraduate education in China.

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[2] C9 universities: It is an elite group of 9 universities in China, formed in 2009 as a part of the Project 985 initiative. This league includes some of the most prestigious universities in the country: Fudan University (FDU), Shanghai Jiao Tong University (SJTU), Harbin Institute of Technology, University of Science and Technology of China, Peking University (PKU), Tsinghua University (THU), Nanjing University (NJU), Xi'an Jiao Tong University (XJTU), and Zhejiang University (ZJU).

[3] The Double Ten-Thousand project: It is a project initiated by China's Ministry of Education in April 2019. Its objective is to develop nearly 10,000 national-level and 10,000 provincial-level first-class undergraduate majors.

At the theoretical level, Pan Maoyuan contributed greatly to enhance theoretical discussion on Chinese undergraduate education. He wrote widely on the essence of higher education, the law of internal and external relations in education, massification of Chinese higher education, the basic functions of HEIs, private higher education, curriculum and instruction in higher education, developmental stages of disciplines in higher education, etc. (Liu & Tang, 2020). Gu Mingyuan also provided rich and forward-looking educational thoughts. The importance of undergraduate education in university education has become a heated topic in recent years; Gu first published the paper titled "Undergraduate education is the foundation of higher education" back in 1990. Lately, he also proposed "the university reform should emphasize on undergraduate teaching, and the best scholars should return to the podium and teach students" (Zhang & Li, 2018). Bie Dunrong's theoretical research is based on practices and provides theoretical support to undergraduate teaching reform (Zhang, 2011). In the article "Rebuilding undergraduate teaching", he surveyed the main problems and challenges and then argued that the reform of undergraduate teaching should start with transforming the concepts of undergraduate education (Bie, 2001).

Some academics conduct innovative and leading research on educational practices. Liu Xianun of Huazhong University of Science and Technology opened up a new area of institutional research in Chinese higher education, shifting structural research at the theoretical level toward problem-solving in practices, and conducting in-depth systemic research on higher education governance and management (Zhou, 2017). In relation to research on faculty, recent research focuses on student-centered teaching methodologies and approaches. For example, Zhou and Zhou (2002) employed survey and classroom observations (recording) to investigate faculty's discourse in terms of discourse quantity, ways to ask questions, interactions, and feedback. From the perspective of student experience, Luo et al. (2009) used NSSE-China survey tool (National Survey of Student Engagement) to compare the performance of THU's undergraduate education with its peer institutions in the U.S., for five comparable indicators, educational stages, and student attainment. The result shows that THU's undergraduate teaching quality is largely comparable to its world-class peers in the U.S.

## 5.7 National Policies

### *5.7.1 General Policies*

#### 5.7.1.1 Educating and Training the Top-Notch Undergraduate Students

In the 1980s, Chinese undergraduate education emphasizes developing top-notch students at the beginning of the economic reform. At that time, the University of Science and Technology of China (USTC) established the first Class for the Gifted Young, the first pilot program to train top talented students in basic science disciplines

(Ye, 2014). In 2009, in response to the Qian Xue-Sen's question—why do Chinese universities lack elite talents?—the government further focuses on educating and training the top talented students.

In 2009, MOE, in partnership with the Ministry of Organization and the Ministry of Finance, launched the Pilot Program for Training Top Talented Students in Basic Sciences. The pilot program was implemented in the five disciplines of mathematics, physics, chemistry, biology, and computer science (THU, 2015a), which was the very beginning of the "Six Excellence and One Top-Notch" Talent Training Project 1.0.[4] The pilot program aims to establish a few national bases for training young talent via basic disciplines at top research universities, to build an institutional mechanism to train top students in HEIs, to attract elite students to engage in basic science research, to further transform these selected students into leading scientists in related disciplinary areas, and to eventually become leading scientists in the global stage (Du, 2014). Subsequently, this program was implemented in 17 ministry affiliated universities, including PKU and THU (the State Council, 2010).

In 2018, MOE issued *Guidelines on Accelerating the Development of High-Quality Undergraduate Education and Comprehensively Improving the Capacity of Talent Training* and decided to further implement the "Six Excellence and One Top-Notch" Talent Training Project 2.0.[5] *Guidelines on the Implementation of the Cultivation Program for Young Talent Students in Basic Disciplines 2.0* issued by MOE and five other ministries expanded the disciplinary areas by adding astronomy, geography, atmospheric science, marine science, geophysics, geology, psychology, basic medicine, philosophy, economics, Chinese language and literature, history, etc. (MOE *et al.*, 2018b). This program has made significant progress in terms of institutional structure, student selection, and training approaches. It also explores the new talent training approach of "one mentorship system with emphasis on student-centeredness, small class sizes and internationalization", to achieve "the best undergraduate students and the best undergraduate education programs" (Zhang, 2016).

This program aims to build a talent training system of excellence and develop world-class students with Chinese characteristics. The Talent Training Program 2.0, based on its original 1.0 program, has developed a series of talent training approaches, along with plans and standards that seek to enhance reform quality and effectiveness (MOE, 2018e). This new program has turned the original individual project into a

[4] Six Excellences refers to the Outstanding Engineer Education and Training Program, the Outstanding Doctor Education and Training Program, the Outstanding Agriculture and Forestry Talents Education and Training Program, the Outstanding Rule of Law Talents Education and Training Program, the Outstanding News Communication Talents Education and Training Program, and the Outstanding Teacher Training Program. "Top-notch" refers to the Training Program for Top-Notch Students in Basic Disciplines.

[5] The Six Excellences and One Top-Notch plan 2.0 includes: Outstanding Engineer Education and Training Program 2.0, Outstanding Doctor Education and Training Program 2.0, Outstanding Agriculture and Forestry Talent Education and Training Program 2.0, Outstanding Teacher Training Program 2.0, Outstanding Rule of Law Talent Education and Training Program 2.0, Outstanding Journalism and Communication Talent Education and Training Program 2.0, and Top-Notch Student Training Program for Basic Disciplines 2.0.

series of plans (MOE, 2019b), from "single armed combat" to "collective forces". This reflects that Chinese higher education reform and development is shifting its role as a follower toward a leading role in certain fields – a "quality revolution" for Chinese higher education in the new era (MOE, 2019c). A report delivered by President Xi Jinping to the 20th National Congress in 2022 emphasized the comprehensive improvement of the quality of independent talent cultivation, focusing on cultivating top-notch innovative talents, which reflects the government's high attention to the work of top-notch innovative talents.

#### 5.7.1.2 Quality Assurance in the Respect of Undergraduate Teaching

China formally launched undergraduate teaching evaluation in the 1980s and 1990s. *The Provisional Regulations on Educational Evaluation of Regular Higher Education Institutions* announced in the early 1990s marked the formation of the basic framework for quality assurance of undergraduate education in China. In 2002, MOE issued *(Trail) Plans for Undergraduate Teaching Evaluation at Regular Higher Education Institutions*, which intended to combine pass/fail, merit-based, and randomized evaluations into one evaluation system to assess undergraduate teaching quality at Chinese universities. This has led to the standardization and institutionalization of quality assessment of Chinese undergraduate education (Liu & Li, 2018).

In 2011, *Guidelines on Undergraduate Teaching Evaluation at Regular Higher Education Institutions* proposed a "five-in-one" evaluation system. This system is based on HEIs' self-evaluation; takes institutional evaluation, professional accreditation and appraisal, international evaluation, and performance indicators of teaching quality as its main content; integrates multiple evaluation results from government, HEIs, specialized organization, and society; and is corresponding to the modern higher education system with Chinese characteristics (MOE, 2011). In 2012, the system to publish an annual evaluation report on HEIs' performance and quality was established and it requires each regular HEI to publish its annual "Undergraduate Teaching Quality Report". This report can be seen as a self-evaluation approach, but also serves as important evidence for institutional evaluation on undergraduate teaching (MOE, 2013). Since 2017, the Higher Education Evaluation Center of MOE developed and released the annual *National Report on the Quality of Undergraduate Education and Teaching at Regular HEIs*, which is the first theme-based report on Chinese undergraduate education quality. The four theme-based quality reports cover undergraduate education, engineering education, newly established undergraduate HEIs, and private undergraduate programs (Sun, 2017).

### *5.7.2 Recent Policy Highlights*

#### 5.7.2.1 Developing World-Class Undergraduate Disciplines

MOE started its so-called Double Ten Thousand project on promoting world-class undergraduate disciplines in 2019. Its mission includes developing 10,000 world-class undergraduate disciplinary programs at both the national and provincial levels respectively (MOE, 2019d). The top three selected disciplines are business administration (674 undergraduate programs), foreign language and literature (609), and computer sciences (577); while over 400 programs are selected respectively in the design, digital information, and mechanical engineering disciplines. The Double Ten Thousand Project is open to all HEIs and disciplines and is implemented in two stages: MOE will first evaluate those applied programs as "first-class at the national level, and after further evaluation and appraisal by MOE to confirm these programs' first-class status in the nation (*ibid*). To apply for the project, each program needs to meet five requirements: clear developmental goals, standardized management, effective reform, excellent teaching forces, and high-quality training (*ibid*).

#### 5.7.2.2 Developing World-Class Undergraduate Curriculum

MOE issued the *Guidelines on the Implementation of World-Class Undergraduate Curriculum* (MOE, 2020c). The objectives to develop a world-class undergraduate curriculum include:

- to design world-class and top-quality undergraduate curriculum;
- to develop new curriculum development concepts;
- to promote reform and innovation in curriculum design;
- to implement effective and scientific evaluation;
- to provide clear guidelines and regulations on curriculum management;
- to stipulate rules on professors' teaching responsibility, enhancing course quality, and raising the standard on students' graduation requirements;
- to improve faculty's teaching ability and skills;
- to improve quality-oriented incentives for curriculum development; and
- to diversify teaching content and develop a multi-category curriculum system.

It aims to develop about 10,000 world-class undergraduate courses at the national and provincial levels within three years (MOE, 2019e). The world-class curriculum sets students in the center of the course programs, and its content reaches the "golden" standard to ensure the curriculum's breadth, depth, and integration of learning[6]. Selected courses must be developed and improved for at least two semesters or

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[6] It refers to high order, innovation, and challenge. "High-order" refers to the organic integration of knowledge ability and quality, which is to cultivate students 'comprehensive ability to solve complex problems and advanced thinking. "Innovation" means that the course content reflects the frontier and the times, the teaching form is advanced and interactive, and the learning results are

two teaching cycles, with effective teaching and learning outcomes, as well as meet requirements in multiple aspects of teaching concepts, teaching outcomes, feasibility, responsiveness to changes in society, management and organization, evaluation, etc (*ibid*). In November 2020, MOE awarded 5,118 courses as the national first-class undergraduate courses, including 1,875 online courses, 728 virtual simulation and experiment courses, 1,463 in-person courses, 868 courses of hybrid mode, and 184 internship and practice courses (MOE, 2020b).

#### 5.7.2.3 Evaluating Undergraduate Teaching

In 2013, MOE launched the first round of teaching reviews and evaluations at regular HEIs in China, and the second-round reviews and evaluations began in 2021.

*The first-round review and evaluation (2013-2018).* The first-round teaching review and evaluation proposed five key questions: are the goals of teaching and learning achieved, does the knowledge and skill development meet the societal needs, what teaching resources and conditions are supported, is quality assurance effective, and are employers satisfied with the graduates (Bie, 2021). As of July 2018, a total of 560 Chinese HEIs have participated in the review and evaluation exercise (*ibid*).

*The second-round review and evaluation (2021-2025).* The second-round review and evaluation is divided into two major categories in terms of the university type (MOE, 2021b). The first group targets the evaluation exercise at those regular HEIs that aspire to become world-class universities with excellent teaching faculty and platforms for teaching and learning, educating and training top talented students, and serving the skill demand for national strategic development. It focuses on reviewing these selected universities' quality assurance capacity and their initiatives and effectiveness to transform undergraduate education and teaching. The second category of the review and evaluation exercise targets three different types of HEIs in terms of goals, mission, and history, which is: regular HEIs focusing on training academic talent, regular HEIs stressing on training technical talent, and local teaching universities. The first two types of HEIs have engaged in the first-round review evaluation, while local teaching universities have a relatively short history and participate in the review and evaluation exercise for the first time. The detailed content covered in the second-round review and evaluation includes university goals for teaching and learning, teaching resources, training plans and approaches, students' development and experience, and teaching outcomes. The evaluation procedures cover: application submission, self-evaluation at the institutional level, peer review, feedback, improvement, and supervisory review (*ibid*).

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inquiry and personalized. "Challenge" means that the course has a certain degree of difficulty, need to jump to be able to get it, teacher preparation and students have higher requirements under class.

#### 5.7.2.4 Developing a Quality Culture

Studies on university quality culture is an important element of quality assurance in higher education (Dong & Sun, 2008). In recent years, undergraduate education in China has increasingly placed emphasis on creating a quality culture. *The 40 Guidelines on Higher Education Development in the New Era* issued by MOE (2018a) stipulates that HEIs should improve their self-evaluation system and internal quality assurance system, should build a self-evaluation system on undergraduate teaching and report evaluation results to public, and should promote discipline accreditation. *The Implementation Plans for Undergraduate Teaching Review and Evaluation in Regular Higher Education Institutions (2021-2025)*, officially announced in 2021, proposes to develop a university-quality culture of self-awareness, self-reflection, self-discipline, self-examination, and self-correction, and to establish a sound quality assurance system for undergraduate teaching with Chinese characteristics and world standards (MOE, 2021c).

## 5.8 Summary

Undergraduate education is at the center of global higher education. With global development, undergraduate education in the world continues to move forward. After more than 40 years of reform and opening-up, undergraduate education in China has made great progress with the joint efforts of the government and universities. In recent years, China's undergraduate education has been under continuous reform and endeavoring to become world-class, which has been recognized internationally. Dr. Carol Bobby, former chairman of the International Network for Quality Assurance Agencies in Higher Education, points out that the concepts of "school-oriented and student-centered", "classification evaluation and guidance" and the approaches of "data-based monitoring of quality and publishing quality reports" in the Chinese higher education are among the first and advanced internationally, and Chinese' experience will provide excellent practical examples for quality assurance in large higher education systems (Fan, 2021).

In recent years, China's effort to develop world-class undergraduate education has been of significance in terms of its talent cultivation. Developing world-class undergraduate education is a holistic, comprehensive, and complex systematic project. Its quality assurance mechanism helps ensure that China realizes and meets its goals of becoming world-class and achieving and sustaining its quality excellence (Lin, 2019). It is believed that, with the effort of the government, HEIs, faculty, and students, undergraduate education in China will continue to progress by leaps and bounds.

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# Chapter 6
# Graduate Education in China

**Zhu Jiabin, Zhang Yingqian, Qiu Tian, and Pan Yuqing**

**Abstract** With rapid development over the past 20 years, the scale and quality of Chinese graduate education have experienced unprecedented expansion. Recently, Chinese graduate education has demonstrated some new trends. In particular, there has been a strong emphasis on the training of science and engineering talents. Moreover, graduate-level professional degree education has played an increasingly important role in producing high-quality engineers. This chapter provides an overview of Chinese graduate education by reviewing the history and its enhancement in quantity and quality as compared to graduate education systems in some leading countries. Using the Graduate Education Excellence Indictor, this chapter showcases the overall strengths and setbacks in the development of Chinese graduate education. Moreover, with the strong emphasis on the development of science and engineering, the chapter illustrates the recent trends of best practices concerning Chinese graduate education, describing in-depth stories as related to the unique features of graduate education in Chinese universities. In addition, an analysis of recent national policies on Chinese graduate education is also provided to illustrate the overall guidance and support from the Chinese government.

**Keywords** Graduate education · Science and engineering education · Professional degree graduate education

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## 6.1 Introduction

The establishment of a competitive graduate education system has become a key part of national educational policies and strategies. Quality graduate education contributes greatly to the training of highly skilled researchers and the workforce, which in turn promotes the development of the national economy and scientific and technological advancement. Therefore, continual reform and innovation in the graduate education system has become a critical component of national strategies.

The rapid development of global graduate education systems over the past four decades have demonstrated the competitive edge of graduate education of the United States (U.S.), the United Kingdom (U.K.), and other developed countries (Altbach, 2004a; Nerad, 2010). Meanwhile, graduate schools from other countries and regions, in particular those from Asian countries such as China, Singapore, and Malaysia, have grown at a fast pace catching up in global rankings over the past two decades (University World News, 2022; Lee et al., 2020). Favorable national policies, heavy investment in Research and Development (R&D), a strong focus on STEM disciplines, and diaspora have all contributed to the development of graduate education in the emerging competitive graduate education systems, including China (Altbach et al., 2012; Cheng & Liu, 2006; Lee et al., 2020).

Since the restoration of graduate education in 1978, China's graduate education system has undergone rigorous trials and continual improvement (Wang & Yang, 2019; Zhao, 2001). The development of Chinese graduate education has drawn lessons from the best practices of other leading countries and has actively implemented experiments and innovations to meet domestic and local needs. With the official establishment of the Chinese postgraduate degree system, signified by the document of *Degree Regulations of the People's Republic of China* was issued in 1980, along with additional policies for implementation, multiple reformative policies and measures were consecutively launched to continually develop and optimize the Chinese graduate degree system (National People's Congress, 2004).

Chinese graduate education has entered a stage of rapid advancement since the 1990s, taking place alongside with the fast economic growth and technological progress of the Chinese society. The favorable national policy issued in 1999 on expanding the recruitment of higher education (MOE, 1999) has allowed the average annual growth of graduate degrees awarded to remain higher than 25% between 1999 and 2007 (National Bureau of Statistics, 2008). National policies covered aspects of graduate education, such as educational quality assurance and the evaluation of degree-granting programs, have laid the foundation for such development. Meanwhile, pioneering institutes and universities, such as Chinese Academy of Sciences (CAS), University of Science and Technology of China (USTC) and Tsinghua University (THU), have explored suitable graduate education practices to meet the rapid social, economic, and technological development in China. Chinese graduate education has benefited tremendously from such targeted national support in terms of sufficient funding, preferential policies, and the support of other resources

(MOE, 2008; MOE, 2017a). Also, Chinese graduate education has developed its own unique features with some Chinese characteristics which will be further discussed.

With the demand from fast economic and technological development, Chinese national policies have shown a strong focus on the training of graduate-level science and engineering talents in the past 2 years. In 2022, the Ministry of Education (MOE) and the State-owned Assets Supervision and Administration Commission of the State Council convened a meeting to promote the training of engineers and awarded licenses to 18 institutions for developing the National Institutes of Excellent Engineers and 4 institutions for developing the National Institute of Innovation for Excellent Engineers (Yu, 2022). In 2023, MOE announced a notice on the construction of the second batch of National Schools of Excellent Engineers (MOE, 2023a). These efforts aim to deepen the collaboration between industry and education in training professional engineering master's and doctoral degrees and to accelerate the cultivation of outstanding engineers.

An overview of Chinese graduate education data is presented next in comparison to the current leading graduate education systems, to provide an overview of the latest trends in the development of Chinese graduate education from the past 2 years. Using an excellence indicator designed for graduate education, this chapter situates the Chinese graduate education system in the context of global comparison with the existing advanced graduate education systems. Moreover, this chapter provides further details about the latest best practices with regards to the Chinese graduate educational system, offering in-depth narratives as related to the unique features of graduate education in Chinese universities. In addition, a synthesis of current literature of the past 2 years offers an understanding of the latest themes in the research findings within the Mandarin literature. Last but not least, the recent trends of Chinese national policies concerning graduate education are mapped to illustrate the overall guidance and support from the Chinese government.

## 6.2 Highlighting Data

### *6.2.1 Number of Graduate Degrees Awarded*

The number of graduate degrees awarded by Chinese institutions in 2022 was 860,760, an increase from 764,393 in 2021, according to the data provided by MOE. Among them, around 90.49% of students were awarded master's degrees, and 9.51% were doctorate recipients (MOE, 2021a; MOE, 2022a).

The growth tendency for doctoral degrees and master's degrees awarded in China between 2010 and 2022 are depicted in Figs. 6.1 and 6.2. Overall, from 2010 to 2022, the total number of graduate degrees granted in China showed an increasing trend (Fig. 6.3). In comparison to 2010, the number of graduate degree recipients more than doubled, with an average annual growth rate of about 7.05%. More precisely, the number of doctoral degree holders climbed from 47,407 in 2010 to 81,887 in 2022,

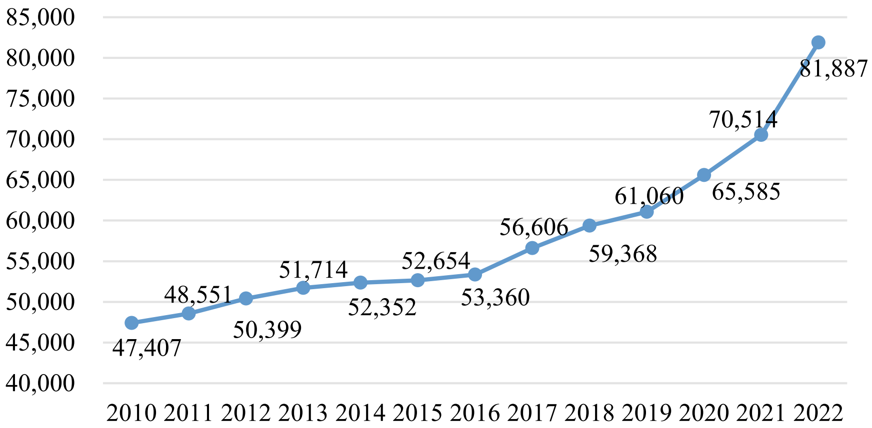


**Fig. 6.1** Number of doctoral degrees awarded (2010–2022). *Source* MOE (2011, 2012, 2013, 2014, 2015, 2016, 2017c, 2018, 2019b, 2020, 2021b, 2022a, 2023d)

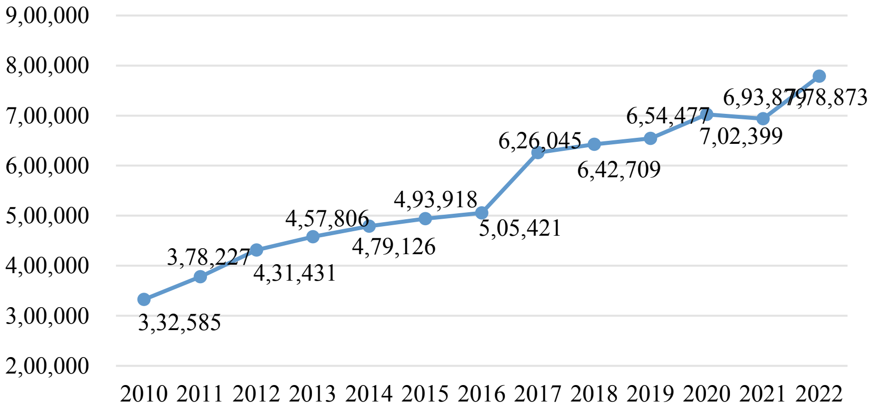


**Fig. 6.2** Number of master's degrees awarded (2010–2022). *Source* MOE (2011, 2012, 2013, 2014, 2015, 2016, 2017c, 2018, 2019b, 2020, 2021b, 2022a, 2023d)

and its average annual growth rate is about 4.66%. With an average annual growth rate of around 7.35%, the number of master's degree holders rose from 332,585 to 778,873. Compared to doctoral degrees, master's degrees have grown at a much faster rate.

Globally, as shown in Fig. 6.4, a comparison with the ten leading countries in graduate education, including the U.S., China, the U.K., Japan, Germany, Australia, Canada, France, the Netherlands, and the Republic of Korea (ROK), demonstrates that China ranked second in terms of the number of master's (693,879) and/or doctoral (70,514) degrees awarded every year. China only lags the U.S. with 988,535 students awarded master's degrees and 72,418 doctoral degrees in 2021.

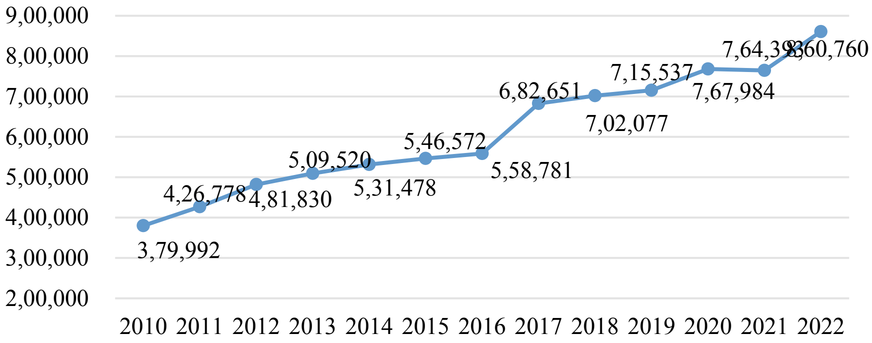


**Fig. 6.3** Number of graduate degrees awarded (2010–2022). *Source* MOE (2011, 2012, 2013, 2014, 2015, 2016, 2017c, 2018, 2019b, 2020, 2021b, 2022a, 2023d)

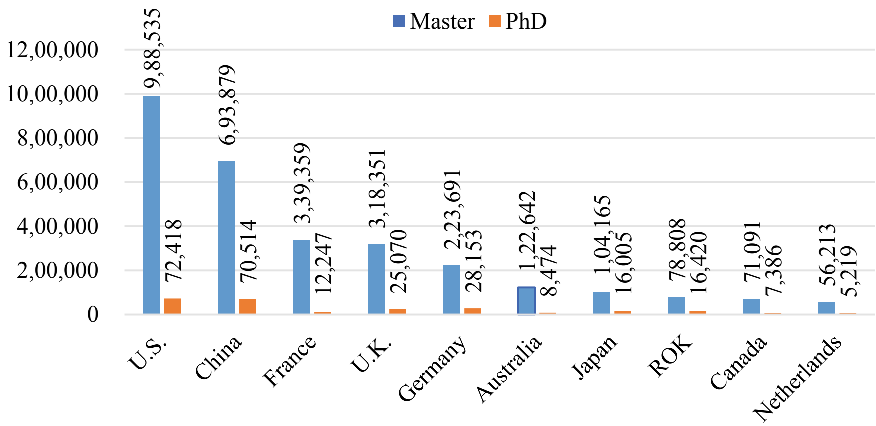


**Fig. 6.4** Number of graduate degrees awarded by ten major countries in 2021. *Source* OECD (2021a); MOE (2021a)

### *6.2.2 Total Enrollment of Graduate Students*

According to MOE, in China, the number of students admitted to master's programs reached 1,103,528, while 138,951 students enrolled in doctoral programs in 2022. The total enrollment number exceeded 1 million (1,242,479) in 2022 in China (MOE, 2022a). From 2010 to 2022, the average annual growth rate of the number of enrolled graduate students was about 7.22%, and the average annual growth rate of the enrollment number at the master's level and doctoral level was about 7.29% and 6.71%, respectively.

The growth curves in Figs. 6.5 and 6.6 indicate an upward tendency of the enrollment of doctoral-level and master-level students from 2010 to 2022. The growth curve of the total graduate student enrollment from 2010 to 2022 is shown in Fig. 6.7.

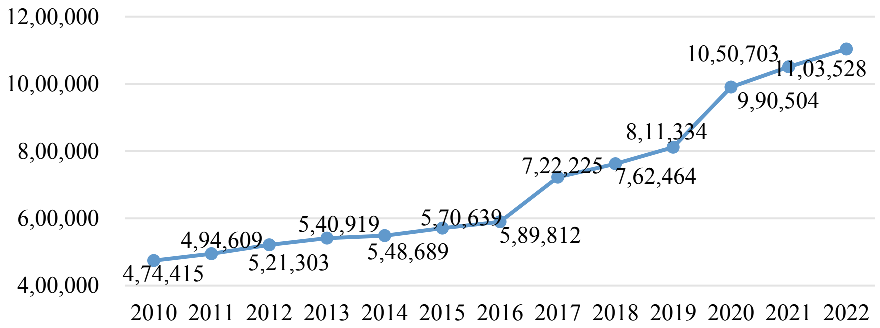


**Fig. 6.5** Number of enrolled master-level students (2010–2022). *Source* MOE (2011, 2012, 2013, 2014, 2015, 2016, 2017c, 2018, 2019b, 2020, 2021b, 2022a, 2023d)

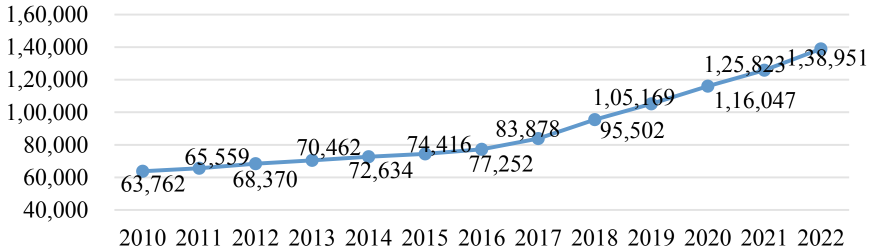


**Fig. 6.6** Number of enrolled doctoral-level students (2010–2022). *Source* MOE (2011, 2012, 2013, 2014, 2015, 2016, 2017c, 2018, 2019b, 2020, 2021b, 2022a, 2023d)

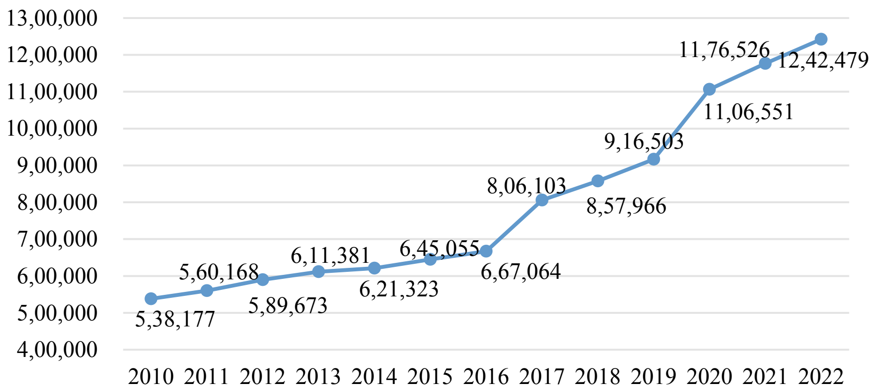


**Fig. 6.7** Number of total enrollments for graduate students (2010–2022). *Source* MOE (2011, 2012, 2013, 2014, 2015, 2016, 2017c, 2018, 2019b, 2020, 2021b, 2022a, 2023d)

For graduate student enrollment in 2021, China ranked third among the leading countries, following the US and Germany (Fig. 6.8). China ranked second for the number of graduate degree awarded (Fig. 6.4) suggesting a higher completion rates for master's and doctoral degrees in China.

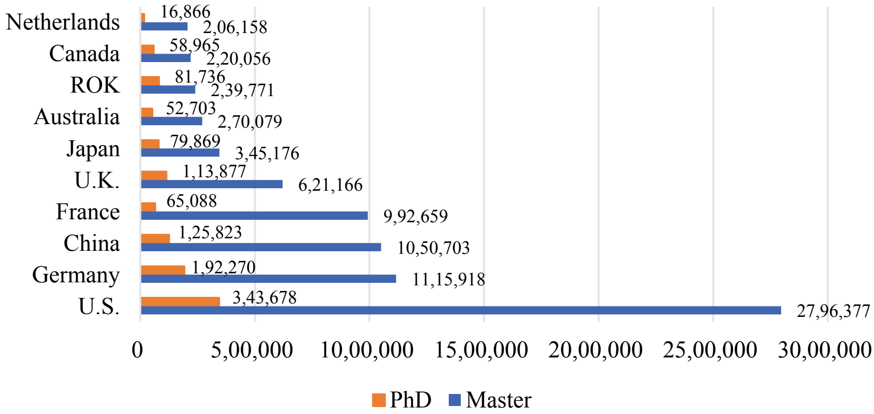


**Fig. 6.8** Total enrollment of graduate students in 2021. *Source* OECD (2021b); MOE (2021a)

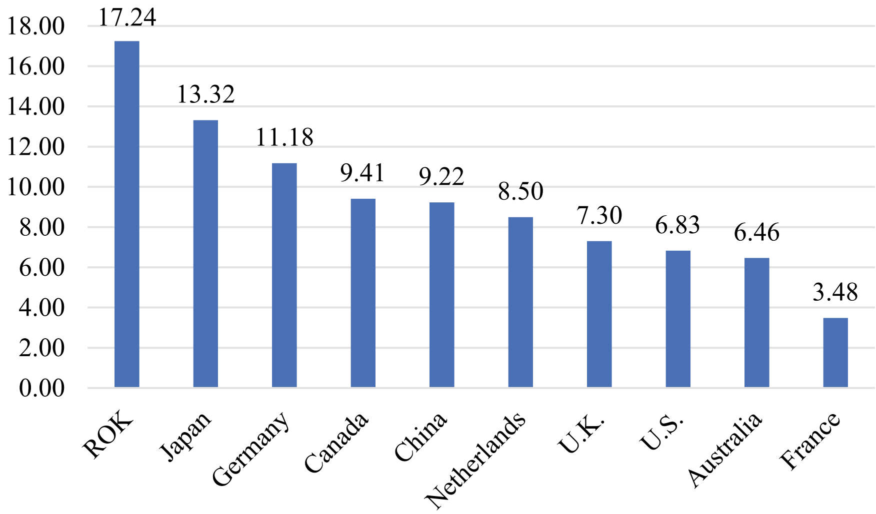


**Fig. 6.9** Percentages of doctoral degrees awarded compared to all graduate degrees awarded in 2021. *Source* OECD (2021a); MOE (2021a)

### 6.2.3 Ratio of Doctoral Degrees to the Total Graduate Degrees

The proportion of doctoral degrees granted to all graduate degrees awarded in China was 9.22% in 2021, which increased slightly from that of 2019 and moved China to the front rank globally. The top three countries that have the highest percentages of doctorates among all graduate degrees were ROK (17.24%), Japan (13.32%), and Germany (11.18%).

### 6.2.4 Workforce (25–64-Year-Olds) with Graduate Education Attainment

The previous data indicate that the scale of graduate education is rapidly increasing in China. Nevertheless, the proportion of the population with graduate degrees in the labor force (e.g., 25–64-year-olds) was rather low. The OECD average percentage of the 25–64-year-old population attained master's degrees or doctoral degrees were roughly 13.9% and 1.3% respectively in 2021 (OECD, 2022). By contrast, only around 1.11% of the Chinese population aged 25–64 held master's degrees or doctoral degrees (see Fig. 6.10), which is far lower than the global average level.

Of the countries on the list (Fig. 6.11), China had the lowest proportion of workforce with graduate education attainment. The Netherlands, France, and the U.K. were the top three countries with the highest ratio of graduate education attainment in their labor forces. In spite of the expansion in the scale of Chinese graduate education, the ratio of the population with graduate education attainment among the labor

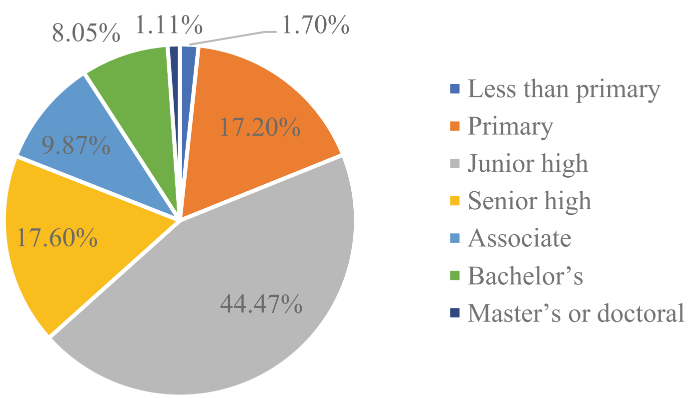


**Fig. 6.10** Educational attainment of 25–64-year-olds in China in 2020. *Source* National Bureau of Statistics (2021a)

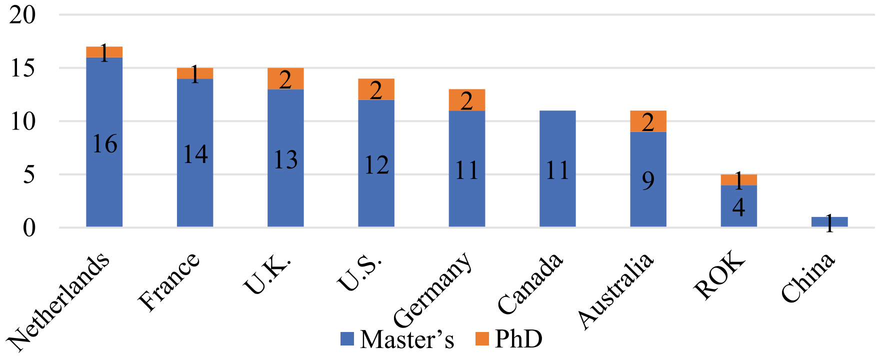


**Fig. 6.11** Graduate educational attainment of 25–64-year-olds (percentage) in 2021. *Source* OECD (2022); National Bureau of Statistics (2021a)

force was yet to be increased. In this regard, one might expect further development in Chinese graduate education shortly.

### 6.2.5 *Student-Faculty Ratio*

Student-faculty ratio is considered to be an indicator for assessing the quality of graduate education, as students are more likely to receive individualized support and attention when the student-faculty ratio is low. In China, the number of graduate supervisors steadily rose from 2010 to 2022 (Fig. 6.12) with an average annual growth rate of 7.94%. The overall number of graduate students at school increased at an average annual growth rate of 7.28% between 2010 and 2022 (Fig. 6.13).

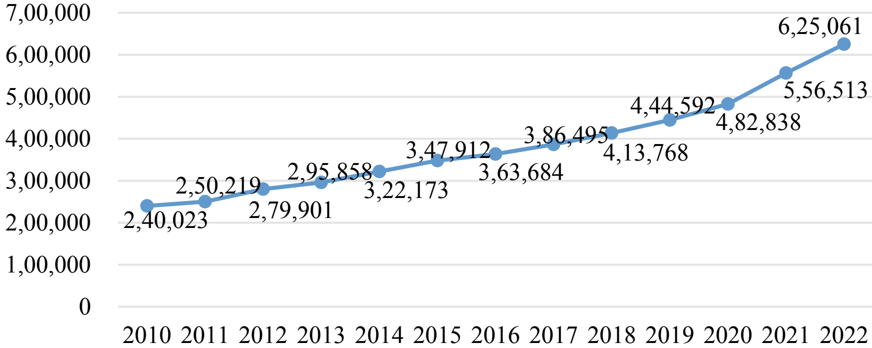


**Fig. 6.12** The number of graduate supervisors (including advisors to master's and doctoral students) for graduate students in China (2010–2022). *Source* MOE (2011, 2012, 2013, 2014, 2015, 2016, 2017c, 2018, 2019b, 2020, 2021b, 2022a, 2023d)

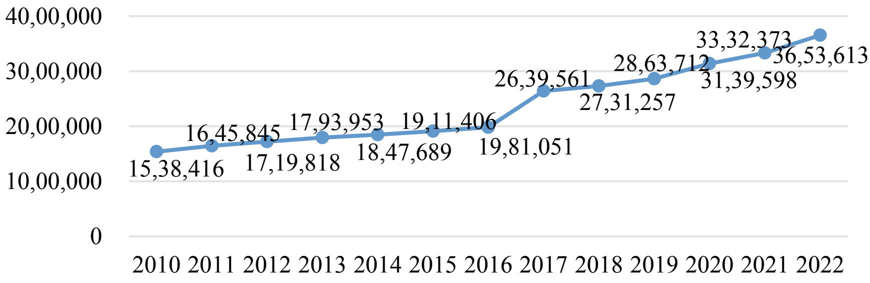


**Fig. 6.13** The growth curve of the number of graduate students in school (including master's and doctoral students) in China (2010–2022). *Source* MOE (2011, 2012, 2013, 2014, 2015, 2016, 2017c, 2018, 2019b, 2020, 2021b, 2022a, 2023d)

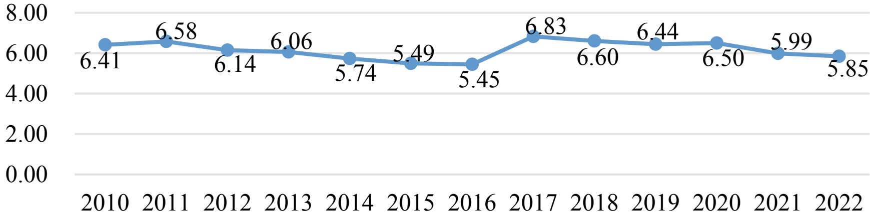


**Fig. 6.14** Graduate student-supervisor ratio for graduate students in China (2010–2022). *Source* MOE (2011, 2012, 2013, 2014, 2015, 2016, 2017c, 2018, 2019b, 2020, 2021b, 2022a, 2023d)

From 2010 to 2022, the graduate student-supervisor ratio fluctuated slightly, with the lowest number (5.45:1) in 2016, which was followed by the highest ratio (6.83:1) in 2017. The average graduate student-supervisor ratio between 2010 and 2022 is about 6:1 (Fig. 6.14). In 2022, the ratio of graduate students to supervisors was around 6.0:1, with 625,061 supervisors and 3,653,613 graduate students at school.

According to the data from the OECD, the student-faculty ratio in Chinese higher education is comparable to that of other leading countries in higher education. It should be noted that the faculty number here refers to faculty members at bachelor, master, and doctoral levels, instead of only graduate supervisors. As shown in Fig. 6.15, Canada, Australia, and China are the top three countries with the highest student-faculty ratio.

### 6.2.6 *Number of International Students in Graduate Education*

The number of international students has become an important indicator for the attractiveness of a certain graduate education system. According to *The Open Doors Report 2019* (Institute of International Education, 2019), China is now the third

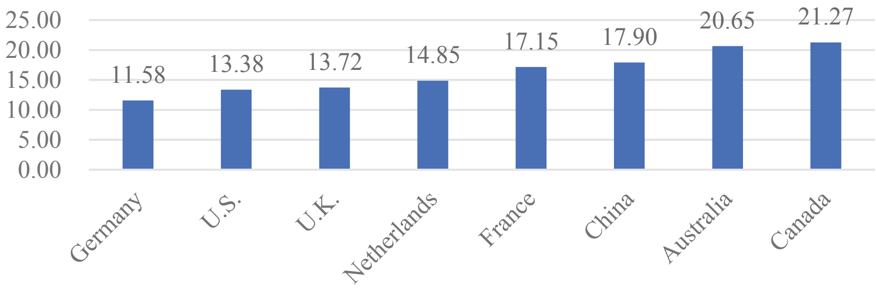


**Fig. 6.15** Student-faculty ratio in higher education in 2021. *Source* OECD (2023);MOE (2022b). *Notes* Since the data on the student-faculty ratio at "all tertiary" level in Canada and Australia were not reported by the source websites, the data applied in this figure are in "bachelor's, master's, and doctoral or equivalent" level

most popular host country for international students across the globe (the top two being the U.S. and the U.K.). However, at the time of writing, the Chinese MOE has yet to release the inbound international student numbers post-2019. The impact of COVID-19 has significantly affected the flow of international students to China, and the post-Covid trend remains uncertain.

The decade before COVID-19 has witnessed a rapid increase in the number of enrolled international graduate students, which increased from 18,978 in 2009 to 85,062 in 2018 (MOE, 2019a) with an average annual growth rate of approximately 20.59% (Fig. 6.16). Compared to the large graduate student population in China, international graduate students only constitute a small proportion, around 10% for Double World-Class universities.

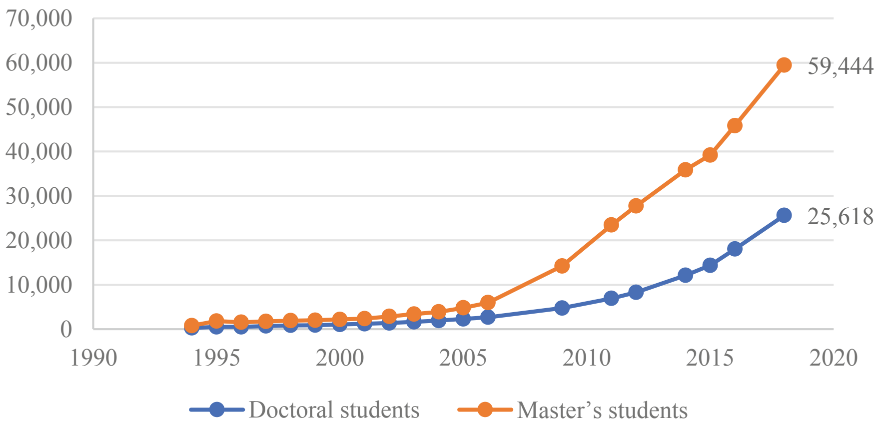


**Fig. 6.16** Number of international graduate students enrolled (1994–2018). *Source* Chen (2008); MOE (2002–2018). *Notes* Data of 1994–2001 are from Chen (2008); and data of 2002–2018 from MOE (2002–2018)

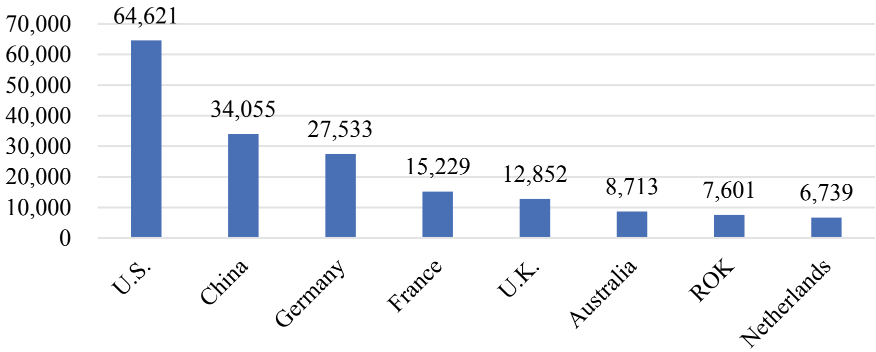


**Fig. 6.17** R&D expenditure for higher education (2020) (USD million). *Source* OECD (2020);National Bureau of Statistics (2021b)

Concerning the distribution of ethnicities among international students in China (including all students at both undergraduate and graduate levels), Asian students account for the largest group. As reported by MOE, ROK, Thailand, and Pakistan sent the most students. In terms of financial support, about 12.81% of the students were funded via the Chinese governmental scholarship; meanwhile, the majority students (87.19%) were self-funded or financed by other resources (MOE, 2019a).

### *6.2.7 Research and Development (R&D) Funding in Higher Education*

The Chinese government invested RMB 2,439.31 billion (about USD341 billion) in R&D in 2020 (National Bureau of Statistics, 2021b), among which RMB 188.25 billion (about USD 26,349 million) was funded in higher education, an increase of 4.8% above the level of 179.66 billion (about USD24,979 million) in 2019 (National Bureau of Statistics, 2020). Compared to the 10 countries previously mentioned, China ranked second for the R&D funding of higher education (Fig. 6.17). However, as the R&D investment of higher education in China is about half of the funding level in the U.S. (USD 64,621 million), there still exists a significant gap between the U.S. and China's R&D expenditure for higher education.

### *6.2.8 The Volume of Academic Research Publications*

Producing high-quality research publications has been considered an important indicator to assess quality of academic research in graduate education. Among the common indexing for research journals, the Social Sciences Citation Index (SSCI)

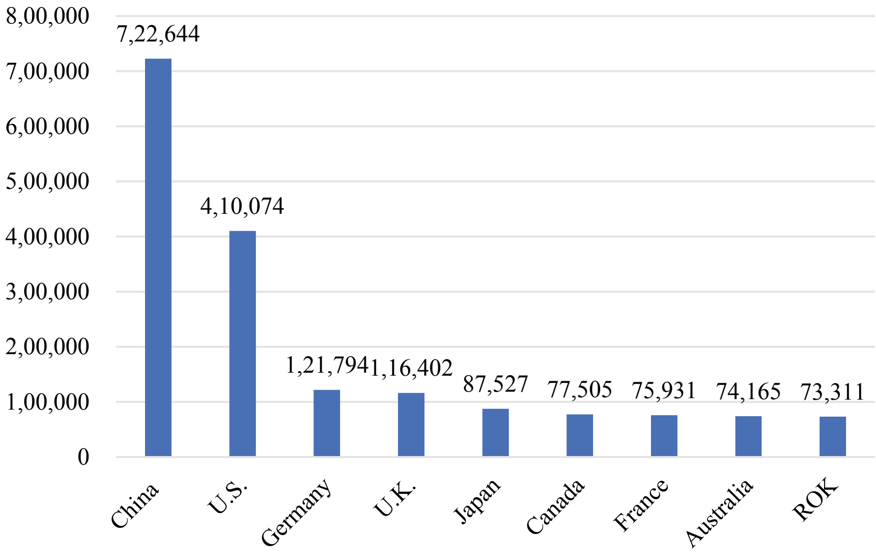


**Fig. 6.18** The number of research publications by scholars from different countries (2022). *Source* WOS (n.d.)

and Science Citation Index Expanded (SCIE) developed by Clarivate have been widely applied as a measure for citations of research journals. According to the data from the Web of Science (WOS), the total number of research articles published in SSCI and SCIE by Chinese scholars in 2022 ranked the first (772,644 publications) among the 10 countries listed in Fig. 6.18. In the meanwhile, the number of research articles published in SSCI and SCIE by Chinese scholars has been increasing from 2010 to 2022 (Fig. 6.19).

To summarize, as demonstrated through the highlighting data section, the recent development of Chinese graduate education is now on the fast track. Chinese advancement in both the quantity and quality of graduate education is suggested by its panel data and the trends of key developmental data over the past decade, particularly through a comparative analysis of the data from the current leading graduate education systems.

## 6.3 Excellence Index

### *6.3.1 Design*

This section intends to develop an excellence index with a set of graduate education excellence indicators to delineate the latest development of graduate education systems in several benchmarking countries across different dimensions. The

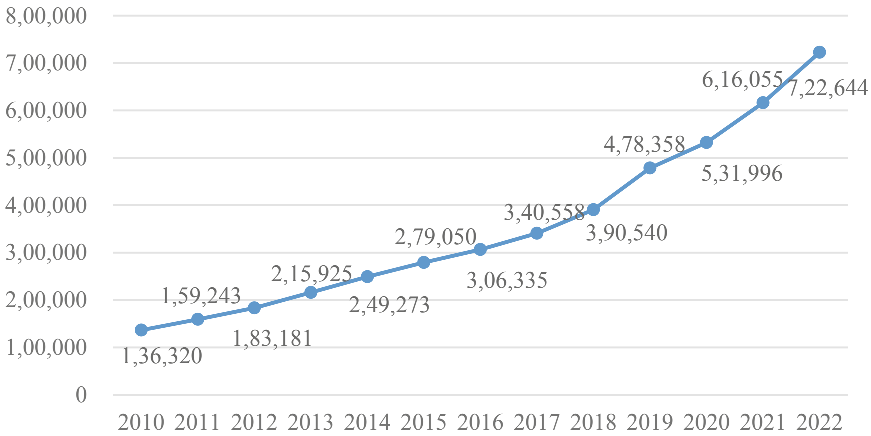


**Fig. 6.19** The number of research publications by scholars of China (2010–2022). *Source* WOS (n.d.)

design of the excellence index follows three basic principles – comparability, accessibility, and representativeness. For comparability, the specific indicators are selected to demonstrate features or characteristics that can be compared across existing graduate educational systems. In terms of accessibility, the source data for all indicators are readily available or easily obtained via simple calculations from public websites or databases. To satisfy the principle of representativeness, the selected indicators capture the features or characteristics of a particular dimension, such as scale or performance. In short, the excellence index is composed of indicators designed to capture the capacity of a certain nation to provide high quality graduate education.

Based on the three principles and a careful synthesis of existing comparative studies on graduate educational systems, the excellence index is composed of ten indicators in three dimensions (Liu & Wang, 2012; Wang, 2015; Wang & Li, 2012; Zhao & Wang, 2013, 2015). The dimensions of the index include performance, scale, and resource aspects of a graduate educational system for a particular country or region. The detailed information and the comparative data for each indicator within every dimension will be discussed as follows.

## *6.3.2 Definitions and Sources*

Overall, there are 10 specific indicators in three different dimensions (Performance, Scale, and Resource) (Table 6.1). The specific indicators and the comparative results across different countries/regions are listed in each dimension.

In the performance dimension, specific indicators include, the ratio of doctoral degrees to the total graduate degrees, the annual growth rate of enrollment of graduate

**Table 6.1** Specific dimensions of the graduate education excellence indicators

| Dimensions | Indicators | Data sources |
|---|---|---|
| Performance | 1. Ratio of doctoral degrees to the total graduate degrees | OECD |
| | 2. Annual growth rate of enrollment of graduate students over the past 5 years | OECD |
| | 3. Attainment of graduate education among 25–34-year-olds (Ratio of 25–34-year-olds with graduate degrees) [1] | OECD |
| | 4. Number of journal publications that were indexed in the SCIE or SSCI | WOS |
| | 5. Ratio of international graduate students[2] | OECD |
| | 6. Ratio of people possessing graduate degrees in the workforce | Chinese Human Capital Report/ OECD |
| Scale | 7. The number of graduate degrees granted | OECD |
| Resource | 8. Student-faculty ratio | OECD |
| | 9. R&D fund | OECD |
| | 10. Ratio of institutions/universities that ranked in the top 50 versus the total number of institutions/universities in a country[3] | Academic Ranking of World Universities (2023) |

*Notes* 1. More specifically, it was defined as the ratio of 25–34-year-olds with master's degrees because the source data have quite a few missing data at the doctorate level. In this indicator, data from 2020 were used for China, and data from 2022 for other countries

2. In this indicator, data from 2018 were used for China, and data from 2021 for other countries
3. Due to the differences in statistical methods used to count the number of institutions in different countries, this indicator was substituted via the ratio of institutions and universities that ranked in the top 50 versus the total number of institutions and universities that entered the Academic Ranking of World Universities (ARWU) in 2023 in a particular country

students over the past 5 years, attainment of graduate education among 25–34-year-olds (defined as the ratio of 25–34-year-olds with graduate degrees), the number of journal publications that were indexed in the SCIE or SSCI, the ratio of international graduate students (defined as the average of the ratio of master-level international students and the ratio of doctoral-level international students), and the ratio of people possessing graduate degrees among the workforce (defined as the total percentage of people with graduate degrees among 25–64-year-olds). In the scale dimension, a specific indicator includes the number of graduate degrees granted. In the resource dimension indicators include, student-faculty ratio, R&D funds (defined as expenditures in R&D activities in tertiary education), the ratio of institutions/universities that ranked in the top 50 versus the total number of institutions and universities in a country (operationally defined as the ratio of institutions and universities that ranked in the top 50 versus the total number of institutions and universities that entered the ARWU in 2023 in a particular country (Shanghai Ranking, 2023).

It should be noted that all data were obtained first as raw data in its original units. Such data were then normalized to a 0–100 scale, representing the highest score as 100. Also, since the source data for two indicators – the annual growth rate of enrollment of graduate students over the past 5 years and the ratio of international students- tended to be clustered at a certain range, it is reasonable to classify them into data ranges rather than normalizing the source data. In this case, the source data that were in the highest level were counted as 100.

### *6.3.3 Findings*

This section compares 10 countries' graduate education systems using the excellence index. The 10 countries are selected for benchmarking because of their unique features in graduate education development based on existing literature about the general development of graduate education in different countries (Altbach, 2004b; Nerad, 2010). The ten countries include the U.S., the U.K., Germany, France, the Netherlands, Australia, Canada, Japan, ROK, and China. Via the calculation of respective indictors in each dimension, an overall excellence indictor score was obtained for each of the ten countries (Table 6.2). Through a comparison of the overall scores, the 10 countries were sorted according to the average scores across the ten indicators.

Through an overall comparison across the 10 countries, as shown in Fig. 6.20, the U.S. with a score of 69.65, is ranked in the top position. The U.K. and France rank in second and third place, respectively. Several European countries follow the top three ranks. China, with a score of 48.90, is ranked in the fifth position of the list followed by the Netherlands, Germany, Australia, Japan, and ROK.

As shown in Fig. 6.20, the Chinese graduate education system has shown great potential by leading in several indictors. First, China ranks as the top country in two indicators: the annual growth rate of enrollment of graduate students over the past 5 years and the number of journal publications that were captured in the SCIE or SSCI. Meanwhile, China ranks second globally in the number of graduate degrees granted, after the U.S. Third, China also ranks second in R&D funding, again second to the U.S. The trend of leading in the growth rate and research output remains similar to the comparison conducted in the 2023 (Zhu et al., 2023).

Meanwhile, there are several indicators in which the ranking of the Chinese graduate education system is falling behind. For example, the ratio of people possessing graduate degrees in the workforce, the attainment of graduate education among 25–34-year-olds, and the ratio of international graduate students. In these three indicators, China ranks at the bottom of the list. Again, the trend of lagging behind in the average degree holders among the workforce remains unchanged from the previous comparison (*ibid*).

Finally, similar to the comparison conducted in the 2023 edition, for the ratio of doctoral degrees to total graduate degrees, China, along with countries such as the U.S., the U.K, ranks in the middle of the list. In contrast, ROK and Japan rank as the top two countries, suggesting greater emphasis on doctoral education despite of the small scale of the two systems.

**Table 6.2** Standardized scores of the graduate education excellence indicators and respective average scores for the listed ten countries

| Countries | The U.S | The U.K | France | Canada | China | Netherlands | Germany | Australia | Japan | ROK |
|---|---|---|---|---|---|---|---|---|---|---|
| Ratio of doctoral degrees to the total graduate degrees | 40 | 42 | 20 | 55 | 54 | 49 | 65 | 37 | 77 | 100 |
| Annual growth rate of enrollment of graduate students over the past 5 years | 12.5 | 62.5 | 12.5 | 25.0 | 100 | 37.5 | 12.5 | 12.5 | 0.0 | 12.5 |
| Ratio of 25–34-year-olds with graduate degrees | 52 | 70 | 100 | N/A | 9 | 97 | 64 | 50 | N/A | N/A |
| Number of journal publications that were indexed in the SCIE or SSCI | 58 | 16 | 11 | 11 | 100 | 6 | 17 | 10 | 12 | 10 |
| Ratio of international graduate students | 100 | 100 | 100 | 100 | 0 | 100 | 100 | 100 | 100 | 100 |
| Ratio of people possessing graduate degrees in the workforce | 71 | 82 | 82 | 71 | 6 | 100 | 71 | 53 | N/A | 24 |
| The number of graduate degrees granted | 100 | 32 | 34 | 7 | 71 | 6 | 23 | 12 | 11 | 8 |
| Student-faculty ratio | 63 | 64 | 81 | 100 | 84 | 70 | 54 | 97 | N/A | N/A |
| R&D fund | 100 | 20 | 24 | N/A | 53 | 10 | 43 | 12 | N/A | 12 |

(continued)

**Table 6.2** (continued)

| Countries | The U.S | The U.K | France | Canada | China | Netherlands | Germany | Australia | Japan | ROK |
|---|---|---|---|---|---|---|---|---|---|---|
| Ratio of institutions/universities that ranked in the top 50 versus the total number of institutions/universities in a country | 100 | 63 | 74 | 53 | 12 | 0 | 0 | 20 | 42 | 0 |
| Total score | 696.5 | 551.5 | 538.5 | 422.0 | 489.0 | 475.5 | 449.5 | 403.5 | 242.0 | 266.5 |
| Average score | 69.65 | 55.15 | 53.85 | 52.75 | 48.90 | 47.55 | 44.95 | 40.35 | 40.33 | 33.31 |

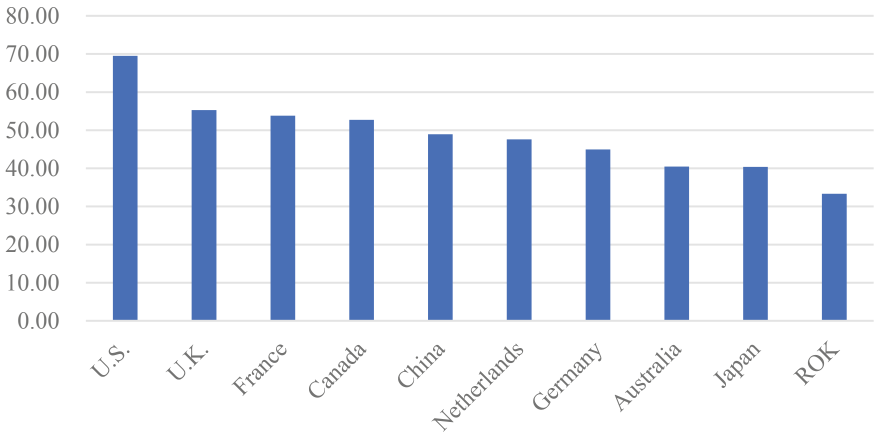


**Fig. 6.20** A list of the ten countries using their average scores across the excellence indictors

China continues to make significant progress, narrowing the gap with leading countries in graduate education. For example, in terms of the indicator of the ratio of institutions/universities that ranked in the top 50 versus the total number of institutions/universities in a country, China has improved its position from the bottom of the ranking to the 7th place among the ten countries.

### *6.3.4 Discussions*

To conclude, the graduate education excellence index has offered an overall view of the graduate education systems of different countries in a comparative manner. Built upon the rapid development of graduate education over the past four decades, Chinese graduate education has demonstrated a competitive edge among the leading countries in graduate education in both its quantity and quality. Based on the comparison of the various indicators within the excellence index, China has also improved in several ways.

First, the Chinese graduate educational system continues to excel in two indicators: the annual growth rate of enrollment of graduate students over the past 5 years and the number of journal publications that were indexed in the SCIE or SSCI. The significant increase in graduate student enrollment over the past 2 years can be attributed to China's national educational policies aimed at expanding the overall scale of higher education earlier in the new century. The original policy to expand the enrollment of both undergraduate and graduate level students started in 1999 (MOE, 1999). The outcome of this policy has inevitably increased the pool of high-quality talent (Li & Chen, 2006). The fast growth of graduate enrollment is tightly connected to the relatively high number of graduate degrees granted, in which China ranks in the top two as compared to other existing graduate education systems, second only to the U.S. The recent increase of graduate students can also be attributed to the fast expansion of professional degree graduate education in China (Yang & Wang, 2021), as will be further explored in later sections.

The leading position of China in the number of journal publications that were indexed in the SCIE or SSCI continued from the last round. The fast growth in research output has benefited from the Chinese government's national policies to promote investment to support the development of science and technology (Xie et al., 2014; Yang & Welch, 2012). In addition, more and more Chinese overseas talents chose to join the academic research of science and technology in Chinese universities and institutes (Bao et al., 2021; Li et al., 2015), which can also contribute to the research output of Chinese higher education (Huang, 2003; Yang & Welch, 2010). It should also be noted that the new Chinese policy of adjusting evaluation standards for research performance has been issued in 2018 (The State Council, 2018). This policy emphasizes that journal articles, along with academic titles, should not be used as the sole indicators for determine the research capacity of a certain researcher or research program. In this context, China still keeps the lead in this indicator, suggesting the continual emphases on high-quality research output among Chinese scholars.

Despite China's leading position in the growth rate of graduate enrollment and the overall number of graduate degrees conferred, China lags behind in the attainment of graduate education among 25–34-year-olds and the ratio of people possessing graduate degrees among the workforce, ranking at the bottom of the listed ten countries. The overall large quantities of graduate degree holders, divided by the large population, lead to relatively low number of degree holders among the general population. With China's increasing need for economic development and a high-quality workforce, it can be expected that the increase of graduate enrollment and the overall number of graduate degrees conferred will be sustained in the Chinese graduate education system in the near future.

The ratio of universities ranked in the top 50 versus the total number of universities (for example, in the ARWU) is quite low in China. According to the ARWU, four universities in China entered the top 50, compared to 28 in the U.S. in 2023. In contrast, in 2021, seven universities in China entered the top 50, compared to 20 in the U.S. in 2021. However, China has quite a large number of institutions that entered the top 1,000 group in 2023. A total number of 214 (157 in 2021) universities are in the top 1000, while the U.S. has 187 (200 in 2021) universities listed in the top 1,000. Strong national policies have supported the development of top universities in China, such as Project 211 and Project 985, and the latest Double World-Class policies. Despite continued progress, Chinese universities still face a considerable journey to reach competitive positions in global rankings.

## 6.4 Best Practices

Challenges emerging from the pandemic and post-pandemic era have prompted considerable changes across multiple areas of Chinese graduate education. The mobility of Chinese students to pursue graduate degrees in foreign countries has encountered notable difficulties during the pandemic. In this case, policies were issued to attract Chinese top students back into the Chinese graduate education system. Second, online learning has played a key role in supporting higher education during the pandemic. The potential of online learning has been emphasized by several national policies and efforts to promote digital learning platforms in graduate education. Third, the key roles of top engineers in leading technological transformation and industrial development have attracted more policy emphases in Chinese graduate education. These policies and implementations in graduate education have demonstrated the best practices in the changing landscape of graduate education in selected Chinese universities and reflected the changes in the Chinese graduate education landscape.

### *6.4.1 Direct-Entry Doctoral Program for Outstanding Overseas Undergraduates with Chinese Nationality*

In an effort to further enrollment reform to select top innovative talents, the document *Opinions on Accelerating the Reform and Development of Graduate Education in New Era* was issued by MOE, National Development and Reform Commission (NDRC), and Ministry of Finance (MOF), which provided suggestions of expanding the enrollment ratio of direct-entry doctoral students and exploring ways to recruit outstanding undergraduates to directly study for doctoral degrees in high-tech fields (MOE et al., 2020). Responding to the call, many "Double World-Class" universities, including THU, Fudan University, Shanghai Jiao Tong University (SJTU), Tongji University (TJU), and Xi'an Jiaotong University, launched direct-entry doctoral programs for outstanding overseas undergraduates with Chinese nationality. The program aims to attract and select excellent undergraduates, improve the quality of student sources, and cultivate top innovative talents in high-tech areas.

As an exploration of attracting excellent applicants, the policy has provided the Chinese graduate enrollment system an opportunity to broaden the pool for talent selection globally. Meanwhile, the direct-entry doctoral programs for outstanding overseas undergraduates have allowed opportunities for students with Chinese nationality to re-enter the Chinese graduate system. Before this policy, the students who pursued degrees in overseas universities needed to take the National Graduate Exam for Master's degrees to re-enter the Chinese graduate system.

To qualify for this selection process, students enrolled in the doctoral programs should be outstanding undergraduates of Chinese nationality from top overseas universities with good academic performance, strong innovative spirit, and research potential, who are interested in returning to China for further study and work. The "application-review" procedure is applied in the recruitment process. After the students submit the applications to the program, the school and the program would review the application materials and select potential applicants to attend the comprehensive assessment. Doctoral applicants are required to obtain an undergraduate degree from an overseas world-class university (ranked in the top 100 in the mainstream world university rankings). In the year of receiving the offer, recent graduates should earn a degree before enrollment. Additionally, the degree must be certified by the Chinese Service Center for Scholarly Exchange (CSCSE) and a credential evaluation report must be submitted to the University and academic department. Moreover, students typically must achieve a minimum 3.5 (4.0) GPA.

Colleges and departments with direct entry programs mainly focus on science, technology, engineering, and mathematics majors, including physics, chemistry, biology, computer science, medicine, mechanical engineering, electrical engineering, material science, and engineering. Based on the diverse characteristics of different schools, the programs are also set up in respective schools for particular majors.

### *6.4.2 The Establishment of the Graduate Education Sector in "Smart Education of China"*

Pointing out the need to accelerate the digital transformation and intelligent upgrading of education and enrich the supply of digital education resources and services, MOE proposed implementing strategic actions to digitize education in the document *The Key Points of the Minister of Education in 2022* (MOE, 2022c), one of which being the establishment of a national public service platform for intelligent education. In this context, "Smart Education of China" was launched on March 28th, 2022, and awarded the 2022 UNESCO ICT in Education Prize (Jiao, 2022). Then on July 14th, 2022, the Graduate Education Sector in "Smart Education of China" was established (Smart Education of China, n.d.). As a national public service platform for intelligent graduate education, the construction of the Graduate Education Sector in "Smart Education of China" follows the nature of graduate education, focuses on graduate students and supervisors, and builds four systems, including a functional system, a service system, a quality assurance system, and an evaluation system (Zhang, 2022).

At present, the Graduate Education Sector covers five columns, including online open courses, case-based teaching, academic research, faculty development, and industry-university research. The online open courses column contains 792 online courses, which share high-quality graduate general fundamental courses, discipline-specific fundamental courses, and professional core courses, supporting graduate students to strengthen their knowledge foundation. As the largest "China Professional Degree Case Database", the case-based teaching column provides more than 4,500 teaching cases, involving text cases, video cases, micro cases, and short video cases. It also shares the “China Clinical Case Outcome Database”, which provides more than 80,000 standardized case reports written by practicing physicians. The academic research column includes 200,000 doctoral dissertation titles. Meanwhile, courses and lectures from diverse universities in terms of teaching experience, skill development, and policy interpretation are shared in the faculty development column. Besides, the industry-university research column integrates with the “Innovation China” platform of the China Association for Science and Technology (CAST), which gathers more than 300,000 enterprise innovation demands.

Since the Graduate Education sector went online, numerous universities and local graduate education departments in China have carried out pilot work with their respective characteristics to expand the supply of online resources, promoting the transformation of graduate education and therefore pushing forward the transformation of graduate education with informatization.

### *6.4.3 National Institutes of Excellent Engineers*

China’s combination of engineering and technology provides an uninterrupted power source for economic and social innovation and development. Engineering has played an important role in bringing about the great development of social productivity and pushed human civilization to new heights. Having the largest engineering education scale in the world, China’s engineering education has made historic achievements, cultivated millions of high-level engineering talents, and significantly accelerated China’s industrialization process. The rapid development of engineering practices calls for an all-around change in the concept, system, and path of China’s engineering education, to satisfy the great demand for high-level talents in multiple critical engineering fields.

As an important initiative for China’s higher engineering education to proactively serve the national developmental strategy in the new era, “the Plan for Educating and Training Outstanding Engineers” (PETOE) was launched and implemented in 2010 (MOE, 2010). MOE has issued a series of measures, emphasizing the training of high-quality engineers with global competitiveness to address the challenges of technological transformation from a labor-intensive to a knowledge-intensive economy. To further explore the various innovative measures for engineering education reform, MOE then launched the “Emerging Engineering Education” (EEE) plan (MOE, 2017b). This plan encourages universities to promote educational innovation in engineering education, adopt new teaching and learning methods such as experiential learning, project/problem-based learning, and study abroad to produce high-quality engineers with global competitiveness. These piloting efforts were further institutionalized by an initiative issued by the three departments of MOE, the Ministry of Industry and Information Technology (MIIT), and the Chinese Academy of Engineering (CAE), that is, the “PETOE 2.0” (MOE et al., 2018). The goals of these programs focus on training a large number of high-quality engineering and technological talents with strong innovation abilities so that they can provide a solid foundation of human resources and satisfy the needs of economic and social development. It should be noted that many of the actual innovative practices focused on the undergraduate levels (Mu et al., 2019; Zhang et al., 2015). How to train graduate-level engineers so that they can lead the technological innovation and transformation in the fast-paced technological revolution has become a critical issue for multiple stakeholders in China.

Facing the challenges of the new round of scientific and technological revolution and industrial change, the demands for high-quality engineering leaders at the graduate level have attracted more attention nationally. On September 27, 2022, on the first anniversary of the Central Talent Working Conference, MOE and the State-owned Assets Supervision and Administration Commission (SASAC) co-organized a meeting to advance the cultivation of excellent engineers (Yu, 2022). The 18 units of the National Institutes of Excellent Engineers jointly issued the *Beijing Declaration on Cultivation of Excellent Engineers*. The declaration highlights the importance of continuous innovation in engineering and technology, which is critical for Chinese modernization. It is of great significance to explore the establishment of a world-class engineering training system with Chinese characteristics. Eighteen units of the National Institutes of Excellent Engineers will make a joint effort to reform the ways of educating excellent engineers. The establishment of the National Institutes of Excellent Engineers has signified that China's PETOE program has entered a new stage of development. These institutes mainly target the development of engineers with professional degrees at graduate levels (master's and doctorate). The first batch of pilot construction units includes 10 universities and 8 enterprises. Ten famous universities such as THU, Beijing University of Aeronautics and Astronautics, SJTU, Huazhong University of Science and Technology, Harbin Institute of Technology, and others have been selected to set up these institutions. In addition, there are 8 enterprises have also been chosen to set up the institute, including large state-owned enterprises, such as China Aerospace Science and Industry Corporation, China Aviation Industry Corporation, China Shipbuilding Corporation, and others.

To accelerate reform in the training of graduate-level professional engineers, MOE issued the *Notice on the Establishment of the Second Batch of National Institutes of Excellent Engineers* in 2023 (MOE, 2023a). The Notice officially announced the list of the second batch of institutes. Fourteen universities with strong engineering schools were selected for building up the institutes. These universities include the University of Science and Technology Beijing, Beijing University of Posts and Telecommunications, Tianjin University, Dalian University of Technology, and others.

The construction of the National Elite Institute of Engineering is aimed at serving the major strategic needs of the country, facing the urgently needed key fields and cultivating leading talents in the industry. The training programs of the National Institutes of Excellent Engineers have distinctive features. On one hand, they stress the implementation of interdisciplinary and project-based teaching; on the other hand, they emphasize the deep integration of universities and enterprises. The construction of the National Institutes of Excellent Engineers is believed to be of great significance and impact on China's higher education and industrial development. Through innovative training models and in-depth cooperation with enterprises, these institutes will produce more engineers with practical experience and innovation abilities, providing stronger talent support for China's manufacturing industry. Meanwhile, constructing the National Institutes of Excellent Engineers also promotes the in-depth integration of industry and academia, and facilitates scientific and technological innovation and industrial upgrading. With the emergence of new high-caliber engineers, China's manufacturing industry will become more competitive, further promoting China's progress toward the goal of a global manufacturing powerhouse.

## 6.5 Inspiring Stories

### *6.5.1 Huang Hongwei: Cultivating Future Engineering Leaders*

To serve national strategical needs, the implementation of major civil engineering projects is a critical area to support the high-quality development of China's economy and society. In this case, the implementation of major projects urgently demands a training of engineering talents and future leaders who can solve difficult and complex engineering and technological problems. TJU has a long history with distinctive features and great influence in the field of civil engineering. In recent years, Tongji people have made remarkable achievements in transportation. On October 23, 2018, the Hong Kong-Zhuhai-Macau Bridge (HZMB), which is known as the "Everest of Engineering", was officially put in function. In the artificial islands and tunnels, which are the most difficult part of the bridge, "Tongji elements" are infused everywhere. Moreover, TJU has worked closely with China Communications Construction Company (CCCC) and trained many excellent talents in the field of transportation and related industries in the project. Regarding the construction of the Zhuhai-Hong Kong-Macao Bridge, Li Yongsheng, the former executive vice president of the university, said, "The work done by TJU mainly focuses on the most difficult part of the bridge, which is the east and west artificial islands and tunnels, and the work done is the most technically challenging part" (Zhang, 2018). The education of Tong Ji University in training talents in transportation will be briefly introduced. In particular, stories about Tongji people will shared further.

#### 6.5.1.1 Developing Engineering Talents in Transportation at TJU

Built in 1914, the College of Civil Engineering at TJU has a long history of engineering educational innovation. The founding father of the college adopted a German model of teaching and training for civil engineers. With the adjustment of Chinese universities in 1952, they attracted a legion of talented faculty from home and abroad.

Facing the future development of transportation, TJU made a systematic plan for civil engineering education. In the early 1980s, to meet the needs of the future development of national aviation and a comprehensive transportation system, the school strategically piloted engineering education in the direction of airport engineering within the major of road engineering, which produced a large number of excellent engineers. Facing the needs of infrastructure construction after the Reform and Opening-up policy, they have actively developed the discipline of Civil Engineering and prepared thousands of engineers to engage in infrastructure construction in China. Since 2017, Civil Engineering at TJU has ranked first in the ARWU Global Ranking of Academic Subjects for seven consecutive years.

So far, the education of civil engineering at TJU has formed its unique features. To meet the demand of fast technological development, which is largely interdisciplinary and user-driven, a comprehensive civil engineering education system has been established, spanning from undergraduate through doctorate degrees. The undergraduate level emphasizes the "education of fundamentals and attributes", the master's level focuses on the "disciplinary training and literacy", and the doctorate level emphasizes the "academic training and innovation". Moreover, a training system of "common foundation + individual development" has been constructed (TJU, n.d.a). By emphasizing the three dimensions of classroom teaching, practical innovations, and exchange and cooperation, the training system consolidates the foundational knowledge and skills of each student; at the same time, it promotes close contact with and mentoring from professors, industrial mentors, and international mentors. Through the training, it aims to enhance student-centered learning and development, and cultivate future-oriented talents.

In recent years, faculty and students at TJU have made remarkable achievements in transportation. They have been involved in many prestigious large transportation projects, including HZMB, Beijing Daxing Airport, Beijing-Shanghai High-Speed Railway, Taklamakan Desert Highway, Yangshan Deep-Water Port and many other. The construction of HZMB serves as an excellent example to showcase the deep engagement of TJU people in large infrastructure projects. HZMB is the longest cross-sea bridge connecting Hong Kong's Lantau Island, the Macau Peninsula, and Zhuhai City in Guangdong Province. This cross-sea bridge project had the longest construction mileage, the largest investment, and the greatest construction difficulty in history. The main project, the "Bridge and Tunnel in the Sea", is over 35 km long, with a submarine tunnel of about 6 km and a bridge of about 22.9 km. During the construction of the HZMB, TJU has carried out many technical problems according to the needs of the project, providing strong technical support for the construction of the bridge. The team of Professor Hongwei Huang was one of the many Tongji people involved, whose story will be shared in further detail.

#### 6.5.1.2 Graduate Student Training in Huang's Team

Prof. Huang Hongwei led the effect of building a professional degree graduate training system in engineering. This training system aims for the deep integration of industry and education for major national projects particularly targeting transportation or infrastructure projects (TJU, 2023). So far, it has formed remarkable features of engineering training, which can be summarized as the strategy of "three deepening, three integrating, and three assurances". Among them, "three deepening" includes, to deepen the roles of major engineering construction projects as important platforms for engineering education; to deepen the role of graduate education for directly serving the needs of major projects; to deepen the role of industry-university integration for training engineering leaders. The concept of "three integrating" entails integrating the nurturing of ideas and values of serving national strategical needs into the completion of major university-enterprise collaborative projects, incorporating the establishment of graduate-level knowledge system into the requirements of major projects and the requirements of talent development, and integrating the enhancement of graduate students' competences into the requirements of solving complicated projects and difficult technical problems. The concepts of "three assurances" promotes the establishment of the organization and operation assurance mechanism in the institutional support, the assurance mechanism for the whole process of engineer training and the deep integration of industry and university, and the mechanism of collaborative nurturing culture to assure high-quality talent training, the deep integration of industry and university, and the cross-disciplinary training (*ibid*).

The graduate training system for engineering degrees proposed by Huang Hongwei's team, which deeply integrates industry and university projects, has been refined and has achieved remarkable results (TJU, 2021). Specifically, this model of engineering training has been highly recognized by society for its contributions to major national projects. Graduate students have participated in 66 national major projects such as HZMB, Daxing International Airport, Mars Exploration and others. Graduate students have been awarded 10 national and provincial scientific and technological awards as completers, including two first prizes of the National Scientific and Technological Progress Award. They have participated in the application or the authorization of 9,300 patents, which accounted for 59.5% of the total number of all the patents within TJU. According to statistics, nearly 1,000 engineering doctoral graduates and over 20,000 engineering master's graduates have been trained, fighting in the key positions of almost all major projects. A large number of master's and chief engineers have emerged among the alumni (*ibid*).

Huang Hongwei's team, the Fifth Research Laboratory of the Institute of Tunneling and Underground Construction Engineering, has been developed from the underground construction teaching and research laboratory in the 1960s. The project was comprised of four professors and one associate professor, the team shares a common goal, that is to address the national challenges in major national transportation engineering projects (TJU, n.d.b). They have been deeply involved in the Hong Kong-Zhuhai-Macao Bridge Gongbei Tunnel, Shenzhen-Zhongshan Corridor, Shanghai Yangtze River Tunnel Project, and other major construction projects. Their achievements include more than 20 awards, including two second prizes in the National Science and Technology Progress Award and six first prizes in the Provincial and Ministerial Science and Technology Progress Awards. The team regularly hosts nearly 70 master's and doctoral students and postdoctoral researchers throughout the year (TJU, n.d.b).

Outstanding engineers have continually emerged among Huang Hongwei's students, one of the examples being Prof. Zhang Dongmei (TJU, 2021). She was involved in the construction of HZMB, where she provided the scientific basis for the 5-step and 14-step excavation method in the design of the Zhuhai-Hong Kong-Macao Bridge (ZHMB), which is now widely used. Prof. Zhang Dongmei is currently the Director of the Institute of Tunneling and Underground Engineering and a Distinguished Professor at TJU (TJU, n.d.c). She has been selected as one of the Science and Technology Innovation Leader under the National "Ten Thousand People Program", one of the "Young and Middle-aged Science and Technology Innovation Leaders" by the Chinese Ministry of Science and Technology. She was also awarded as one of the "Scientific and Technological Talents in Shanghai Civil Engineering Society". Besides, she has won the first prize of Shanghai Scientific and Technological Progress Award as the first completer, the second prize from National Scientific and Technological Progress Award as the main member, and the first prize from MOE's Scientific and Technological Progress Award as the main member.

Another excellent student of Prof. Huang's team is National Excellent Youth Winner, Prof. Zhang Dongming (TJU, n.d.d). As a member of the first "Shanghai Science and Technology Youth 35 People Leading Program", he is one of the leaders among the younger generation of Shanghai science and technology talents. Prof. Zhang Dongming is now the Deputy Director of the Institute of Geotechnical Engineering at the School of Civil Engineering, TJU. As an explorer of AI-enabled research on safety and control of urban underground infrastructure, his research has greatly enriched the theoretical connotation and practical methods of resilient urban underground space. In his recalling of stories with Prof. Huang, he mentioned that "Prof. Huang told us to go into the field and mingle with field workers If you were only deriving formulas and doing your calculations at home, you can neither find the real problem, nor solve the real problem" (TJU, 2021).

### *6.5.2 Zhang Fusuo: Cultivating Agricultural Science and Technology Talents*

Since 2006, Prof. Zhang Fusuo, a faculty member of the CAE and a professor at the China Agricultural University (CAU), has led a research team to the front lines of agricultural production. The research team aimed to solve problems such as the misalignment between the training of agricultural science and technology talents and social needs, the disconnect between scientific research results and practical application needs, and the separation between talent training and agricultural production. In 2009, this team settled in the farmhouse of Baizhai Township, Quzhou County, Hebei Province, committed to scientific research and social services and provided on-site professional support to farmers. This endeavor gave rise to the "Science and Technology Backyard", an innovative platform integrating scientific and technological innovation, social service, and talent cultivation, burgeoned (Mo, 2018).

In recent years, the network of "Science and Technology Backyard" has grown and spread all over the country. It provides various services for local farmers concerning agriculture. Moreover, it has trained hundreds of graduate students with outstanding practical abilities in agriculture. Professor Zhang Fusuo said, "if the problems faced by scientific research and talent training in the agricultural field cannot be solved, universities will become ivory towers, and technology and talents will not be able to play their due roles" (Liang, 2023).

#### 6.5.2.1 The Origin of Science and Technology Backyard

The main goal of the Science and Technology Backyard is to act as a scientific and technological service platform serving at the front line of production, integrating agricultural scientific and technological innovation, demonstration and promotion, and talent training. A basic Science and Technology Backyard can comprise a farmhouse, one or more graduate students, a group of interested farmers, and some basic science and technology training and service facilities, science and technology experimental fields, and technology demonstration facilities (Lin, 2023a, 2023b).

Since its first establishment in 2009, a total of 81 Science and Technology Backyards have been established across the country by 2017. The project was initially called the "Science and Technology Backyard of the CAU". In November 2018, the China Rural Professional and Technical Association helped the establishment of the China Agricultural Technology Association. So far, the number of Science and Technology Backyards nationwide has reached 1,048, covering 31 provinces, autonomous regions, and municipalities across the country. In 2022, MOE and three other departments jointly issued the *Notice on Supporting the Construction of a Group of Science and Technology Backyards* to support 68 training units in 31 provinces nationwide to build 780 Science and Technology Backyards. At the same time, the Science and Technology Backyard model has also been promoted by the Food and Agriculture Organization of the United Nations and has been extended to Laos and 8 African countries (Liang, 2023).

#### 6.5.2.2 The Continual Improvement of Science and Technology Backyard

On May 1, 2023, President Xi Jinping responded to the students in the Science and Technology Backyard of CAU with great expectations," I hope that students will aspire to a high level of ambition and be down-to-earth, closely combine classroom learning with rural practice, cultivate a love for agriculture, practice farming skills, build a career on the stage of rural revitalization, and contribute their youthful strength to accelerating the modernization of agriculture and rural areas, and to building a modernized socialist country in an all-round way."

The support of the central government and relevant departments is the key to the rapid development of Science and Technology Backyards. In 2022, the General Office of MOE, the General Office of the Ministry of Agriculture and Rural Affairs, and the General Office of the China Association for Science and Technology issued the *Notice on Promoting the Graduate Training Model of Small Colleges of Science and Technology to Help Revitalize Rural Talents* (MOE et al., 2022). The notice emphasized promoting the training model of graduate students at Science and Technology Backyard to contribute to the revitalization of rural talents. The notice pointed out that this training model is an "integration of teaching and learning, field and classroom, theory and practice, research and application, innovation and service, and can radiate and drive agriculture-related universities to deepen the reform of graduate training models" (*ibid*). The same year, the China Association for Science and Technology and the National Rural Revitalization Administration jointly issued the *Opinions on Implementing the Science and Technology Assisting Rural Revitalization Action*. The opinions emphasized the permanent role of the China Agricultural Association's Science and Technology Backyards in rural areas. It also strengthened the construction of the Science and Technology Backyards alliance, promoted the integration and mutual promotion of Science and Technology Backyards with local organizations and teams, and focused on the leading agricultural industries. It intended to optimize and integrate agricultural production technology to achieve increased production, improved quality and cost savings" (CAST and National Rural Revitalization Administration, 2022).

Relevant departments in provinces and cities are also constantly taking effective measures to support and ensure the continued advancement and development of local Science and Technology Backyards (Wang & Zhu, 2023). For example, Guangxi and Chongqing took the lead in issuing a special document to support their development. Moreover, universities in Beijing, Sichuan, Jiangxi, Fujian, Chongqing, Yunnan, and other provinces set up special priority to guarantee graduate student quotas and corresponding funding support. Agricultural technical associations at different levels also set up rules and regulations to improve their organizational capabilities and service efficiency. The China Agricultural Technical Association has issued several documents to establish the organizational structure, application process, operation, and other procedures. The provincial Agricultural Technical Associations have also issued relevant policies and support measures. Provinces such as Fujian, Guangxi, and others have issued guiding policies for the development of Science and Technology Backyards. All of these varied supports have provided Science and Technology Backyards with immense opportunities.

#### 6.5.2.3 Innovative Training Models for Agricultural Talents

The graduate training model of the Science and Technology Backyard has unique features. The graduate training program frequently places its graduate students, particularly those pursuing professional degrees, to the front line of agricultural production. After students' completion of theoretical courses, they then focus on researching and solving practical problems in agricultural practices. Through this approach, the training model produces "high-level application-oriented talents in agriculture who know, love, and develop agriculture". This training model strongly supports the "integration of teaching and learning, field and classroom, theory and practice, research and application, innovation and service" (MOE et al., 2022).

The implementation of Science and Technology Backyard has gradually explored and developed a successful way of combining higher education in agriculture with production and practice. They have allowed the graduate students move the beyond the ivory tower through activities such as establishing field schools and organizing field observation, allowing graduate students to participate in agricultural science and technology services as both a student and an agricultural technician. The Science and Technology Backyard has created a combined training model consisting of "school + base + countryside" (Tang, 2023). They train graduate students with solid theoretical foundation and practical agricultural skills; moreover, they establish individualized learning plan while helping students to combine the needs of local agricultural development. Overall, they intend to promote students' comprehensive quality and innovation ability.

When admitted to the program, students must first participate in 3–4 months of practical training in the Science and Technology Backyard, before officially starting their formal coursework. Moreover, each graduate student will perform both their research tasks and service tasks. The thesis committee of graduate students is also unique in that it often comprises "dual supervisors" and county and township technicians. In their thesis defense, local farming representatives are welcomed to attend and ask questions (Tang, 2023).

The talent training model of Science and Technology Backyard has been recognized as one of the top ten hot spots in China's graduate education in 2022. It has won the first prize of the Beijing Teaching Achievement Award, the second prize of the National Teaching Achievement Award, the distinguished prize in the National Teaching Achievement Award for Higher Education (Graduate Students) and has become a model for graduate training nationwide (Wang & Zhu, 2023). At present, more than 700 graduate students have graduated through the Science and Technology Backyard training program, more than 70% of which are employed in agricultural careers. These innovative students have introduced 284 agricultural green technologies, integrated 113 sets of technical procedures, developed 34 types of green agricultural inputs and agricultural products, and published more than 10 technical monographs (Fan & Zhao, 2023). According to incomplete statistics from the China Agricultural Technology Association, in 2022, more than 1,200 graduate students were stationed in 211 Science and Technology Backyards of the China Agricultural Technology Association, and a total of more than 26,000 diaries were written, 230 patents were applied for, and 463 academic articles were published. With the joint efforts of teachers and students of the Science and Technology Backyard, more than 20 academic articles have been published in journals such as Nature and Science and their sub-journals.

Starting from Baizhai Township, the Science and Technology Backyard spreads across the country. Although the backyard is small, it helps farmers solve local problems and trains qualified agricultural talents (Lin, 2023a, 2023b). Prof. Zhong Denghua, secretary of the Party Committee of the CAU and academician of CAE, said that "the Science and Technology Backyard had torn down four walls—the wall between school and society, the wall between disciplines, the wall between teaching and research, and the wall between teaching and learning" (*ibid*). At the same time, the Science and Technology Backyard has built another four bridges—the bridge between universities and rural areas, the bridge for teachers and students to go deep into the grassroots, the bridge for talents and science and technology to serve rural revitalization, and the bridge for teaching and learning.

## 6.6 Latest Research

### *6.6.1 Overview of the Chinese Graduate Education Research*

The quick growth of Chinese graduate education has provided an immersive opportunity for educational research exploration. Meanwhile, the scholarly research of the educational practices has provided a strong evidence-based support for Chinese graduate education.

To offer an analysis of the main themes and trends based on the Mandarin literature on Chinese graduate education, analysis in this chapter used the full-text database of Chinese journals—China National Knowledge Infrastructure (CNKI). "Graduate education" was used as the keyword. The time duration for the literature analyses was from January 1, 2022, to December 31, 2023. The search results were refined to include only the core journals on higher education. Only journals that were indexed in the CSSCI were included. A total of 642 articles were retrieved manually by filtering out articles that were redundant or irrelevant. This section provides an overview of the Chinese literature on graduate education from 2022 to 2023, followed by an introduction of the main themes and key trends of research in graduate education from 2022 to 2023.

Regarding the publication venues, the list of journals that demonstrate a focus on graduate education was provided in Table 6.3. According to the results, some journals showed trends to publish more research on graduate education than others. Articles on graduate education are found primarily in five Mandarin journals. These journals are *Academic Degree & Graduate Education* (247), *Journal of Graduate Education* (78), *Research on Chinese Higher Education* (20), *Higher Education Exploration* (15), *Journal of Higher Education* (12). The journal *Academic Degree & Graduate Education* produced 247 articles, accounting for 38.5% of the total articles. The number of publications of the Journal of Graduate Education ranked second, with 78 accounting for 12.1%. Both journals focus on important theoretical issues, major practical challenges, and the latest trends in graduate education.

**Table 6.3** Top five journals that publish the most research on graduate education

| No | Journal | Publications |
|---|---|---|
| 1 | Academic degree and graduate education | 247 |
| 2 | Journal of graduate education | 78 |
| 3 | Research on Chinese higher education | 20 |
| 4 | higher education Exploration | 15 |
| 5 | Journal of higher education | 12 |

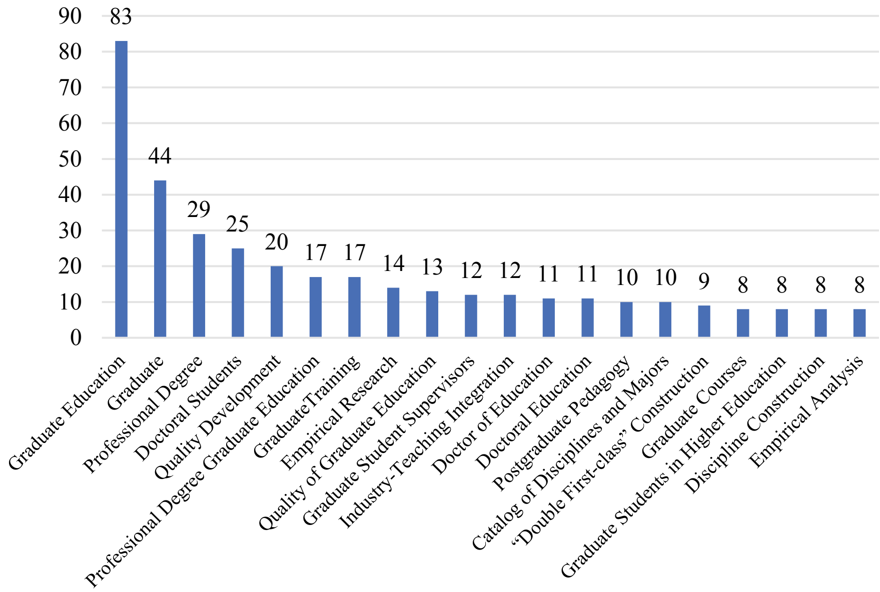


**Fig. 6.25** Top 20 keywords in the graduate education literature

An analysis of keywords of the 642 retrieved articles was performed to identify the key trends. The top 20 keywords and their corresponding frequency counts are shown in Fig. 6.25. A thematic grouping of these keywords leads to four main themes discussed in the following section. The themes can help the understanding of the latest development trends and research hotspots in graduate education.

### *6.6.2 Main Themes and Key Trends*

The following themes focus on introducing the trends of research topics of relevant research articles. The research themes related to graduate education can be summarized into the following four aspects:

#### 6.6.2.1 Reform of the Graduate Training Model

The keywords involved in this topic include training models, integration of industry and education, interdisciplinary, quality evaluation and others. With the optimization and adjustment of the structure of enrolling disciplines/subjects and the continual expansion of enrollment scale, universities have carried out diversified reforms and explorations in graduate training models and have summarized some of their piloting efforts. Specifically, some universities have carried out the reform of the graduate training model in a hierarchical and classified manner, setting up suitable policies and designing respective training systems/curriculums for each degree program (Hao & Niu, 2023). Moreover, additional universities have tried to start new interdisciplinary training program at the university level or integrate interdisciplinary training into existing degree programs (Cheng et al., 2022). These types of reforms tend to require more institutional support and can be more challenging in the implementation. In addition, there are also reforms and innovations aimed at one or several aspects of graduate training, which mainly focuses on specific issues such as enrollment, course teaching, mentoring, quality evaluation and others, aiming to solve problems or issues that arise during the training process in a targeted manner (Chen & Kang, 2022; Liang et al., 2023; Xu et al., 2022). In particular, the industry-university collaborative training model has attracted a lot of attention. It seeks to build a joint training effort for graduate students, increasing the participation of a wider community and improving graduate students' innovative practical ability and professional competences (Li, 2022a, 2022b; Yang, 2022).

#### 6.6.2.2 Training Professional Degree Graduate Students

The keywords of this topic include engineering education, engineers, professional doctorates, practical ability, classified training, and others. As MOE proposes to optimize the structure of the types of graduate degrees and vigorously develop professional degree graduate education, professional degree education has attracted greater attention in Chinese graduate education. In the context, the number of types of enrolling majors and the scale of enrollment have been greatly increased. Professional degree graduate education has become the main channel for cultivating high-level applied-oriented professionals in China, with the training embodying the features of "academic", "practical", and "vocational" simultaneously, ultimately targeting the needs of social and economic development (Niu & Liu, 2023). Researchers have tried to conduct in-depth research on the training objectives, training pathways, quality assurance system of outstanding engineers to promote the reform and improvement of the engineer training system (Gu et al., 2022; Wang et al., 2022a, 2022b; Yao et al., 2022). In addition to the training of engineering professional graduate students, some scholars have also tried to discuss the importance, necessity, and feasibility of cultivating master's and doctoral degrees in certain professional degrees, for example, professional graduate degrees in education, that is Master of Education and Doctor of Education (Li et al., 2023; Shen & Xia, 2022).

#### 6.6.2.3 Forming an Effective Mentoring Relationship

Keywords under this topic are graduate supervisors/mentoring, supervision/mentoring, disciplinary differences, academic abilities, satisfaction, faculty qualification, and others. The mentoring relationship between supervisors and graduate students is the most basic and core educational relationship in graduate education, which directly affects the outcomes of the graduate training and the potential improvement of the quality of graduate education. First, concerning the institutional support, existing studies have attempted to conduct more research on optimizing the selection procedure of graduate mentors, the professional development of qualified mentors, and the corresponding monitoring and evaluation system for such mentoring relationships (Han et al., 2022; Li, 2022a, 2022b). In addition, some scholars have begun to explore more micro-level factors, such as how certain factors at the school, environment, and the personal level of supervisors (e.g., supervisors' study abroad experiences) may affect the formation and development of supervision relationships, and the potential impact on graduate students' learning outcomes (Wang et al., 2022a, 2022b; Zhai & Fan, 2022). Besides, some other researchers have begun to pay attention to the impact of some macro-level factors, such as the employment system of faculty, disciplinary differences, and the research investment of the system, exploring their impact on the training of graduate students (Pan & Gu, 2022; Zhai & Fan, 2022). Results have indicated that national policies such as policies concerning disciplinary construction can also impact the supervision relationship, mainly through the supervisors' prioritization of responsibilities and their role-modeling (Han et al., 2022; Zhang et al., 2023). Fourth, some studies focus on the survey of graduate students' satisfaction with supervisors, believing that it can more objectively reflect the quality of supervisors' guidance and provide more targeted suggestions for improvement (Xu & Shen, 2022). This part of the research mostly uses empirical research methods, using qualitative or quantitative data to reflect students' self-reported thoughts on supervision and supervision relationships. However, such studies can suffer from the limitation of data availability, therefore require more similar studies to validate the findings.

#### 6.6.2.4 Other Topics

In addition to the above three main themes, some scholars have paid attention to the comprehensive quality of graduate education, especially ideological and political education, and conducted certain exploration and research on its educational content, curriculum construction, and teaching quality. The goals are to establish an ideological and political education for graduate students and explore the practical logic of ideological and political education. In addition, some scholars focus on exploring certain aspects of graduate training, such as the analysis of rationality and proposed changes of the admission system, academic writing of graduate students, and the career development of graduate students and the impact on the social economy and other. All of these other research findings together provide additional references and suggestions for enhancing the quality of graduate training.

To summarize, the research focus in China's graduate education for 2022 are mainly to understand changes in the graduate training model and address emerging problems in the current era. There is a significant emphasis on reforming and innovating existing models to foster the development of high-skilled talent, which is of great importance. Also, attention is directed toward the training of professional degree graduate students, particularly in the engineering field. It delineates the challenges and opportunities in nurturing top-tier engineering professionals, as well as some current exploration and piloting efforts of training models in universities and academia. Furthermore, scholars are beginning to recognize the importance of cultivating professional talents in other specific disciplines, such as agriculture and art disciplines, aiming to meet the diverse socioeconomic demands for skilled professionals in different industries. Graduate education is an important part of higher education and the primary way to cultivate top-tier talents. To provide more comprehensive and practical suggestions, researchers need to conduct more exploration and research to investigate the practical problems and provide more targeted strategies and suggestions for enhancing graduate education.

## 6.7 National Policies

### *6.7.1 Adjustment of the Catalog of Graduate Programs*

In a Chinese context, degree programs in most universities and institutions train graduate students according to the Catalog of Disciplines and Majors. In this sense, the structure and quality of the Catalog of Disciplines and Majors can affect the effectiveness of universities in cultivating high-level talents to serve high-quality economic and social development. Adjusting and revising the catalog of disciplines and majors of graduate education is an important initiative to better serve the national needs to build a global talent center and innovation hub. Moreover, adjusting the catalog of graduate majors can be of great support to the transformation and upgrading of industry by the supply of quality graduate students in much-needed fields. The new round of scientific and technological revolution and industrial change takes place at an unprecedented speed. At the same time, the demand for talent in the industry has undergone profound changes. Demands for new disciplines and specialties keep emerging, which exerts requirement for optimizing the structure of the disciplines and majors for graduate education. Therefore, adjusting and adding several new disciplines and majors, and improving the system of disciplines and majors have become an urgent need for graduate education. In addition, for the goal of "constructing a disciplinary system, academic system, and discourse system with Chinese characteristics", it is necessary to construct a catalog of graduate education disciplines and majors with Chinese characteristics, reflecting world-class standards (Liu, 2022).

In January 2021, the State Council made systematic arrangements for deepening the reform of the higher education discipline and major system in the new era, raising requirements for the task of catalog revision. Deputies to the National People's Congress and members of the Chinese People's Political Consultative Conference (CPPCC) have also put forward opinions and suggestions toward the adjustment of disciplines and majors many times. Therefore, based upon the policy issued in 2009, that is, *Measures for the Establishment and Management of the subject Catalog of Degree Conferment and Talent Cultivation*, the Academic Degrees Committee of the State Council revised and formed a new version of the catalog of disciplines and majors of graduate education (Academic Degrees Committee of the State Council and MOE, 2009).

In 2022, the Academic Degrees Committee of the State Council and MOE issued *The Graduate Education Subjects and Majors Catalog (2022)* and *Graduate Education Subjects and Majors Catalog Management Measures* (Academic Degrees Committee of the State Council and MOE, 2022). The new version comprises 14 categories, 117 first-level disciplines, 36 doctoral degree categories, and 31 master's degree categories. The implementation of the new catalog of disciplines and majors has allowed a new structure and mechanism for setting up discipline catalogs for graduate education in 2023. Every year, the Academic Degrees Committee of the State Council issues a *Notice on Dynamic Adjustment of the List of Revoked and Added Degree Authorization Points* for the previous year (Academic Degrees Committee of the State Council, 2023). In this notice, it also issues the list of revoked and added degree conferring programs to the relevant degree-granting units. To further optimize the catalog of disciplines and majors of graduate education and its management methods, MOE and five other departments issued the notice of *Reform Plan for Adjusting and Optimizing the Setting of Disciplines and Majors in General Higher Education* at the beginning of 2023, which proposes that in national graduate education, the guiding role of the catalog of disciplines and majors should be implemented effectively (MOE et al., 2023). At the same time, it is important to improve the management system of disciplines and majors, implementing methods for managing catalogs of disciplines and majors in graduate education and methods for establishing and managing interdisciplinary programs. Moreover, it is necessary to adjust the existing majors and optimize the exit mechanism for different majors.

### *6.7.2 Professional Degree Graduate Education*

Professional degree graduate education provides an excellent channel for cultivating high-level applied professionals. Since the establishment of the professional degree education system in 1991, China has gradually built a high-level application-oriented professional talent training system with Chinese characteristics. The rapid scientific and technological revolution and industrial transformation demands the training of excellent professional talents. Such degrees have unique merits to adapt to the increasingly refined division of labor and the diversified demand for talents. They have become the main channels for cultivating high-level applied talents and require vigorous professional degree graduate education development. In this context, the

Academic Degrees Committee of the State Council and MOE issued the *Developmental Plan for Professional Graduate Degree Programs (2020–2025)* (Academic Degrees Committee of the State Council and MOE, 2020). The plan points out that "developing professional degrees in graduate education is an inevitable choice for the economy and society to enter the stage of high-quality development. It is an important path for building an innovative country and is a strategic focus of the reform and development of degree and graduate education". The plan clarifies the development goals of professional degree graduate education. Also, it provides detailed regulations concerning the subject category, enrollment scale, training model, institutional support and other aspects. More on this Plan will be discussed in Chap. 7.

To promote the healthy development of professional degree programs and academic degree programs in graduate education, MOE issued the *Opinions on Further Promoting the Classification and Development of Academic and Professional Degree Graduate Education* (MOE, 2023b). The document pointed out that the newly established disciplines and majors in the above-mentioned catalog of disciplines and majors in graduate education are mainly professional degree categories. To be specific, for the developments of the two types of degrees, the document stated that "the layout of academic degrees shall adhere to a high starting point, emphasizing doctoral degree granting programs to vigorously support original innovation". For the development of professional degrees, the document suggests that "professional degrees shall adhere to a demand-oriented approach. In principle, new master's degree-granting units only carry out professional degree graduate education, and new master's degree authorization programs should be professional degree programs". Moreover, for degree-granting units that have been authorized to set up both academic and professional degree granting programs, "the focus should be on professional degree development to support industry and regional development". At the same time, the plan also proposed that the proportion of the two types of graduate students shall be optimized. In specific, it proposed that "by the end of the '14th Five-Year Plan', the enrollment scale of master's professional degree graduate students will be expanded to account for about two-thirds of the total enrollment of master's degree students. The number of graduate students with doctoral professional degrees shall be significantly increased" (*ibid*).

### 6.7.3 Emphasis on High-Level Science and Engineering Talent

The talent reservation of a nation greatly affects its innovation capacity and its sustainable development in technology and economy. In the light of the intense international competition, vigorously cultivating talents in science and engineering has become a key initiative for many countries globally. In this context, MOE, MOF, and NDRC jointly issued *Several Opinions on Further Promoting the Construction of World-Class Universities and First-Class Disciplines* in 2022 (MOE et al., 2022). The policy emphasizes that constructing "double first-class" should "accelerate the training of strategic scientific and technological talents, first-class scientific and technological leaders, and innovative teams, in order to provide a strong support for building a modern and powerful socialist country in an all-round way" (*ibid*). Moreover, the policy proposes to "vigorously cultivate and introduce many strategic scientists, first-class scientific and technological leaders, young scientific and technological talents, and innovation teams with international standards". As mentioned in Sect. 6.4.3, MOE and the State-owned Assets Supervision and Administration Commission of the State Council jointly held a meeting to push the progress of training outstanding engineers (Yu, 2022). In this meeting, the National Colleges of Excellent Engineers and the National Innovation Institutes of Excellent Engineers have officially been established. At the same time, the meeting pointed out that "it is critical to understand the extreme importance of cultivating outstanding engineers, strive to solve core problems, and realize the fundamental transformation of the way of running engineering education from the singleness and independence of disciplines and majors to the inter-discipline and deep integration of universities and enterprises. Also, it is critical to transform the goals of training from focusing on theoretical teaching to engineering innovation capabilities and transform the evaluation standards from focusing on papers and awards to actual innovation contributions" (*ibid*).

The report of the 20th National Congress of the Communist Party of China also emphasized the importance of scientific, technological, and engineering talents. It is believed that "to accelerate the construction of national strategic talents, efforts should be made to cultivate more masters, strategic scientists, first-class scientific and technological leaders and innovation teams, young scientific and technological talents, and excellent engineers, great craftsmen, and highly skilled personnel" (Xi, 2022). To speed up the training of outstanding engineers, the General Office of MOE issued *Notice on the Establishment of the Second Batch of National Institutes of Excellent Engineers* in 2023 (MOE, 2023a). The Notice stated that MOE, in conjunction with the State-owned Assets Supervision and Administration Commission of the State Council, has decided to support some universities to jointly build the second batch of the National Elite Institute of Engineering along with some state-owned enterprises. The notice announced the list of the second batch of fourteen institutes. It required that universities must work closely with enterprises to build up the institutes. In 2023, the Promotion Conference for the Integrated Training of Industry and Education for Outstanding Engineers was held in Beijing. China's Outstanding Engineer Training Consortium was established at the meeting, and core courses, competency standards, and work guidelines for training outstanding engineers were released. In-depth discussions were held on deepening the reform of engineering master's and doctoral training and building an integrated industry-university collaborative training system for outstanding engineers. It provides an important basis and reference for universities to build excellent engineering colleges and cultivate engineering talents.

### 6.7.4 *Emphasis on Graduate Degree Training for Elementary and Secondary Science Teachers*

The 20th National Congress of the Communist Party of China described a grand blueprint for comprehensively building a modern socialist country. It emphasized the basic and strategic role of education, science and technology, and talents and set higher standards for cultivating a team of high-quality teachers. To further prepare talents in science and engineering, it is imperative to strengthen the educational quality by improving the training of teachers. The overall quality of teachers in high school, middle school and primary school can have an immerse impact on students' development.

In 2023, MOE launched the National Excellent Primary and Secondary School Teacher Training Plan (the "National Excellent Plan") by issuing *The Opinions on Implementing the National Excellent Primary and Secondary School Teacher Training Plan* (MOE, 2023c). The Opinions propose that high-level universities, particularly the Double World-Class universities, select graduate students with excellent professional performance and willingness for teaching as members of the "National Excellent Plan". They will be engaged in intensive disciplinary courses and a systematic study of teacher education module courses (including participation in educational practices). By so doing, this plan will provide "primary and secondary schools with a group of outstanding teachers with deep educational sentiments, excellent professional qualities, and solid basic teaching skills"(*ibid*). The Opinions clearly state that the first batch of pilot projects will support 30 domestic "Double World-Class" universities to undertake training tasks. In specific, this batch of pilot programs supports outstanding recent undergraduate graduates in science and engineering to pursue graduate studies in science and engineering or education masters. It also supports the selection of graduate students enrolled in science and engineering to participate in this program. As an active exploration to leveraging the strengths of high-level institutions, the plan aims to train and prepare science teachers to teach at primary and secondary schools, promoting the establishment and continuous improvement of the teacher education system with Chinese characteristics. By training competent science teachers, comprehensive universities, as represented by the "Double World-Class" universities, will elevate the overall degree levels of teachers and improve the quality of science education.

## 6.8 Summary

To summarize, with the rapid growth over the past 20 years, Chinese graduate education has demonstrated an improvement in both quantity and quality as compared to current leading graduate education systems. Meanwhile, considering the key role of science and engineering in driving the economic and technological development, the Chinese national policies have shown a strong focus on training graduate-level science and engineering talents. Emphasis has also been on strengthening the educational quality of science and engineering education by enhancing the graduate-degree training of pre-college science teachers. The national-level policies have played a key role in guiding the direction of Chinese graduate education development. The graduate education reform and practices of leading Chinese universities have also reflected such a focus on the training of science and engineering talents by initiating various relevant programs or formulating university-level/departmental-level measures or regulations. Recent scholarly research has shown a similar trend and offered some support for the educational practices although in-depth empirical research are still needed to further support such reformative efforts. Through continual educational reform and innovation, multiple stakeholders in the Chinese graduate education system have sought to devote a joint effort in improving the overall quality of Chinese graduate education with the main goal of satisfying the needs of Chinese social and economic environment.

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# Chapter 7
# Professional Education in China

**Lu Chang, Peng Bokang, and Chen Xi**

**Abstract** Professional education plays a pivotal role in meeting societal demands and propelling industrial progress. This chapter presents a comprehensive overview of the genesis, evolution, and current state of professional education in China, starting with a historical perspective, development milestones, and leading academic programs. It proceeds to examine critical data on China's professional education, presenting highlighting data of domestic enrollment and degree conferral of professional degree, and positioning it within a global context through comparative analysis. Indicators for assessing the excellence of professional education are introduced and explained. Top Chinese and global universities are compared based on the implemented Excellence Index. The chapter then showcases three best practices from different perspectives and two motivational narratives that highlight the achievements of Chinese professional educators. Moreover, an in-depth literature review on professional education in China was conducted and visualized, revealing trends in research on professional education. It concludes with an exploration and critical assessment of major national policies shaping professional education in China, suggesting that ongoing, in-depth acts are necessary to define and refine China's strategic approach to enhancing its professional education system.

**Keywords** Professional degree · Academic degree · Higher education · Graduate enrollment and graduation · Social advance and industry changes

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## 7.1 Introduction

Professional degrees designed to equip students with strong professional and practical skills, to address skill demands in specific occupational fields, typically in knowledge-intensive domains. In contrast to academic degrees focusing on scientific research and theoretical innovation, professional degree education adheres to specific requirements and quality standards concerning occupation objectives, target students, curriculum design, training methodologies, as well as knowledge and skill structures. Since the establishment of the professional degree education system in 1991, China has systematically developed a specialized talent training system for applied professionals at post-secondary levels. Its pioneering training model emphasizes integration and collaboration between industry and universities to develop students' practical competencies. This has resulted in the establishment of a developmental framework for professional degree education, characterized by industry guidance, societal participation, and universities as the primary entities.

In the past decades, China has witnessed a remarkable surge in the significance and popularity of professional master's and doctorate degrees, driven by a confluence of socio-economic factors and governmental policies on education. The burgeoning Chinese economy, with its fast shift towards high-tech and service industries, demands a workforce with advanced skills and specialized knowledge, fueling the demand for professional degrees arises. Specifically, there is a growing emphasis on higher education aligned with industry needs, fostering an environment where practical expertise and research innovation are paramount (GAIN, 2022). The government's push toward modernization and international competitiveness has further elevated the status of professional degrees. Professional degrees such as the Master of Business Administration (MBA), Master of Public Administration (MPA), and professional doctorates are increasingly regarded as vital for career advancement in the Chinese job market, with graduates securing leadership roles and commanding higher salaries. Furthermore, these programs have adapted global educational standards, incorporating international curricula and fostering cross-border collaborations, thus attracting a diverse student body and bolstering the internationalization of Chinese higher education. This trend reflects China's strategic goal of cultivating a highly skilled workforce capable of driving innovation, economic progress, and social development, positioning the country as a formidable global educational powerhouse.

Graduate education plays a significant role in nurturing highly skilled individuals and fostering innovative thinking. It serves as a vital pillar for national advancement, societal development, and supports global talent competitiveness. Over the span of more than seven decades since the establishment of the People's Republic of China, the nation has successfully trained over 10 million individuals at the doctoral and master's levels (Gaojidata, 2023). As indicated by *the 2022 National Education Development Statistical Bulletin*, the total number of graduate students in China in 2022 reached 3.6536 million, solidifying China's prominence in the realm of graduate education (Ministry of Education [MOE], 2020). With China entering a new era, various industries are experiencing an increasingly pressing demand for highly skilled and innovative professionals, thereby emphasizing the pivotal role of graduate education. Notably, professional education at graduate levels, serving as the primary avenue for cultivating advanced applied professionals, contributes to diversifying talent training, propelling the knowledge economy industry forward, and elevating the standards of modern society. This chapter focuses its discussion on professional degree education at graduate levels.

### *7.1.1 Background*

From 1990 to 1996, the exploratory phase to lay the foundation for professional degree education took place. In October 1990, the first professional degree program, Master of Business Administration (MBA) degree, was introduced in China, marking the beginning of professional postgraduate education in the country.

Two years later, in 1992, the State Council's Academic Degrees Committee approved the proposal to issue professional degree certificates by specific fields, which represented a significant breakthrough in China's degree system, moving away from the traditional method of conferring degrees solely by broad categories. By 1995, the focus on professional degree education intensified. Suggestions were made to increase the proportion of professional degree candidates within postgraduate education, strengthen the link between professional degrees and occupational qualifications, and establish new professional degrees timely. In 1996, the Interim Measures for the Establishment and Approval of Professional Degrees were introduced, institutionalizing the nature, objectives, levels, approval, implementation, and granting of professional degrees, thereby creating a solid regulatory foundation for the advancement of professional degree postgraduate education in China.

### *7.1.2 Status Quo*

As of now, China has developed a comprehensive professional education system, primarily centered around master's degrees and complemented by doctoral and bachelor's degrees. Table 7.1 outlines the professional degree programs of different categories offered in Chinese universities. At the master's level, Electronic Information (405) is the most offered professional degree programs, followed by Art (333) and Translation (320). Accounting, Mechanical Engineering, and Law programs are also popular among professional degree programs, with around 300 universities offering such programs. At the doctoral level, Electronic Information leads the chart with 47 programs offered at Chinese higher education institutions. Table 7.1 reflects the distribution of professional degree programs across disciplines at Chinese universities. It highlights strong emphasis on expanding such programs in certain fields, such as Electronic Information, Mechanical Engineering, and Business Administration, among others. It also shows a significant number of master's programs across

**Table 7.1** Professional degree programs at master's and doctoral levels

| Professional degree category | Number of master's programs | Number of doctorate programs |
|---|---|---|
| Electronic information | 405 | 47 |
| Art | 333 | – |
| Translation | 320 | – |
| Accounting | 300 | – |
| Mechanical | 294 | 40 |
| Law | 290 | – |
| Materials and chemical engineering | 285 | 35 |
| Business administration | 274 | – |
| Public administration | 271 | – |
| Resources and environment | 271 | 39 |
| Biology and medicine | 235 | 24 |
| Finance | 229 | – |
| Civil and hydraulic engineering | 225 | 25 |
| Journalism and communication | 219 | – |
| Engineering management | 203 | – |
| Chinese international education | 199 | – |
| Education | 196 | 31 |
| Energy and power | 190 | 29 |
| Applied statistics | 188 | – |
| Sports | 184 | – |
| Social work | 175 | – |
| International business | 168 | – |
| Tourism management | 139 | – |
| Agriculture | 130 | – |
| Pharmacy | 130 | – |
| Applied psychology | 130 | – |
| Nursing | 123 | – |
| Clinical medicine | 123 | 53 |
| Transportation | 115 | 18 |
| Landscape gardening | 95 | – |
| Public health | 89 | – |
| Library and information science | 74 | – |

(continued)

**Table 7.1** (continued)

| Professional degree category | Number of master's programs | Number of doctorate programs |
|---|---|---|
| Cultural heritage and museology | 71 | – |
| Oral medicine | 68 | 27 |
| Auditing | 59 | – |
| Taxation | 56 | – |
| Asset valuation | 54 | – |
| Insurance | 53 | – |
| Veterinary medicine | 53 | 16 |
| Traditional Chinese pharmacology | 53 | – |
| Traditional Chinese medicine | 47 | 23 |
| Architecture | 45 | – |
| Forestry | 41 | – |
| Urban planning | 36 | – |
| Publishing | 33 | – |
| Military | 30 | – |
| Policing | 8 | – |

*Source* Gaojidata (2023)
*Notes* Where the number of doctorate programs is not offered, it is indicated with a dash (–)

various disciplines, with fewer but notable doctorate programs, particularly in highly technical or specialized areas.

## 7.2 Highlighting Data

Since its first implementation in 1990, professional degree education in China has experienced rapid growth and notable success. Notably, the number of awarded professional master's degrees has seen a significant increase in recent years, reflecting the increasing demand for highly skilled nation's economic development and societal progress (GAIN, 2023). The following sections delve into detailed statistics regarding student enrollments and degree recipients in professional degree programs over the last decade in China (MOE, ). Further, international comparison enables discussion on the trends of professional education in China and in the world (OECD, 2023).

### 7.2.1 Professional Master's Student Enrollments in China

Table 7.2 and Fig. 7.1 outline the enrollment of master's students in China from 2011 to 2021, detailing the total number of students, the gender distribution, and the proportion of students in academic versus professional programs. Over the decade, the total number of master's students has seen a steady increase, from 494,609 in 2011 to 1,050,703 in 2021. The percentage of female master's students has also risen, starting at 256,192 in 2011 and reaching 553,531 in 2021, indicating a significant and consistent increase in female participation in master's level education.

The distribution between academic and professional programs has notably shifted over the years. In 2011, the majority of master's students were enrolled in academic programs (68%), but by 2021, this trend reversed with the majority of students (62%) enrolling in professional programs. This shift suggests an increasing emphasis on professional degrees in China, aligning with the country's strategic focus on developing a skilled workforce equipped with practical and industry-relevant skills. The data also reflect the broader global trend where professional education is increasingly valued for its direct applicability to the workforce. The growing numbers indicate that Chinese educational policy and student preferences are adapting to the demands of the job market, which increasingly favors candidates with specialized professional qualifications.

**Table 7.2** Master's student enrollments in China (2011–2021)

| Year | Total master's students | Female master's students | Master's students in academic programs (%) | Master's students in professional programs (%) |
|---|---|---|---|---|
| 2011 | 494,609 | 256,192 | 336,110 (68%) | 158,499 (32%) |
| 2012 | 521,303 | 269,222 | 324,152 (62%) | 197,151 (38%) |
| 2013 | 540,919 | 278,288 | 316,060 (58%) | 224,850 (42%) |
| 2014 | 548,689 | 288,058 | 309,942 (57%) | 238,747 (43%) |
| 2015 | 570,639 | 304,600 | 308,922 (54%) | 261,717 (46%) |
| 2016 | 589,812 | 322,938 | 310,195 (53%) | 279,617 (47%) |
| 2017 | 722,225 | 388,556 | 320,121 (44%) | 402,104 (56%) |
| 2018 | 762,464 | 418,806 | 322,660 (42%) | 439,804 (58%) |
| 2019 | 811,334 | 446,643 | 474,273 (58%) | 337,061 (42%) |
| 2020 | 990,504 | 530,891 | 388,009 (39%) | 602,495 (61%) |
| 2021 | 1,050,703 | 553,531 | 553,531(38%) | 648,976(62%) |

*Source* MOE (2012–2022)

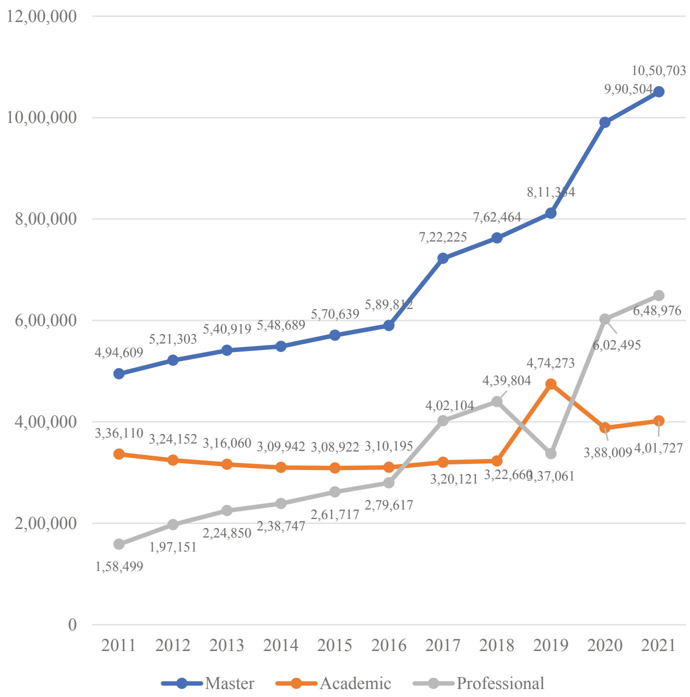


**Fig. 7.1** Trend of master's student enrollments in China (2011–2021). *Source* MOE (2012–2022)

### *7.2.2 Professional Doctoral Student Enrollments in China*

Table 7.3 and Fig. 7.2 traces the enrollment trends of doctoral students in China from 2011 to 2021, illustrating the total number of students, gender distribution, and the allocation between academic and professional programs. Over the 10-year span, total doctoral student enrollments have increased from 65,549 in 2011 to 125,823 in 2021. The number of female doctoral students has seen a significant rise as well, from 7,417 in 2011 to 53,831 in 2021, indicating a marked improvement in gender diversity at the doctoral level.

There has also been a gradual but notable shift in the type of doctoral programs students are enrolling in. In 2011, the vast majority of doctoral students were in academic programs (98%), with only a small fraction (2%) in professional programs. By 2021, the percentage of students in academic programs decreased to 86%, while those in professional programs rose to 14%. This change points to an evolving landscape in doctoral education in China, with an increasing recognition of the value of professional doctorates, which are geared towards providing advanced training and skills for specific professions.

**Table 7.3** Doctoral student enrollments in China (2011–2021)

| Year | Total doctoral students | Female doctoral students | Doctoral students in academic programs (%) | Doctoral students in professional program (%) |
|---|---|---|---|---|
| 2011 | 65,549 | 7,417 | 64,116 (98%) | 1,443 (2%) |
| 2012 | 68,370 | 25,489 | 66,638 (97%) | 1,732 (3%) |
| 2013 | 70,462 | 26,896 | 68,743 (98%) | 1,719 (2%) |
| 2014 | 72,634 | 28,380 | 70,619 (97%) | 2,015 (3%) |
| 2015 | 74,416 | 29,679 | 72,491 (97%) | 1,925 (3%) |
| 2016 | 77,252 | 31,639 | 74,743 (97%) | 2,509 (3%) |
| 2017 | 83,878 | 35,073 | 81,178 (97%) | 2,700 (3%) |
| 2018 | 95,502 | 41,012 | 88,718 (93%) | 6,784 (7%) |
| 2019 | 105,169 | 45,719 | 94,783 (90%) | 10,386 (10%) |
| 2020 | 116,047 | 49,593 | 102,328 (88%) | 13,719 (12%) |
| 2021 | 125,823 | 53,831 | 107,708 (86%) | 18,115 (14%) |

*Source* MOE (2012–2022)

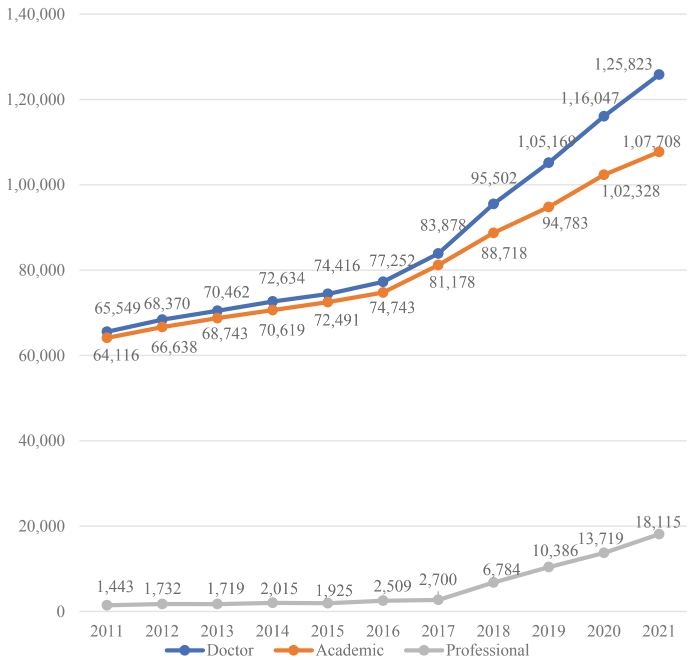


**Fig. 7.2** Trend of doctoral student enrollments in China (2011–2021). *Source* MOE (2012–2022)

The trend suggests a broadening in the approach to doctoral education in China, acknowledging the importance of both academic research and professional practice. This reflects the changing needs of the Chinese economy, which increasingly demands high-level expertise not only in traditional academic disciplines but also in applied and professional fields.

### 7.2.3 *Professional Master's Degree Recipients in China*

Table 7.4 and Fig. 7.3 provide a comprehensive overview of master's degree recipients in China from 2011 to 2021, including the total number of degree recipients, the number of female recipients, and the distribution of recipients in academic and professional programs. The data show a consistent increase in the total number of master's degree recipients over the decade, starting from 379,705 in 2011 and reaching 700,742 in 2021. The number of female master's degree recipients has also seen a steady rise, from 190,153 in 2011 to 391,759 in 2021, indicating a significant increase in the participation of women in postgraduate education.

There has been a notable shift in the type of master's degrees conferred. In 2011, a vast majority of recipients were from academic programs (87%), while by 2021, the proportion of master's degrees conferred in professional programs had risen to 58%. This shift indicates a changing emphasis in higher education in China, with an increasing focus on professional programs that align more closely with industry needs and practical skills. The trend suggests a growing recognition of the value of

**Table 7.4** Master's degree recipients in China (2011–2021)

| Year | Total master's degree recipients | Female master's degree recipients | Master's degreerecipients in academic program (%) | Master's degreerecipients in professional program (%) |
|---|---|---|---|---|
| 2011 | 379,705 | 190,153 | 329,610 (87%) | 50,095 (13%) |
| 2012 | 434,742 | 222,780 | 346,575 (80%) | 88,167 (20%) |
| 2013 | 460,487 | 237,334 | 330,606 (72%) | 129,881 (28%) |
| 2014 | 482,210 | 252,368 | 311,275 (65%) | 170,935 (35%) |
| 2015 | 497,744 | 260,738 | 299,334 (60%) | 198,410 (40%) |
| 2016 | 508,927 | 269,502 | 291,715 (57%) | 217,212 (43%) |
| 2017 | 520,013 | 277,011 | 284,656 (55%) | 235,357 (45%) |
| 2018 | 543,644 | 295,098 | 285,705 (53%) | 257,939 (47%) |
| 2019 | 577,088 | NA | 290,602 (50%) | 286,486 (50%) |
| 2020 | 662,451 | 365,286 | 292,992 (44%) | 369,459 (56%) |
| 2021 | 700,742 | 391,759 | 295,683 (42%) | 405,059 (58%) |

*Source* MOE (2012–2022)
*Notes* NA suggests that the data were not reported by MOE

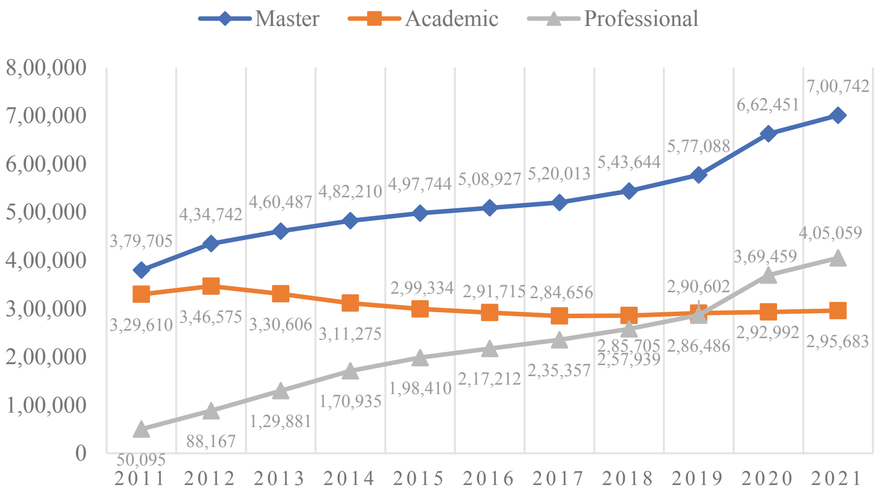


**Fig. 7.3** Master's degree recipients in China (2011–2021). *Source* MOE (2012–2022)

professional master's degrees in China, which reflects the country's strategic focus on developing a skilled workforce equipped with workforce-aligned skills. The equal distribution of academic and professional program recipients by 2019 underlines a substantial alignment with market demands and the diversification of educational offerings to cater to a variety of professional fields.

### *7.2.4 Professional Doctorate Recipients in China*

Table 7.5 and Fig. 7.4 detail the number of individuals who received doctorate degrees in China annually from 2011 to 2021, providing a breakdown by gender and by the type of program—academic versus professional. Over the period, there was a steady increase in the total number of doctorate recipients, starting at 55,618 in 2011 and rising to 72,019 in 2021. The number of female doctorate recipients also grew, from 18,189 in 2011 to 30,639 in 2021, indicating a positive trend towards gender diversity in doctoral education.

The majority of doctorate degrees awarded during this period were in academic programs, maintaining a high proportion of 94% or more each year. However, there is a slight but noticeable increase in the proportion of doctorates awarded in professional programs, from 2% in 2011 to 6% in 2021. This suggests a growing recognition of the importance of professional doctorates, which are tailored towards equipping students with advanced practical skills and knowledge for specific professions. This table reflects the evolving landscape of doctoral education in China, where there is an emphasis on maintaining a strong academic foundation while also increasing

**Table 7.5** Doctorate recipients in China (2011–2021)

| Year | Total doctorate recipients | Female doctorate recipients | Doctorate recipients in academic program (proportion) | Doctorate recipients in professional program (proportion) |
|---|---|---|---|---|
| 2011 | 55,618 | 18,189 | 49,145 (98%) | 1,144 (2%) |
| 2012 | 51,713 | 19,250 | 50,401 (97%) | 1,312 (3%) |
| 2013 | 53,139 | 19,980 | 51,248 (96%) | 1,891 (4%) |
| 2014 | 53,653 | 20,588 | 51,675 (96%) | 1,978 (4%) |
| 2015 | 53,778 | 22,564 | 51,649 (96%) | 2,129 (4%) |
| 2016 | 55,011 | 21,535 | 52,700 (96%) | 2,311 (4%) |
| 2017 | 58,032 | 22,802 | 55,823 (96%) | 2,209 (4%) |
| 2018 | 60,724 | 23,887 | 58,450 (96%) | 2,274 (4%) |
| 2019 | 62,578 | 25,037 | 60,436 (97%) | 2,142 (3%) |
| 2020 | 66,176 | 27,444 | 63,510 (96%) | 2,666 (4%) |
| 2021 | 72,019 | 30,639 | 67,889 (94%) | 4,130 (6%) |

*Source* MOE (2012–2022)

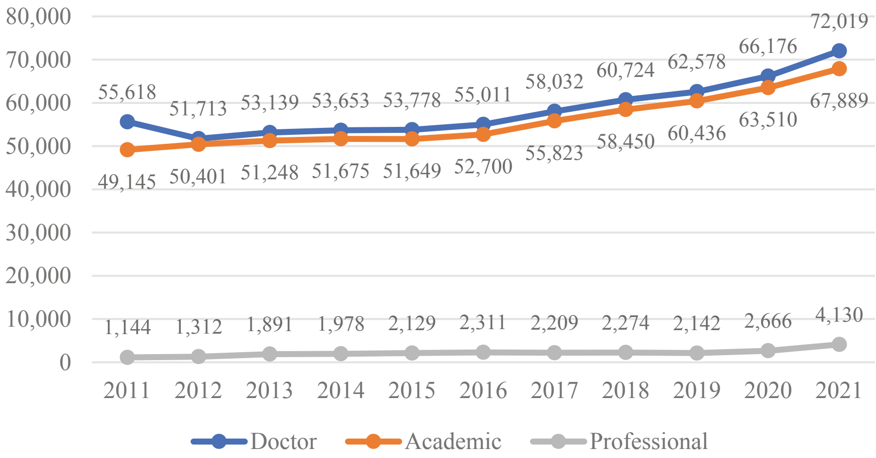


**Fig. 7.4** Doctorate recipients in China (2011–2021). *Source* MOE (2012–2022)

the provision of professional-oriented programs to meet the diverse needs of an advancing society and economy.

### 7.2.5 Professional Master's Student Enrollments in China and the World

Table 7.6 presents data on professional master's student enrollments in China compared to other countries around the world, as reported by the OECD for the years 2019 through 2021. The table breaks down total master's student enrollments into enrollments in professional programs and academic programs, providing percentages for each category where available.

In China, there is a significant and growing enrollment in professional master's programs, with a notable jump from 811,334 total enrollments in 2019 to 2,822,920 in 2021. The percentage of students enrolled in professional programs increased from 58% in 2019 to a dominant majority in the following years, whereas the percentage in academic programs remained lower at 42% in 2019, with a similar proportion in subsequent years.

In contrast, the United States (U.S.) does not provide a breakdown of professional versus academic program enrollments. The United Kingdom (U.K.), Germany, and Japan report no enrollments in professional master's programs for these years, with all master's students enrolled in academic programs. France shows a high percentage of enrollments in professional programs, constituting 70% of total enrollments in 2019, although the number slightly decreased by 2021. The Netherlands and Switzerland have a much smaller proportion of students in professional programs, 7% and 5% respectively in 2019, with slight increases in the following years. The Republic of Korea (ROK) shows a consistent majority of enrollments in professional programs, with 64% in 2019 and a similar distribution in the subsequent years.

The data indicate that while some countries like China and France have a significant portion of students in professional master's programs, other countries like the U.K., Germany, and Japan focus exclusively on academic programs. The varied distribution underscores differing national priorities and structures in postgraduate education.

## 7.3 Excellence Index

This section outlines a framework of excellence index assessing professional education in China and globally. The methodology for choosing and defining these indices is detailed, followed by a comparative analysis of the professional education development at selected institutions.

**Table 7.6** Professional master's student enrollments in China and the world

| | Master's student enrollment | | | |
|---|---|---|---|---|
| Country | Year | Total enrollment | Enrollment in professional programs (%) | Enrollment in academic programs (%) |
| China | 2019 | 811,334 | 474,273 (58%) | 337,061 (42%) |
| | 2020 | 990,504 | 530,891 | 388,009 |
| | 2021 | 1,050,703 | 648,976 | 401,727 |
| France | 2019 | 996,046 | 692,277 (70%) | 22,054 (2%) |
| | 2020 | 1,018,720 | 709,903 | 16,158 |
| | 2021 | 992,659 | 660,684 | 15,884 |
| Germany | 2019 | 1,070,851 | 0 (0) | 1,070,851 (100%) |
| | 2020 | 1,084,652 | 0 (0) | 1,084,652 |
| | 2021 | 1,115,918 | 0 (0) | 1,11,5918 |
| Japan | 2019 | 350,765 | N/A | N/A |
| | 2020 | 349,501 | N/A | N/A |
| | 2021 | 345,176 | N/A | N/A |
| Netherlands | 2019 | 184,714 | 12,582 (7%) | 172,132 (93%) |
| | 2020 | 195,384 | 12,839 | 182,545 |
| | 2021 | 206,158 | 17,420 | 188,738 |
| ROK | 2019 | 238,012 | 153,186 (64%) | 84,826 (36%) |
| | 2020 | 236,255 | 151,104 | 85,151 |
| | 2021 | 239,771 | 151,271 | 88,500 |
| Switzerland | 2019 | 72,252 | 3,382 (5%) | 68,870 (95%) |
| | 2020 | 75,361 | 3,631 | 71,730 |
| | 2021 | 80,579 | 3,697 | 76,882 |
| U.S | 2019 | 2,678,712 | N/A | N/A |
| | 2020 | 2,734,112 | N/A | N/A |
| | 2021 | 2,796,377 | N/A | N/A |
| U.K | 2019 | 485,396 | 0 (0) | 485,396 (100%) |
| | 2020 | 527,190 | 0 (0) | 527,190 |
| | 2021 | 621,166 | 0 (0) | 621,166 |

*Source* OECD (2023)
*Notes* N/A suggests that the data were not reported by OECD; 0 suggests that OECD reported 0 in that category. Russian was excluded from the comparisons, for related data were not reported by OCED in 2020 and 2021

## *7.3.1 Framework Development*

Drawing on the OECD's work (Bottani, 1994), this chapter emphasizes three primary quality indicators: context, resources and process, and outcomes. Context indicators encompass the educational environment, while resource and process indicators cover aspects such as cost, resources, and educational procedures, including financial, participant, staff, and research and development (R&D) specifics. Outcome indicators focus on educational achievements, covering student, system, and labor market success. UNESCO's model (Education Indicators Technical Guidelines, 2009) introduces additional factors like enrollment rates and grade survival rates. Integrating these with established frameworks for professional degree evaluation (Guo & Wu, 2018; Hua & Hong, 2017; Ma et al., 2019; Tian et al., 2018), this chapter introduces a two-fold framework to assess the scale and outcomes of professional education.

Table 7.7 presents a framework for evaluating the quality of professional education programs. It encompasses two dimensions: scale and educational outcomes, each with specific indicators derived from various authoritative sources. This table provides a structured approach to assessing the effectiveness and prestige of professional education programs, guiding prospective students, employers, and policymakers in their decision-making processes.

Under the scale dimension, three indicators are utilized: the number of professional degree programs offered, the professional degree-academic degree enrollment ratio, and the faculty-student ratio. These indicators help gauge the breadth and depth of professional education offerings and the resources allocated to students. The data for these metrics are collected from the China Academic Degrees and Graduate Education Information Network and selected universities' official websites, ensuring a robust and accurate measure of program scale and institutional capacity.

The educational outcomes dimension focuses on the impact of professional education on graduates' careers. It includes indicators such as employment outcome, which reflects the university's graduate employment rate and the alumni outcome surveyed by the QS Global Ranking Indicator. Additionally, employer reputation is considered, leveraging global perspectives from the QS Global Ranking Indicator. This indicator serves as a proxy for the quality and industry recognition of the educational programs offered.

**Table 7.7** Excellence index for professional education

| Dimension | Indicators | Source |
|---|---|---|
| Scale | Number of professional degree programs offered | China Academic Degrees and Graduate Education information network; universities' official websites |
| | Professional degree-academic degree enrollment ratio | China Graduate Enrollment information network; universities' official websites |
| | Faculty-student ratio | Universities' official websites |
| Educational outcomes | Employment outcome | QS global ranking indicator |
| | Employer reputation | QS global ranking indicator |

## 7.3.2 Index Design

In China, five universities were recognized as top 100 universities in the Shanghai Ranking's Academic Ranking of World Universities (ARWU), QS Global Ranking Indicator, and Times Higher Education World University Rankings in 2024. This initiative aims to enhance R&D in crucial disciplines at leading Chinese universities such as Tsinghua University and Peking University, reflecting their teaching and research caliber as indicative of the pinnacle of Chinese higher education.

The analysis also encompasses data from top global universities to benchmark excellence index. Top-tier international universities ranked by ARWU, including the global top five (i.e., Harvard University, Stanford University, Massachusetts Institute of Technology, University of Cambridge, University of California, Berkeley), institutions ranked 21st to 25th (i.e., University of California, San Francisco, Tsinghua University, Imperial College London, University of Toronto, Washington University in St. Louis), those ranked 75th to 79th (i.e., University of Groningen, Monash University, Aarhus University, Technion-Israel Institute of Technology,

The University of Texas M. D. Anderson Cancer Center) and 96th to 100th (i.e., Nanjing University, Purdue University - West Lafayette, Brown University, McMaster University, Stockholm University) exemplify world-class universities, defined by their global standing and adherence to international excellence standards (Altbach, 2003).

### 7.3.2.1 Scale

The first dimension evaluates the extent of professional education, including the variety of professional degree programs offered, the faculty-student ratio, and the professional-to-academic degree enrollment ratio, with detailed computation methods for each metric described subsequently.

*Number of Professional Degree Programs Offere*d. This metric reflects the development of professional degree programs at universities, indicating the educational system's capacity to cater to the labor market's demands with diverse professional programs. Scores range from 0 to 100, with zero for institutions lacking professional programs, 60 for those with 1–2 programs, 80 for 3–5 programs, and a full score of 100 for institutions offering 6 programs and above.

*Faculty-Student Ratio*. Recognized as a vital measure of teaching quality, the faculty-student ratio is utilized by top global university rankings such as QS, U.S. News, Times, and ARWU. It gauges the potential for students to receive quality training and mentorship for their future careers. The score for this indicator is normalized from 0 to 100, where a higher ratio indicates better teaching quality.

*Professional Degree-to-Academic Degree Enrollment Ratio*. This ratio compares the intake of new students into professional programs versus academic programs, revealing the emphasis placed on professional education relative to academic research. It serves as a barometer of how much a country and the job market value professional education. This ratio is also standardized to a scale of 0 to 100.

#### 7.3.2.2 Educational Outcomes

The second dimension appraises the success of professional education through two primary indicators: employment outcome post-degree and employer reputation, with data sourced from reputable rankings.

*Employment Outcome*. This metric cites QS Employment Outcome. The employment outcomes indicator is formulated to assess how effectively universities ensure the employability of their graduates and nurture individuals who will become influential leaders in their chosen professions. This formula considers both the quantitative measure of graduate employment and the qualitative impact of alumni, offering a nuanced perspective on a university's role in enhancing the employability and subsequent accomplishments of its graduates. This metric combines two essential measurements from the QS Graduate Employability Rankings, namely the Graduate Employment Rate and the Alumni Outcomes Score. To ensure an impartial evaluation among institutions of different sizes, the Alumni Outcomes Score is adjusted based on the student population. The ultimate result is standardized on a scale from 0 to a 100 and adjusts the Graduate Employment Rate using a logarithmic function.

*Employer Reputation*. Based on over 75,000 responses to the QS Employer Survey, this indicator ascertains the institutions producing the most capable and innovative graduates according to employers. This measure is a testament to the efficacy of professional education from an employment standpoint and is already normalized to a 0–100 scale.

### *7.3.3 Findings*

Tables 7.8 and 7.9 display the standardized performance on the excellence index for the world's top 100 universities, with a focus on Chinese institutions in one and a global perspective in the other. The unstandardized excellence indicators on each dimension can be found in Appendix A.

Table 7.8 outlines performance indicators for selected Chinese universities within the global top 100 rankings. It lists institutions such as Tsinghua University, Peking University, Zhejiang University, Shanghai Jiao Tong University, and Fudan University, with respective world rankings from 22 to 56. The excellence index ranges from 49 to 68, suggesting a measure of overall quality or impact of professional education. The program number score for each listed Chinese university is either 80 or 100, indicating a substantial breadth of programs offered. Faculty-student ratios vary from 12.47 to 17.17, which are lower compared to the world average of 30, reflecting more faculty members per student. Degree ratios, which could indicate the level of professional degrees awarded compared with academic degrees awarded, vary widely, with

**Table 7.8** World top 100 Chinese universities' standardized performance on excellence index

| Institutions | World ranking | Excellence index | Program number | Faculty-student ratio | Degree ratio | Employment outcome | Employer reputation |
|---|---|---|---|---|---|---|---|
| Tsinghua University | 22 | 68 | 100 | 13.3 | 46.01 | 82.2 | 96.9 |
| Peking University | 29 | 59 | 80 | 12.47 | 25.77 | 82.6 | 95.4 |
| Zhejiang University | 33 | 51 | 100 | 15.51 | 6.13 | 37.7 | 95.7 |
| Shanghai Jiao Tong University | 46 | 55 | 100 | 17.17 | 16.56 | 55.5 | 83.3 |
| Fudan University | 56 | 49 | 80 | 15.24 | 11.04 | 49.6 | 89.8 |
| **Average of top world universities in China (top 100)** | **–** | **56.4** | **92** | **14.73** | **21.10** | **61.52** | **92.22** |
| **Average of top world universities in the world (top 100)** | **–** | **56** | **87** | **30** | **23** | **68** | **66** |

*Notes* N/A suggests that the data were not reported by the source websites

Tsinghua University notably high at 46.01 compared to an average of 21.10 for top Chinese universities and 23 for the world. Employment outcomes and employer reputation are indicators of graduates' success in the job market and the esteem held by employers, with scores generally high among the Chinese universities, notably higher than the world average for employer reputation.

Table 7.9 contrasts the performance of a selection of top-ranking universities worldwide, including the top 1–5, 21–25, 76–80, and 96–100 ranks. Institutions like Harvard, Stanford, and MIT occupy the top three ranks with excellence indices ranging from 49 to 71. The faculty-student ratio is significantly lower for these top institutions, except for the University of California, Berkeley, which has a high ratio of 33.24. Degree ratios vary, with Imperial College London standing out at 100. Employment outcomes are generally high, indicating successful graduate employment rates, and employer reputation is perfect at 100 for most top-ranked institutions.

*Program Variety*. Chinese universities are commendable for their range of programs, with institutions like Tsinghua University and Zhejiang University offering a wide array of professional degrees. This variety reflects the commitment of these universities to meet the diverse educational and professional demands of students. On the global stage, venerable institutions such as Harvard and Stanford match this variety, showcasing an equally impressive breadth in their educational programs.

**Table 7.9** World Top 100 universities' standardized performance on excellence indicators

| Institution | World ranking | Excellence index | Program number | Faculty-student ratio | Degree ratio | Employment outcome | Employer reputation |
|---|---|---|---|---|---|---|---|
| *Top 1–5* | | | | | | | |
| Harvard University (U.S.) | 1 | 66 | 100 | 8.86 | 19.02 | 100 | 100 |
| Stanford University (U.S.) | 2 | 61 | 100 | 0 | 4.29 | 100 | 100 |
| Massachusetts Institute of Technology (U.S.) | 3 | 49 | 80 | 4.99 | 10.43 | 100 | 100 |
| University of Cambridge (U.K.) | 4 | 65 | 100 | 14.13 | 9.2 | 100 | 100 |
| University of California, Berkeley (U.S.) | 5 | 71 | 100 | 33.24 | 21.47 | 98.7 | 100 |
| *Top 21–25* | | | | | | | |
| University of California, San Francisco (U.S.) | 21 | 42 | 60 | NA | 24.54 | NA | NA |
| Tsinghua University (China) | 22 | 68 | 100 | 13.3 | 46.01 | 82.2 | 96.9 |
| Imperial College London (U.K.) | 23 | 75 | 80 | 13.3 | 100 | 83 | 99.4 |
| University of Toronto (Canada) | 24 | 73 | 100 | 53.74 | 19.02 | 96.4 | 96 |
| Washington University in St. Louis (U.S.) | 25 | 30 | 100 | 3.88 | 0 | 33.7 | 10.4 |
| *Top 76–80* | | | | | | | |
| University of Groningen (the Netherlands) | 76 | 49 | 80 | 62.05 | NA | 22.3 | 29.9 |
| Monash University (Australia) | 77 | 73 | 100 | 100 | 27.61 | 61 | 75.2 |
| Aarhus University (Denmark) | 78 | 47 | 100 | 19.67 | NA | 45.1 | 24.7 |
| Technion-Israel Institute of Technology (Israel) | 79 | 44 | 60 | 40.44 | NA | 30.7 | 27.8 |
| The University of Texas M. D. Anderson Cancer Center (U.S.) | 80 | 71 | 60 | NA | NA | 70 | 83.2 |
| *Top 96–100* | | | | | | | |
| Nanjing University (China) | 96 | 38 | 100 | 28.53 | 11.04 | 23.7 | 25.4 |

(continued)

**Table 7.9** (continued)

| Institution | World ranking | Excellence index | Program number | Faculty-student ratio | Degree ratio | Employment outcome | Employer reputation |
|---|---|---|---|---|---|---|---|
| Purdue University - West Lafayette (U.S.) | 97 | 52 | 80 | 29.09 | 14.72 | 53.4 | 81.2 |
| Brown University (U.S.) | 98 | 46 | 80 | 10.8 | 19.63 | 74.8 | 42.4 |
| McMaster University (Canada) | 99 | 55 | 80 | 62.6 | NA | 37.2 | 38.2 |
| Stockholm University (Sweden) | 100 | 52 | 80 | 38.5 | NA | 76.2 | 15.2 |
| **Average of top world universities** | – | **56** | **87** | **30** | **23** | **68** | **66** |

*Notes* N/A suggests that the data were not reported by the source websites

*Faculty-Student Ratio.* The faculty-student ratio is a critical index of the educational quality a university offers. Chinese universities show variation in this metric, with Tsinghua University setting a benchmark for others. In comparison, globally recognized universities such as MIT and Harvard are often ahead, maintaining lower student-to-faculty ratios, which may indicate a more personalized and intensive educational environment.

*Degree Ratio.* The degree ratio at Chinese universities signals a strong emphasis on professional education, suggesting a strategic focus on equipping students with vocational skills and knowledge. This is paralleled by high degree ratios at global universities, pointing to a well-rounded approach that values both academic excellence and professional competencies.

*Employment Outcom*e. Employment outcomes are a crucial measure of educational effectiveness. All included Chinese universities, particularly Tsinghua and Peking University, fare well in securing promising career prospects for their graduates. Their global counterparts, especially Harvard and Stanford, however, are often perceived as providing a significant edge to their graduates, with exceptional employment outcomes that underscore the value of their education in the global job market. The reasons can be attribute to those elite U.S. institutions often benefit from well-connected alumni network.

*Employer Reputation.* Employer reputation is a testament to the quality of graduates a university produces. Tsinghua University has earned a sterling reputation among employers within China. When it comes to global recognition, universities like Harvard and Stanford stand out, reflecting the enduring value and prestige their graduates bring to the workplace.

*Overall Comparisons.* In summary, the results provide a quantitative comparison on key performance metrics for top universities, offering insights into where Chinese institutions stand both domestically and internationally. The data suggest that while Chinese universities are competitive globally, especially in terms of employer reputation, there is variability in how they compare to other top institutions around the world in areas such as faculty-student ratios and degree ratios. The metrics also imply that top-ranked global universities maintain a high standard in terms of employment outcomes and academic excellence. The world's top universities, especially within the top 5 universities, showcase exceptional performance across all indices, reflecting their prestigious status and excellent performance on all dimensions. Notably, data for some indicators like faculty-student ratios and employment outcomes for certain institutions are marked as N/A, indicating that the information was not reported by the source websites. This absence of data highlights the challenges in gathering comprehensive global educational statistics and the need for standardized reporting across institutions.

Findings are useful for prospective students, faculty, and policymakers for benchmarking the performance of educational institutions and for identifying areas of strength and potential improvement. They offer a snapshot of the competitive landscape of higher education, demonstrating the achievements of top universities in China in comparison to their international counterparts.

## 7.4 Best Practices

### *7.4.1 Fostering High-Quality Teacher Education: The National Teaching Excellence Plan*

Teachers are the foundation of education. To enhance the teacher education system in China and a robust groundwork for fostering top-tier innovative talents, Ministry of Education (MOE, 2023) recently issued *The Opinions of Ministry of Education on Implementing the National Plan for Cultivating Outstanding Primary and Secondary School Teachers* (hereinafter referred to as the National Teaching Excellence Plan). The document points out that, beginning in 2023, MOE will support high-level universities, represented by those in the Double World-Class Project, to select students with excellent academic performance and a passion for teaching as graduate students under the National Teaching Excellence Plan. While strengthening their discipline-specific curriculum, they will systematically study modules in teacher education (including participating in educational practice) to provide a group of excellent teachers to primary and secondary schools. MOE seeks to educate those who have a profound dedication to education, exceptional professional competence, and solid teaching skills to become potential teachers for primary and secondary schools.

Currently, there are over 700 institutions offering teacher education programs in China. However, the proportion of high-level institutions, particularly comprehensive and technical universities, is not high. According to MOE, the volume of teacher education is substantial, but the discipline structure and training levels need optimization. Training graduate student under the National Teaching Excellence Plan should be an important task for universities in the Double World-Class Project, starting with pilot projects and continuing to scale. The first batch of pilot projects supports 30 Double World-Class universities such as Peking University, Tsinghua University, Fudan University, and Shanghai Jiao Tong University. Each year, each university will select no less than 30 additional outstanding science and engineering undergraduate students through recommendation and selection to pursue master's degrees in science and engineering or education. On the other hand, these universities also carry out a second-round selection among current on-campus science and engineering graduate students from other faculties and departments to be trained to become high-quality science teachers for primary and secondary schools. Qualified non-education major candidates will be evaluated based on their academic performance and interviews.

In training graduate students, universities participating in the National Teaching Excellence Plan systematically provide modules in teacher education, either independently or in collaboration with regular universities (MOE, 2023). These modules typically include a minimum of 18 credits covering pedagogy, psychology, teaching of primary and secondary school courses, and the history of science and technology. Additionally, students are required to complete at least eight credits in educational practice. This comprehensive approach aims to enhance professional competence and foundational teaching skills. The universities develop teacher education preparatory courses for graduate students enrolled under the National Teaching Excellence Plan through recommendation and exemption. These courses guide students to start their learning journey from the fourth year of undergraduate studies, utilizing both online and offline methods. High-level universities are encouraged to offer elective courses in teacher education to all students. Additionally, credits earned in teacher education courses during the undergraduate stage of the National Teaching Excellence Plan graduate students can be applied towards related modules in their graduate training. Graduate students involved in the graduate teaching support team as part of the plan will have their teaching practice credited towards the educational practice component in their training.

Moreover, there are mainly four aspects of national policy support. First, they are included in the exemption recognition from the national primary and secondary school teacher qualification examination to obtain the teacher qualification (hereinafter referred to as exemption recognition). Graduate students who have completed the required credits can apply for the primary and secondary school teacher qualification certificate in accordance with the relevant provisions of exemption recognition for education graduate students.

Second, the project attempts to establish a cooperative training relationship between the Double World-Class universities and high-quality primary and secondary schools locally and nationally, so that graduate students under the plan will have a better chance to teach in the related primary and secondary schools when graduating.

Finally, universities covered by the National Teaching Excellence Plan should establish a professional development tracking service mechanism for graduates who become teachers, providing continuous support, especially for graduates under the plan who become teachers to apply for doctoral programs to further enhance their professional level. Local education administrative departments, primary and secondary schools should create favorable conditions to support graduate students under the Plan to innovate in teaching and formulate a 5-year cycle professional development support plan. For example, they could arrange priority participation in national-level teacher training, support management position training, to help graduate students under the plan grow fast into leading talents in primary and secondary education, take up leadership positions in primary and secondary schools, and lead local basic education reform and development.

Wen (Xinhuanet, 2023) from Peking University commented that it is an important milestone in promoting the openness of teacher education and the cultivation of high-caliber teachers, and it has foundational and strategic significance for the implementation of science education to promote national scientific and technological innovation. He believes that the plan transformative initiatives in teacher education in China. First, it encourages high-level universities to engage in teacher education, marking a departure from the tradition of normal universities exclusively providing teacher training. This shift aligns with global trends, enriching training models and elevating the quality of teachers. Notable universities like Peking University and Tsinghua University are among the first 30 pilot institutions. Second, the plan supports dual graduate degrees, allowing graduate students to pursue a Master of Education alongside their primary degree, fostering a comprehensive improvement in teacher training quality. Third, it facilitates a “second selection” process for mature undergraduate and graduate students, aiming to enhance the quality of prospective teachers and professional degree education. Finally, the plan emphasizes the focus on training science teachers, addressing the shortage of high-level science educators and aligning with strategic goals for scientific and educational strength. The National Teaching Excellence Plan emerges as a strategic and innovative approach to elevate teacher education in China.

Wang Linyuan, the party secretary of the School of Education (SOE) at Shanghai Jiao Tong University (SJTU), reported that as a pioneer of teacher education in high-level comprehensive universities, the SOE at SJTU was established in November 2020 (Banyuetan, 2023). The SOE takes it upon itself to cultivate outstanding teachers for the future and has conducted some practices in teacher education. Regarding the curriculum, system, and model, the SJTU Solution has been explored and formed a pioneering “3 + 3” teacher education training model and constructed a system of joint cultivation by universities and high schools. The first “3” represents the three-way integration of the School of Education, the academic faculties from different disciplines, and the practice base among top high schools. The second “3” represents the collaborative efforts of educational mentors, subject mentors, and practice mentors in jointly nurturing students and providing coordinated guidance. Specifically, during the two and a half years of master’s study, the SOE offers courses related to education, while other faculties in SJTU will teach professional courses in subjects like mathematics, physics, chemistry, and biology. Students will also undergo training in teaching skills at high school practice sites.

Unlike normal universities (or teachers’ colleges), SJTU implements a full-year education internship, allowing students to fully experience a complete academic year of teaching and management in high schools (Banyuetan, 2023). To cultivate students’ innovative qualities, the SOE also makes full use of the school’s resources, collaborating deeply with the National Double Innovation Demonstration Base—the Student Innovation Center. The school encourages students to participate in interdisciplinary education and practical activities such as science and technology competitions during winter and summer vacations, enhancing their scientific and engineering literacy and cultivating interdisciplinary course design and practical skills.

In summary, the National Teaching Excellence Plan is a strategic plan for overall layout. In the near future, its significance will be increasingly demonstrated in strengthening the construction of the teacher workforce as the most important foundational work in building a strong educational nation and encouraging high-level universities to cultivate high-quality graduate-level teachers for primary and secondary schools, thus allowing excellent individuals to educate even more outstanding ones and to solidify the foundation for cultivating top innovative talents.

### 7.4.2 *Training Professionals at Remote Campus Established by Industry*

Off-campus university operations are increasingly popular in the rapid development of higher education in China and play an indispensable role and influence in the development of professional education. Off-campus university operations, also called branch campuses or satellite campuses, refer to universities establishing branches or institutions outside the city of their main campus and carrying out various educational activities. It is an important characteristic of the spatial layout evolution of higher education in China and an important mode of operation that emerged with the expansion of higher education in the country. Over the past forty years, China's higher education has developed from elitist to mass universal education, reflecting the scale of expansion driven and led by governmental policies.

Since the inception of off-campus university operations in China in the mid-1980s, spanning over four decades, the sector has undergone three significant historical phases: exploratory beginnings, rapid expansion, and subsequent regulatory adjustments, responding to shifts in higher education structure and distribution through multiple policy revisions.

One reason for the continued expansion of off-campus operations was the rising enthusiasm of some developed cities and regions to "thrive the city (or region) with education". Some economically developed cities, in search of new economic growth and increased talent and intellectual support, actively introduced renowned universities to enhance higher education strength by building higher education parks. Off-campus university operations experienced a growth surge, with over two-thirds of off-campus operations established during this period. Off-campus operations during this period were mainly concentrated in Shandong, Liaoning, Guangxi, Guangdong, and other regions. Despite Zhuhai City's unsuccessful attempt to establish Zhuhai University, a few Chinese universities have established branch campus in this region, including Sun Yat-sen University, Jinan University, Beijing Normal University, Beijing Institute of Technology, and Jilin University. Peking University and Tsinghua University also have developed their branch campuses in Shenzhen during this period.

After 2010, with the rise of the internet and other emerging industries, off-campus operations gained further momentum as part of local economic transformation strategies. However, by 2017, issues with this model began to surface, prompting MOE to adopt a more cautious approach. Tightened policies culminated in 2021, which discouraged new off-campus operations across provinces, especially those with undergraduate programs.

Tian and Jiang (2022) have categorized off-site university operation models into generative, segmented and extension models. Generative models involve new institutions with strong independence, segmented models have branches with the same identity as the main campus, and extension models focus on research and high-level talent cultivation. Governance of off-site operations should be differentiated based on partnerships between universities and cities, considering factors like economic development and educational resource distribution based upon the following arrangements. The first type of arrangement is Prestigious universities and famous cities. Such collaborations should be supported as they can enhance local industries and alleviate professional development. Successful models like Harbin Institute of Technology (Shenzhen) show the benefits of integrating with local economies and can guide other universities to follow the pathway. The second type refers to prestigious universities with second and third-tier cities. These require focused supervision and regular assessment due to challenges like management inefficiency and lowered admission standards. The third type is ordinary universities in provincial capitals, which means moving from less developed cities to provincial capitals should be carefully considered as it can dilute a university's reputation and does not necessarily enhance its competitiveness. And the last type involves joint research institutes. This active model needs more systematic standards and clear entry criteria to ensure the effectiveness of the research institutes and their integration with the industry.

In August 2021, MOE (2021) issued *The Opinions on the Setting of Higher Education Institutions during the 14th Five-Year Plan Period*, clearly stating the discouragement and non-support for universities to carry out off-campus operations across provinces, especially putting strict control over ministries and commissions affiliated universities and universities in central and western regions to conduct off-campus operations in eastern regions. This document emphasized a more reginal approach to higher education by MOE.

Off-campus university operations have played an important role in higher education reform and innovation, and in supporting local economic development. They have achieved positive results and, to a certain extent, alleviated the shortage and uneven distribution of higher education resources. Also, off-campus university operations have spurred the growth of Chinese universities by leveraging social resources to increase educational space and enrollment. They have met local needs for economic and cultural advancement, easing the mismatch between the supply and demand of higher education. These operations have not only contributed to local economic stimulation by drawing on the intellectual capital of universities but have also fostered technological innovation and the development of high-tech industries. For example, campuses like Sun Yat-sen University's in Zhuhai have significantly invested in local infrastructure, while Shandong University's Weihai Campus has empowered local tech industries with its academic programs. These initiatives have also been beneficial for the cities hosting off-campus operations, as they often receive an increased share of enrollment quotas, thereby enhancing their educational quality and talent pools. Cities with rapid economic growth but lacking in higher education resources, like Shenzhen, have seen improvements in the quality of education and growth in high-end talent reserves. Moreover, the cultural impact of high-level universities has enriched the cultural landscape and spirit of these cities. Economically developed cities offer universities improved funding and resources, which helps alleviate financial and land constraints faced by these institutions. In return, universities like the Harbin Institute of Technology in Shenzhen contribute to local industries through research and innovation. Local governments support these collaborations by providing policy incentives and institutional conveniences, fostering a symbiotic relationship that benefits both the universities and the localities.

### *7.4.3 Professional Degree Training Based in Hospitals*

A great number of research institutions in various professional fields also offer professional degree training. For example, the Shanghai Mental Health Center (SMHC) offers graduate professional degree programs that are designed to train the next generation of professionals in the field of mental health. The programs integrate academic learning with practical skills, providing students with the knowledge and experience needed to address mental health issues effectively within the community and clinical settings.

SMHC was established in 1935, originally known as the Shanghai Pu Ci Sanatorium. Located in the southwestern suburbs of Shanghai, it was funded by philanthropist Lu Bohong and managed by the Christian church. It was one of the largest and best-equipped psychiatric hospitals in the Far East at the time. The hospital covers an area of about 100 acres, with a building area of about 30,000 square meters. After decades of development, SMHC has now become a top-tier mental health center in Shanghai. It undertakes tasks such as medical treatment, teaching, clinical trials, prevention, rehabilitation, psychological counseling/therapy, and international academic exchanges in mental health. It is the largest mental health institution in the country with the most comprehensive services and leading disciplines. In May 2006, it became affiliated with the School of Medicine of Shanghai Jiao Tong University. SMHC is also the branch of the Shanghai Center for Disease Control and Prevention, the Shanghai Clinical Quality Control Center for Mental Health, the Shanghai Psychological Counseling Training Center, a national clinical trial institution for psychotropic drugs, and a WHO/Shanghai Research and Training Cooperation Center in Mental Health. SMHC has a complete range of clinical departments with strong technical capabilities, mainly diagnosing and treating patients with schizophrenia, mood disorders, organic mental disorders, mental disorders in children, adolescents, and the elderly, neurotic disorders, and drug dependence. The Center has various clinical specialties including general psychiatry, geriatric, rehabilitation, clinical psychology, pediatrics, infectious diseases, and voluntary drug rehabilitation. As of now, SMHC is the one and only Grade III psychiatric hospital in China, demonstrating its outstanding expertise on this professional field.

Apart from clinical services, as one of the most influential psychological counseling centers, the Shanghai Psychological Counseling and Treatment Center also provides psychological counseling services for patients with various psychological disorders and those experiencing psychological distress. The Shanghai Mental Health Hotline (64,383,562) is one of the earliest hotline services in Shanghai. Since December 2008, it has merged with the Shanghai Public Health Hotline (12,320

Shanghai) to form the Shanghai Psychological Aid Hotline (Shanghai 12,320–5), continuing to provide psychological crisis intervention and mental health promotion services to the citizens of Shanghai.

Moreover, the Shanghai Institute of Mental Health was established in March 1981, with 14 research labs including drug dependence, biochemistry, genetics, neuroelectrophysiology, brain imaging, and psychological measurement. It mainly conducts clinical application research in psychiatry. In the past decade, it has won 23 national, provincial, and municipal scientific research awards. Currently, it hosts key medical disciplines in Shanghai, including the Shanghai Clinical Medical Center for Mental Diseases, Geriatric Psychiatry, and Preventive Psychiatry.

As a teaching and research hospital affiliated with the Medical School of Shanghai Jiao Tong University, Fudan University Shanghai Medical College, Tongji University Medical School, and Shanghai University of Traditional Chinese Medicine, the Center offers doctoral and master's programs in psychiatry and mental health, as well as postdoctoral research stations, and master's programs in psychology. It is also a teaching and research site for psychology at Shanghai Normal University and East China Normal University. As one of the WHO Mental Health Research and Training Cooperation Centers, it conducts extensive academic exchanges and scientific research cooperation with psychiatric communities worldwide.

SMHC, affiliated with the School of Medicine at Shanghai Jiao Tong University was established in 1935. It is a top-tier, Grade III specialized psychiatric hospital in Shanghai, responsible for the city's mental health care, teaching, research, prevention, rehabilitation, psychological counseling, and international academic exchanges. In 2011, the Center was authorized to grant a master's degree in psychology, a primary discipline of Shanghai Jiao Tong University, responsible for postgraduate education, management, and discipline development. In 2014, it received an authorization point for a professional master's degree in applied psychology. In 2015, the Center added a doctoral program in Neuroscience and Psychology, an interdisciplinary subject of Shanghai Jiao Tong University. In 2018, the Institute of Psychology and Behavioral Sciences at Shanghai Jiao Tong University was officially approved for establishment. In 2020, it received an authorization point for a doctoral degree in psychology, a primary discipline of Shanghai Jiao Tong University. Until now, the SMHC has its complete graduate degree program training system.

The Center has its unique advantages for training professional students. It owns the largest clinical psychological counseling center in China (Shanghai Psychological Counseling and Treatment Center), with abundant clinical resources and practice bases, forming specialized psychological teams in clinical psychology, child and adolescent psychology, crime and addiction behavior, geriatric psychology, and crisis intervention. Currently, the discipline has 15 doctoral supervisors, 17 master's supervisors, 41 lecturers with doctoral degrees or senior titles in psychology or related fields, plus 118 teaching staff. The Center has developed four interdisciplinary centers: Shanghai Key Laboratory of Severe Mental Illness, Shanghai Clinical Medical Research Center for Psychiatric and Psychological Disorders, Shanghai Smart Psychological Assessment and Intervention Engineering Technology Research Center, and WHO Mental Health Research and Training Cooperation Center, leading new models of psychological health services. It conducts long-term research in clinical psychology, basic psychology, and neuroscience, undertaking nearly a hundred national-level research projects and international cooperative research projects, and has received numerous national and provincial-level scientific research awards.

Typically, the professional degree programs at SMHC include rigorous coursework covering a wide range of topics such as clinical psychology, psychiatry, mental health counseling, and psychotherapy. The curriculum is comprehensive, touching upon various aspects of mental health including diagnosis, treatment, and the management of mental disorders. These programs often encourage a multidisciplinary approach, bringing together insights from medicine, neuroscience, social work, and psychology. In addition to theoretical learning, students in the program are usually required to complete clinical rotations or internships. These practical experiences are crucial as they allow students to work directly with patients under the supervision of experienced professionals. This hands-on training is essential for developing the skills necessary to assess, diagnose, and treat individuals with mental health conditions.

The graduate professional degree program at SMHC may also emphasize research, encouraging students to engage in projects that can contribute to the field's body of knowledge. Research components can include thesis work or participation in ongoing studies, which help students develop critical thinking and analytical skills. Graduates of the program are expected to emerge as competent mental health practitioners who can contribute to the well-being of individuals and communities. They are trained to be empathetic, ethical, and knowledgeable professionals capable of addressing a variety of mental health issues with a deep understanding of cultural and societal factors that influence mental health.

The Center has also established long-term scientific research and talent training cooperative relationships with world-renowned universities such as Harvard University in the USA, the University of Nottingham in the UK, the University of Hamburg in Germany, and Deakin University in Australia. The center coordinates annual short-term overseas study funding projects. It has established long-term psychological therapy training programs with international psychological institutions like the International Psychoanalytical Association (IPA), the German Psychoanalytical Association, the Freud Institute in the UK, and the American Group Therapy Association, training many clinical psychology professionals. Currently, the doctoral training directions of this discipline focus on clinical psychology, social psychology and mental health, and cognitive neuroscience.

The aim is to train composite professionals capable of engaging in clinical research, education, and management in government departments, medical institutions, educational departments, communities, psychological counseling, and treatment institutions, and who have good scientific research capabilities. In the past 5 years, the employment (including further study) rate of master's graduates has been nearly 100%, mainly working in clinical, research, education, and management in their respective professional fields.

Besides the professional degree program, entrusted by the Ministry of Health, the Center annually organizes national psychiatric physician and nursing refresher and training courses as part of continuing education programs, training many core personnel in psychiatric medical care and nursing. The Psychological Counseling and Therapy Training Center trains high-quality psychological counselors and therapists nationwide, forming a unique brand. Since 2009, the Center has been one of the first standardized training bases for resident physicians in Shanghai, and it is also affiliated with academic organizations such as the Mental Health Branch of the Chinese Preventive Medicine Association.

In summary, the various research institutes and hospitals strive for their own pathways of professional education by combining cut-edging research method and their years of professional practices in the field, research institutes like SMHC establish their own mode of professional degree education.

## 7.5 Inspiring Stories

### *7.5.1 Wang Weiye: From Advanced Math Research to Inspiring High School Minds*

#### 7.5.1.1 Inspiring Educational Odyssey: From Fudan University to Kongjiang High School

After completing his doctoral degree in Mathematics from Fudan University at the age of 27, Dr. Wang Weiye decided to return to his alma mater, Kongjiang High School, to become a high-school teacher. His former class teacher and distinguished mathematics teacher at Kongjiang High School, Xu Min, was surprised but supportive of his decision (Fudan Alumni, 2022). In his 7 years back at Kongjiang High School, Wang Weiye has served as the head teacher of the innovation class and has taught two senior-grade classes. Students admire him for his ability to solve any math problem, and parents are grateful for teaching their children more than just how to take exams, whereas Wang's goal is to help his students recognize the true beauty of mathematics.

Wang Weiye's aspiration for teaching continues to grow strongly. For Wang Weiye, this is his deepest realization as a student: teaching students how to learn is far more important than teaching them how to solve problems. His colleague, Ding Changxin, noted Wang's student-centered approach provides valuable growth opportunities for the students, though exhausting for himself. He rarely focused on his students' college entrance exam scores; instead, he remembered how many of them developed a love for mathematics because of his teaching.

In an alumni interview from Fudan University, Wang Weiye shared that his journey from a student at Fudan University's Department of Mathematics to a respected teacher at Kongjiang High School is a testament to his commitment to education (Fudan Alumni, 2022). He recalled his university days with a sense of ordinary yet profound experiences, valuing the strong instruction and the camaraderie of dorm life at Fudan. The valuable lessons learned from his university professors have shaped his own teaching philosophy, which is characterized by patience, clarity, and a willingness to accommodate students' needs.

After receiving his doctorate, Wang chose to return to his alma mater, Kongjiang High School, influenced by his former teachers and driven by a desire to contribute to the next generation. His decision to teach at a high school, though unusual for a Ph.D. graduate back then, is a heartfelt tribute to his educational roots and a determination to give back to his community.

#### 7.5.1.2 Embracing the Change: The Future of High School Innovation for Teaching

Nonetheless, Wang's perspective on the teaching profession is realistic, acknowledging the slow salary growth and the challenges of industry transition, yet he remains passionate about the intrinsic value of teaching (Wenhuibao, 2017). His advice to those aspiring to be teachers is to stay abreast of technological trends and to understand the realities of the profession through firsthand experience. He suggests that maintaining a learner's curiosity and the ability to embrace new tools are crucial for success in the evolving landscape of education.

He says: "You need to adapt to the trends of the times and cultivate and exercise a curiosity and ability to learn new things. For instance, 20 years ago, there were probably few teachers who knew how to use PowerPoint (PPT), but now, it is almost unthinkable to find a teacher who can't use it. In fact, PPT is just one example; it represents new things and technologies that will appear in teaching. In the future, we are likely to encounter many technologies that we can't even imagine right now, so our ability to learn new things and technologies is crucial".

Jiang Mingyan, the principal of Kongjiang High School, says that in the past 5 or 6 years, the school has already hired about ten Ph.D. graduates as front-line teachers (Wenhuibao, 2017). In the past, the school relied on "emotional retention" and "compensation retention", but it should focus on "cultural retention", creating a good campus culture, and providing platforms and channels for young teachers to grow. This is the real way to attract talented individuals who are passionate about the teaching profession. On this, Jiang Mingyan believes that highly educated individuals are not necessarily good teachers. Rather, he believes that a qualified teacher needs not only a good professional foundation but, more importantly, a positive educational value orientation. He said, "What makes Wang Weiye special is that, in addition to having a high level of professional mathematics, he has his own unique understanding and commitment to education. What the teaching staff really needs are individuals who are truly passionate about education".

## 7.5.2 *Zhuang Shen: Integrating the Boundary of Practice and Theory as an Architect*

### 7.5.2.1 Architectural Journeys: The Path of Zhuang Shen from Tongji University to Global Recognition

Zhuang Shen is a professor at the School of Design, Shanghai Jiao Tong University, and serves as a co-founder of the Shanghai Atelier Archmixing Architectural Design Co., Ltd. Zhuang Shen devotes all his life to architecture. From September 1989 to July 1994, he attended the College of Architecture and Urban Planning at Tongji University, where he pursued my undergraduate studies in Architecture. From September 1994 to April 1997, he continued at the College of Architecture and Urban Planning at Tongji University, working towards the master's degree in Architectural Design and Theory. After graduation, he worked as an architect at the Architectural Design and Research Institute of Tongji University from April 1997 to January 2001. Later, from January 2001 to July 2009, he was a founding partner and lead architect at the Shanghai DASHE Architecture Design Firm. Since July 2009, he has been serving as a founding partner and lead architect at the Shanghai Atelier Archmixing Architectural Design Co., Ltd.

Interestingly, Zhuang Shen does not hold a Ph.D. degree, when it is typically required for professorship at top-tier universities. However, he has attained remarkable success in the architecture industry both domestically and globally. He has received more than 20 awards of various kinds at both international and domestic levels. Among these, there are five major international awards, including the Royal Institute of Chartered Surveyors' Outstanding Achievement in Construction Management Award, and the DFA Asia's Most Influential Design Award, among others. There are also 16 major domestic awards, including the Third China Architectural Society Excellent Architectural Creation Award, Ministry of Construction Annual Excellent Survey and Design Award, etc. Moreover, he has his unique understanding of professional education in architecture (LinShi, 2020). As a professor, Zhuang Shen believes that when exploring the gist of education, the most important thing has always been to help students discover themselves (Sohu, 2017).

### 7.5.2.2 Architectural Self-Discovery: Zhuang Shen's Perspective on Education and Professional Growth

In an interview, Zhuang Shen recalled his educational training and the transitions to work. He said that in the era when he graduated, university architectural education needs to be better aligned with professional demands (Sohu, 2017). Young university students have advantages in design modeling, and the skills needed for construction drawings can be self-taught through work. Therefore, they often perform well in their jobs.

Zhuang Shen has experienced rapid growth through hands-on learning. After working at the design institute for 3 years, he was fortunate enough to have completed several projects. Hence, when he later left the institute to cofound his own design company, he was able to handle engineering issues smoothly and with composure. He believes the environment for today's architecture students has changed; there's also a significant "inflation" of various procedural standards in the architectural design industry. Therefore, it is more difficult for young architects to start their own practices nowadays.

However, the increased demands of the industry should not be the main reason for any disconnect between educational and professional integration. Zhuang Shen emphasizes that students should learn to discover and understand their own characteristics during educational and professional training—What kind of thinking do you like? Which thinking are you best at? Can you freely apply this way of thinking? These questions are beneficial for future professional development or employment itself. Meanwhile, basic functional training does not imply homogenized results; in fact, it relates to each student's different backgrounds and personal characteristics (Sohu, 2017).

After years of practices in the professional fields as well as teaching in the higher education institutions, Zhuang Shen consider all education that can produce such results to be good (Sohu, 2017). Regardless of whether it is the more traditional educational system of his own era or the more diversified education and learning methods of today, their purpose should be to discover the most suitable design method for oneself. Essentially, learning is not about emulating others, but about discovering oneself. Today, with so much available to learn, should people try to learn everything? He insists that it is impossible. If there is anything that can be learned, it is through learning from others that we trigger our own thinking, find ourselves, identify what we are most accustomed to doing, and what we are most capable of doing, which is the most crucial cycle of teaching and learning.

## 7.6 Latest Research

This section examines studies about professional education within China over the past 2 years from the China National Knowledge Infrastructure (CNKI) platform. An advanced search is conducted using (professional degree OR professional education) as key search terms. To ensure the selected literature met quality and relevance standards, journals indexed in the China Social Science Citation Index (CSSCI) were chosen. The latest publications from the years 2022 to 2023 were reviewed.

Figure 7.5 summarizes the primary themes related to professional degree or professional education. The horizontal axis lists various themes such as professional degrees and Graduate education among others. The vertical axis represents the count of the primary themes among the selected publications. The figure shows professional degrees appears to be the most frequent theme, with a count exceeding 30, while other themes like full-time education and practical exploration are among the

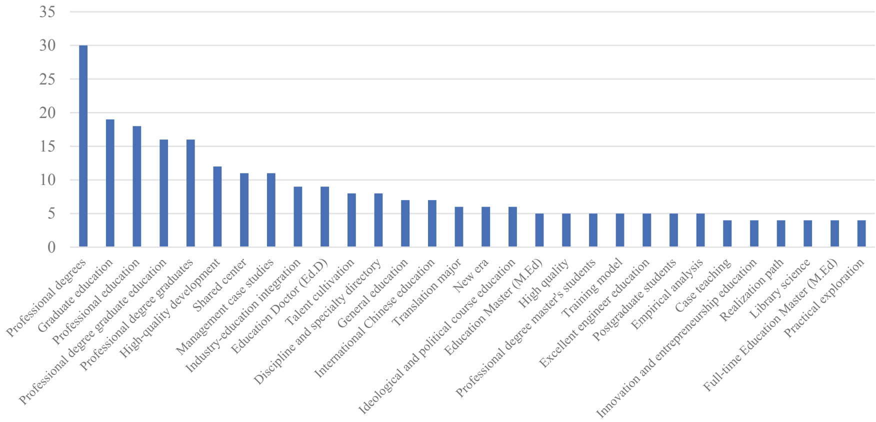


**Fig. 7.5** Publications distributed by primary theme

least frequent, with counts close to or at 5. This suggests a significant emphasis on professional degrees in the given context.

Figure 7.6 depicts a wide range of subject areas covered in selected published articles, with higher education being the most prominent subject with 346 articles. Other notable subject areas include educational theory and management, Chinese language and literature, and library information and digital libraries, each with counts ranging from 30 to 35 articles. Subjects like music and dance, publishing, fine arts, calligraphy, sculpture, and sociology and photography show moderate frequency, with counts between 10 and 23. Lesser covered subjects include vocational education, computer software and applications, and medical education and engineering, among others, with counts ranging from 5 to 9. The chart indicates diverse academic interests with strong emphasis on educational topics. By taking a closer look into the selected articles, four themes emerge as follows.

### *7.6.1 Exploration of Training Modes for Professional Degree Programs*

The recent body of literature has provided critical insights into various aspects of professional degree programs including curriculum setup, evaluation methods, and integration mechanisms with the industry. For example, Li et al. (2023) scrutinized the self-assessment procedures of several educational master's programs, pinpointing issues such as an overemphasis on qualifications and insufficient collaboration. They

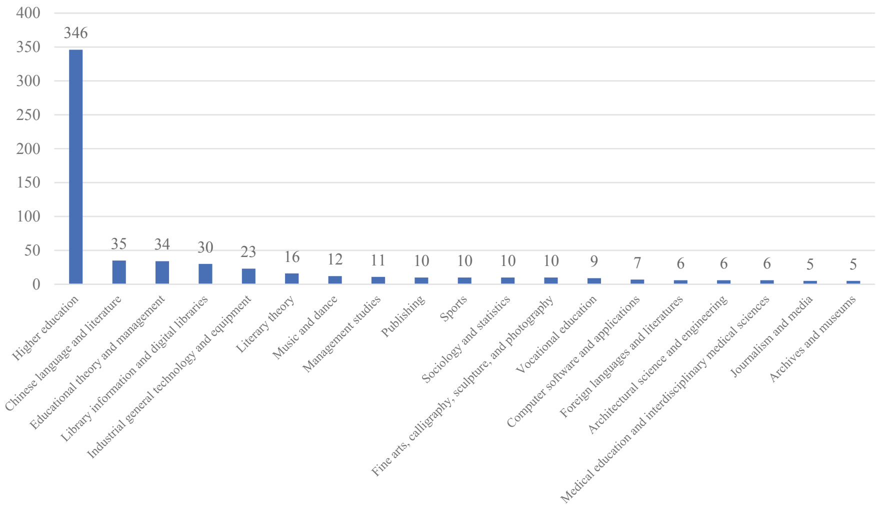


**Fig. 7.6** Publications distributed by subject area

proposed a shift towards developmental assessments and enhanced feedback mechanisms. Meanwhile, Wang and Wei (2023) examined the bidirectional internationalization of professional degree programs at the University of Science and Technology of China, particularly the MBA program, detailing successful internationalization efforts and implications for wider educational reform. Li and Yan (2022) advocated for a balanced approach to professional degree education, merging vocational and academic aspects to meet modern workforce demands. This called for adjustments in degree frameworks and curricula. Yang (2023a) delved into the high-quality development of professional degree education, stressing innovation and a "trinity" educational philosophy for comprehensive reform. Hua (2022a) discussed the growth and diversification in China's professional degree offerings over three decades, urging the integration of industry and education and calling for an overhaul in the approach to applied talent training. Zhang et al. (2023) highlighted France's successful professional degree model, emphasizing the need for expansion and deeper industry-education integration in China. It showcased the Science and Technology Courtyard model as a new paradigm for cultivating applied talents in agricultural sectors, stressing the importance of practice communities. Additionally, Yang et al. (2023) explored a cooperative education model between universities and enterprises that blends theoretical and practical learning for professional students.

Hua's (2022b) research on the expansion of professional master's degree programs showed a positive correlation with human capital accumulation, suggesting an optimal ratio for professional to total master's enrollments. Xiong et al. (2023)

described a curriculum development model at the South China University of Technology that responds to national needs and industry standards for engineering graduate students. Lastly, He et al. (2023) analyzed the characteristics of national professional degree level evaluations, emphasizing the need for moral education integration and demand-oriented training to guide institutions in strengthening their self-assessment capabilities. These contributions collectively underscore the ongoing evolution and the critical need for reform in China's professional degree graduate education.

### *7.6.2 Professional Degree Training Models by Discipline*

Many studies have also been conducted on specific professional degree graduate education in China, reflecting a concerted effort to address the evolving needs of various professional fields and to align educational outcomes with industry requirements.

Li's (2022) research provided a thorough analysis of the synergistic relationship between industry demands and graduate education. By proposing a collaborative training system for materials and chemical engineering students, the study emphasized the need for a curriculum that is responsive to the dynamics of industry trends. The successful application of this model at the case university serves as an exemplary case study, showcasing the benefits of such integration, including enhanced employability and practical skill development for graduates. Lin et al. (2022) represented a significant stride in engineering education reform. They outlined a comprehensive strategy that hinges on Shanghai Jiao Tong University's alignment with industry needs, thus reshaping the talent development landscape. The university's three-dimensional reform approach, which restructures training programs, processes, and platforms, is not just a pedagogical shift but also a strategic move to position the institution as a key player in supporting the nation's engineering prowess. Han (2022) took a macroscopic view of the role of engineers in national development. By leveraging the Harbin Institute of Technology's model, Han advocated for a paradigm shift in engineering education. This reform was not merely academic but is also seen as a crucial element in the broader context of technological innovation and the evolution of human civilization. Yu et al. (2022) delved into the oft-overlooked educational value of horizontal scientific research projects. These projects are pivotal in the context of professional degree education, especially for engineering students, where the gap between theoretical knowledge and practical application can be significant. The call for enhanced recognition of such projects within university research evaluation systems underscores the paper's relevance.

Wu and Gao (2023) identified the challenges and prospects of training publishing professional masters. They shed light on the outdated educational models and advocates for a reform that brings students closer to the realities of the publishing world. Their proposed solutions aim to revitalize the curriculum with practical scenarios and collaborations with publishing enterprises, ensuring that graduates are not only academically equipped but also industry ready. Hu et al. (2022) described a pioneering educational model implemented at Nanjing University of Finance and Economics. Here, a "full-process collaborative empowerment and dual-system integration" model is dissected, showing how it melds theoretical learning with practical application, thus forging finance and economics professionals who are adept and responsive to the demands of a dynamic career landscape. Hua et al. (2022) critically assessed the teaching practice abilities in full-time Master of Education students. The research highlighted the innovations at East China Normal University and discusses how practical teaching can be enhanced through more effective theoretical support. This research is vital for its insights into the pedagogical frameworks that can better prepare education graduates for the complexities of modern teaching environments. Tang and Peng's (2022) investigation into the comprehensive quality of full-time Master of Education students was a significant contribution to the field. Through surveys and interviews, the paper identified gaps in teaching ability, research capability, and professional ethics. The study is notable for its actionable recommendations that can significantly elevate the standards of education master's programs.

Chen and Li (2022) examined the evolving landscape of digital publishing education. As digital publishing becomes increasingly central to the cultural industries, the authors argued for a reimagined approach to talent cultivation that meets the sector's burgeoning needs. They proposed new education models and strategies that not only serve the industry but also contribute to cultural development and national progress. Hu (2022) explored the training models for finance and economics professional master's degree students, reflecting on the challenges of creating highly specialized, application-oriented talents. The paper emphasizes a "full-process dual-system" training model that seeks to blend academic knowledge with practical skills, aiming to produce graduates who can navigate the complexities of the financial sector effectively.

Together, these studies form a comprehensive body of work that not only highlights the current state of professional degree graduate education in China but also create a vision for the future. They advocate for innovative educational models, deep industry linkages, and reforms that prioritize the development of practical skills and industry readiness among graduates. These contributions are crucial for informing policy, guiding educational reform, and shaping the development of professional degree programs that are attuned to the needs of both students and the industries they will enter.

### *7.6.3 Professional Doctorate Training Paths, Trends, and Challenges*

Another comprehensive collection of research articles offers an in-depth exploration into various facets of professional doctoral education in China, covering a wide range of disciplines and perspectives.

Han and Luo (2022) highlighted the dual benefits of professional doctorates in career development—enhancing human capital and serving as a status symbol. Zheng (2023) emphasized the need for professional doctoral programs in fine arts that balance practical skills with academic knowledge. Zhai et al. (2022) reviewed two decades of the literature to trace the evolution of professional doctoral education, identifying trends and future research directions. Yu and Cao (2023) compared the operational mechanisms of Engineering Doctorates in China and the U.K., suggesting China learned from the U.K.'s collaborative models. Mu and Liu (2022) called for doctoral programs in translation to adopt interdisciplinary and industry-aligned approaches. Shen and Xia (2022) critiqued China's Doctor of Education degree standards, advocating for reforms that match the sector's needs and highlight practical skills. Wang and Li (2022) analyzed Harvard's doctoral programs, focusing on how their dual-track system encourages innovation. Yang's (2023b) study on China's doctoral education reforms proposed changes to address imbalances and quality issues, aiming to align with national and global needs. Finally, Zuo and Li (2023) examined the divergence between China's Ed.D. and Ph.D. programs, suggesting a need for more practical focus in Ed.D. programs and advocating for reforms that consider the unique contributions of both academic and practical orientations in doctoral education.

Together, these articles present a rich tapestry of research and analysis on professional degree doctoral education in China, offering valuable insights into its evolution, current state, and future directions. They address a range of themes, from the impact of doctoral education on career development and the cultivation of fine arts doctorates, to comparative studies of operational mechanisms and curriculum design in different countries. These contributions are crucial for informing policy, guiding educational reform, and shaping the development of professional degree programs that are attuned to the needs of both students and the industries they will enter.

The literature suggests that candidates for a professional doctorate should possess both professional experience and academic foundations. This combination is essential for deeply understanding and engaging with the complexities of professional work. The curriculum for professional doctorates often includes modules on core subjects, research methods, electives, and seminars on cutting-edge issues, focusing on the interplay and integration of academic and professional knowledge. The role of the professional doctoral thesis is emphasized as a demonstration of the candidate's research capability, combining academic innovation with professional practice. Quality assessment in professional doctorate education looks at both the academic and professional levels, evaluating the candidate's ability to innovate within their field and their potential for employability and problem-solving.

In summary, the professional doctorate aims to bridge the gap between theoretical knowledge and practical application, producing professionals who can contribute significantly to their fields with innovative solutions to complex problems. These goals are achieved through a carefully structured educational process that combines academic rigor with practical experience.

### *7.6.4 Responsibilities of Mentors, Enterprises, Practical Training Bases, and Universities in Professional Education*

This collection of academic research offers a profound examination of various aspects of professional degree graduate education, delving into the challenges, intricacies, and proposed reforms across different fields and aspects of this educational sector.

The study by Wang and Yang (2022) presented an in-depth analysis of the complex role of external practice supervisors in professional degree graduate education, utilizing Commons' institutional theory to dissect the inherent conflicts, dependencies, and order that characterize these roles. The article not only highlighted the multifaceted nature of the supervisors' roles but also the governance challenges they face due to conflicts of interest and multiple role identities. To harmonize these conflicts and enhance the effectiveness of supervision, the study suggested a mix of collective action governance for resolving transaction conflicts and hierarchical governance for maintaining transaction scarcity value and efficiency.

Yang and Shi's (2023) research explored the quality evaluation of practice sites for professional degree graduate students, a critical component in developing practical skills essential in professional settings. Employing qualitative methods and the analytic hierarchy process, the study develops a comprehensive quality evaluation method that aligns with the goals of moral education and practical ability development. This research provides a nuanced understanding of the role of these practice bases and offers a valuable reference for higher education administrators to enhance the quality of these crucial training grounds.

Xu and Wei (2023) found that non-academic sectors highly value practical skills and innovation in Ph.D. graduates, suggesting a need for doctoral programs to incorporate practical training to enhance employability. Wang and Wei (2023) explored the challenges of integrating industry and education in professional training, noting enterprises' low engagement. They recommend a strategic approach including policy support to improve industry-education collaboration and ensure professional education's relevance. Zhang et al.'s (2022) work on developing on-campus internship sites for Master of Translation and Interpreting (MTI) students addressed the limitations and challenges of off-campus internships. The paper proposed principles of authenticity, correspondence, and localization for constructing effective on-campus bases, advocating for a comprehensive approach involving various internship positions, content, forms, and effective management and assessment systems. The involvement of professional organizations in these processes is underlined as crucial for ensuring the relevance and quality of internships.

In summary, these articles provide a deep dive into the nuances of professional degree graduate education, addressing a range of challenges from the governance of external supervisors to the development of effective internship programs. They offer insights into the current state of professional education and propose innovative solutions and reforms aimed at enhancing its quality, relevance, and alignment with industry needs. These contributions are invaluable for educators, policymakers, and industry professionals involved in shaping the future of professional degree graduate education.

## 7.7 National Policies

### *7.7.1 Standardizing the Training Mode for Professional Education Against Academic Education*

The directive underscores the commitment to embody the principles outlined by the 20th National Congress of the Communist Party of China and instruction on education from General Secretary Xi Jinping. The goal is to elevate the development and innovation of both academic and professional degree postgraduate education, concentrating on the superior cultivation of exceptional innovative talents and establishing a distinguished postgraduate education framework.

The approach emphasizes the equal significance of academic and professional degree postgraduate education and improving the autonomous cultivation of top-tier innovative talents. The principles focus on addressing key developmental issues, respecting educational laws, ensuring reform effectiveness, and innovating mechanisms within training institutions.

The overarching objective is to refine the internal mechanisms that support the distinct development and integrated innovation of both types of postgraduate education by 2027. This will result in an enhanced training quality for both academic and practical innovative talents, a more advanced governance system, and increased governance capabilities, thereby contributing significantly to the establishment of a strong educational nation. To streamline the approach towards postgraduate education in China, there is an emphasis on maintaining equal importance between academic and professional degree programs. Both avenues are critical for nurturing high-level innovative talents, and the focus should be on a robust foundational theory, specialized knowledge, and innovation on the following aspects including equal importance and balanced development, strategic planning, development targets, talent selection mechanisms, training programs, and textbook construction. The overarching objective is to achieve a balanced progression in both academic and professional postgraduate education. This progression aims to meet the nation's talent requirements and contribute to establishing a formidable education nation.

### *7.7.2 Expanding Professional Degree Education Compared to Academic Degrees at the Graduate Level*

*The Developmental Plan for Professional Graduate Degree Programs (2020–2025)* was released by the Degrees Committee of the State Council and MOE (2020). It aims to significantly increase the proportion of professional degree postgraduates. By the end of the 14th Five-Year Plan period, the target is for about two-thirds of all master's postgraduate enrollments to be in professional degree programs, with a notable rise in doctoral professional degree postgraduates as well. This initiative emphasizes the equal importance of both academic and professional degrees in cultivating high-level innovative talents and insists on giving both types of degrees equal attention in the development process.

The issuance of the Plan is a response to the demand for high-level applied specialized talents and aims to address current shortcomings in professional degree postgraduate education, such as the lack of diversity in degree categories, insufficient flexibility in setting these categories, and the need for more innovation in training models. Additionally, the development of doctoral professional degrees is seen as lagging, with an insufficient number of authorization points and a small scale of training.

Professional degree programs are to be more demand-oriented, with new master's degree-awarding bodies focusing predominantly on professional education. The directive also outlines the need for a deep integration of teaching and practical application across both academic and professional degrees. For academic degrees, the focus is on theoretical knowledge and interdisciplinary studies, while for professional degrees, it emphasizes vocational applicability through case studies, internships, and real-world problem-solving.

Ren Youqun, the former Director of the Degree Management and Postgraduate Education Division of MOE, highlighted the need to reverse the notion of academic degrees being more prestigious than professional ones. The recent expansion in the scale of professional degrees, which now represent over half of all degrees awarded, reflects China's commitment to developing a dual structure in postgraduate education that values both academic inquiry and professional application.

The document underscores the classified development of both degree types, with specific recommendations for admissions, training programs, and evaluation methods that reflect the distinct needs of each pathway. For academic degrees, the enhancement of foundational theory and original research is prioritized, whereas professional degrees are steered towards meeting industry requirements and practical skills.

Reforms are guided by a focus on basic discipline training for academic degrees, aiming to nurture future academic leaders, and a focus on engineer training for professional degrees, aligning with national strategic needs. The efforts mark a significant push towards qualitative improvements in China's postgraduate education system, enhancing its contribution to the country's high-quality development and international competitiveness.

In response to these employment patterns, MOE is taking steps to diversify and improve doctoral training. This includes legally defining separate degree requirements for academic and professional doctorates, expanding professional doctoral degrees in various disciplines, and increasing the enrollment numbers for professional doctorates. MOE also plans to optimize the discipline layout for professional degrees, enforce differentiated standards for academic and professional doctorates, and integrate doctoral education with research and industry sectors.

Additionally, MOE will focus on implementing the document as a key approach, continuously optimizing the professional layout of disciplines, strengthening the differentiated requirements for the two types of degrees in positioning, standards, enrollment, training, evaluation, faculty, and other links, strengthening classified review and evaluation, deepening reforms across the entire chain, actively promoting the deep integration of the doctoral education system with the scientific research and industrial systems, and shaping new drivers and advantages for development, Ren Youqun stated (China Education Online, 2023).

## 7.8 Summary

Professional education has been gaining increasing attention in higher education in China. This chapter examines the status quo, distribution of disciplines, domestic and global highlighting data, excellence index, three best practices, two inspiring stories, latest relevant research, and national policies of professional education in China.

Starting from the introduction of MBA, China has gradually increased enrollments, graduates, and the scale of professional education at both master's and doctoral levels across diverse disciplines. In comparison with global professional master enrollments, professional education in China demonstrates a relatively high ratio of professional degree against academic degree, demonstrating the promotive effect of related national policies. Furthermore, this chapter implements excellence indices to evaluate professional education, and conducts comparisons among elite universities in China and in the world based on the excellence indices.

Apart from quantitative narratives including highlighting data and excellence indices, the chapter also takes a closer look at three best practices and two inspiring stories, demonstrating the trials and efforts constantly made by researchers and stakeholders to improve the quality of professional education in China.

Last but not least, a comprehensive literature review and examinations of national policies are conducted to reveal the developmental trends of professional education in research and practice. Findings suggest that China has been and will be investing more to expand the scale of professional education and striving to find the optimal pathways to train students.

To conclude, China has witnessed noteworthy accomplishments in professional education, producing a multitude of skilled professionals across diverse sectors. The nation, along with its universities and colleges, plans to continue investing in the enhancement of professional education in the future.

# Appendix A

**Table A.1** World top 100 universities' unstandardized performance on excellence indicators

| Institution | Rank | Program N | Faculty-student ratio | Degree ratio | Employment outcome | Employer reputation |
|---|---|---|---|---|---|---|
| Tsinghua University | 22 | 6 | 11.2 | 7.8 | 82.2 | 96.9 |
| Peking University | 29 | 5 | 10.9 | 4.5 | 82.6 | 95.4 |
| Zhejiang University | 33 | 7 | 12 | 1.3 | 37.7 | 95.7 |
| Shanghai Jiao Tong University | 46 | 7 | 12.6 | 3.0 | 55.5 | 83.3 |
| Fudan University | 56 | 5 | 11.9 | 2.1 | 49.6 | 89.8 |
| University of Science and Technology of China | 64 | 4 | 8.1 | 2.3 | 24.8 | 17.5 |
| Sun Yat-sen University | 73 | 5 | 15.1 | 1.5 | 16.7 | 22.3 |
| Huazhong University of Science and Technology | 91 | 7 | 15.5 | 1.2 | 16.8 | 29.2 |
| Central South University | 95 | 7 | 20.4 | 0.9 | 9.9 | 3.4 |
| Nanjing University | 96 | 7 | 16.7 | 2.1 | 23.7 | 25.4 |
| *Top 1–5* | | | | | | |
| Harvard University | 1 | 6 | 9.6 | 3.4 | 100 | 100 |

(continued)

(continued)

| Institution | Rank | Program N | Faculty-student ratio | Degree ratio | Employment outcome | Employer reputation |
|---|---|---|---|---|---|---|
| Stanford University | 2 | 7 | 6.4 | 1.0 | 100 | 100 |
| Massachusetts Institute of Technology | 3 | 5 | 8.2 | 2.0 | 100 | 100 |
| University of Cambridge | 4 | 6 | 11.5 | 1.8 | 100 | 100 |
| University of California, Berkeley | 5 | 6 | 18.4 | 3.8 | 98.7 | 100 |
| *Top 21–25* | | | | | | |
| University of California, San Francisco | 21 | 1 | NA | 4.3 | NA | NA |
| Tsinghua University | 22 | 6 | 11.2 | 7.8 | 82.2 | 96.9 |
| Imperial College London | 23 | 4 | 11.2 | 16.6 | 83 | 99.4 |
| University of Toronto | 24 | 7 | 25.8 | 3.4 | 96.4 | 96 |
| Washington University in St. Louis | 25 | 6 | 7.8 | 0.3 | 33.7 | 10.4 |
| *Top 76–80* | | | | | | |
| University of Groningen | 76 | 5 | 28.8 | NA | 22.3 | 29.9 |
| Monash University | 77 | 7 | 42.5 | 4.8 | 61 | 75.2 |
| Aarhus University | 78 | 7 | 13.5 | NA | 45.1 | 24.7 |
| Technion-Israel Institute of Technology | 79 | 1 | 21 | NA | 30.7 | 27.8 |
| The University of Texas M. D. Anderson Cancer Center | 80 | 1 | NA | NA | 70 | 83.2 |
| *Top 96–100* | | | | | | |
| Nanjing University | 96 | 7 | 16.7 | 2.1 | 23.7 | 25.4 |

(continued)

(continued)

| Institution | Rank | Program N | Faculty-student ratio | Degree ratio | Employment outcome | Employer reputation |
|---|---|---|---|---|---|---|
| Purdue University - West Lafayette | 97 | 5 | 16.9 | 2.7 | 53.4 | 81.2 |
| Brown University | 98 | 5 | 10.3 | 3.5 | 74.8 | 42.4 |
| McMaster University | 99 | 3 | 29 | NA | 37.2 | 38.2 |
| Stockholm University | 100 | 4 | 20.3 | NA | 76.2 | 15.2 |

*Notes* All reported data were obtained from the official websites of the universities. N/A suggests that the data were not reported by the source websites

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# Chapter 8
# Vocational Education in China

**Yu Tianzuo, Yan Xiaomei, and Jin Yuqi**

**Abstract** Vocational education, the form of education most closely aligned with the working world, has become a strategic choice for countries worldwide. This chapter provides an overview of vocational education in China. This chapter first selects representative data and excellence indicators to illustrate the basic features and developmental trends of secondary vocational education in China compared to major global counterparts. Secondly, it shares the Ministry of Education's efforts in promoting the digitization and standardization of Vocational education and local governments' initiatives in fostering industry-education integration. The compelling cases are presented to show vocational education and its roles in fostering personal growth and societal advancement. The chapter also shares narratives of exemplary "dual qualified" teachers and their contributions to teaching, research, and service. In addition, this chapter reviews the recent research trends of vocational education research in China in the past 5 years and the key policies shaping China's vocational education. Overall, the Chinese government has established a relatively comprehensive vocational education system. This chapter also discusses some challenges, such as funding constraints, teacher shortages and qualifications, the property rights of digital resources, infrastructure needs for industry-education integration, and the stigma of vocational education.

**Keywords** Vocational education · Industry-education integration · Teaching resource databases · *Vocational education law* · Dual qualified teachers introduction

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## 8.1 Introduction

### 8.1.1 *Developing Vocational Education as a Key Priority in National Policies*

Enhancing vocational education stands as a pivotal strategic imperative for nations globally, given its direct alignment with the demands of the contemporary workforce. As for its close links to real-world professions, vocational education is instrumental in addressing a myriad of challenges of today's society, contributing to the world's sustainable development. For example, the U.K. government has recently invested £400 million to fund 62 continuing education schools to build and improve their infrastructure and create more associated jobs across the country (Department for Education, 2022). In Germany, a national continuing education strategy was adopted by the federal government and its organizations, states, industries, and trade unions (Bundesministerium für Bildung & Forschung, 2023).

Without exception, the Chinese government has attached great importance to vocational education, elevating its role in socioeconomic development as well as education reform and innovation. Over 70% of students in vocational education come from the rural areas (MOE, 2023a). "One person in vocational education means one person employed and one household lifted out of poverty" (People's Daily, 2021). Vocational education has proved to be the most effective means to prevent poverty against intergenerational poverty within a household, playing a crucial role in China's efforts to fight the hard battles against poverty and in pursuit of a moderately prosperous society for all. Vocational education has assumed the important task of cultivating diversified talents, developing technical skills, and promoting employment and entrepreneurship. Its contributions extend to supporting the transformation and modernization of Chinese manufacturing, developing the national industrial landscape, improving services, and safeguarding people's livelihoods (MOE, 2023a).

### 8.1.2 *Vocational Education Development in China*

Vocational education in China can be traced back to ancient times. Time-honored apprenticeships used to take the form of passing skills from father to son, or from master to apprentice based on contracts or sectors. As early as the mid-1990s, to seek self-strength and prosperity in China, a group of people of vision created the Fujian Shipbuilding Academy, marking the formal commencement of modern vocational education in China (*ibid*).

China's vocational education has actively adapted to the needs of socioeconomic development. It places equal emphasis on both formal schooling and vocational training, promoting a horizontal integration of vocational education with general education. This approach has also accelerated the building of a modern vocational

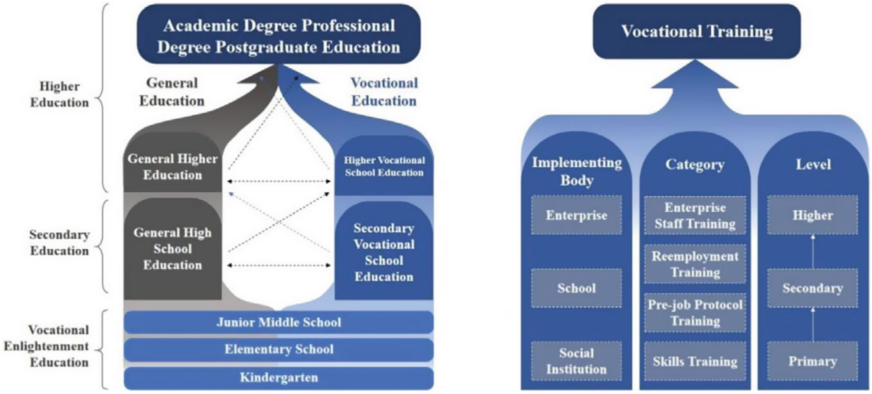


**Fig. 8.1** Modern vocational education system *Source* MOE (2023a)

education system designed to support lifelong learning for all (Fig. 8.1). Vocational education includes vocational enlightenment education, secondary vocational education, and higher vocational education. Vocational training covers various types including skills training, pre-job protocol training, reemployment training, and staff training among others. Based on the standards of vocational skills, vocational training falls into the levels of elementary, secondary, and higher vocational training and other adaptive training. Enterprises, schools, and social organizations all contribute to providing vocational training (*ibid*). This chapter focuses on vocational education, including secondary vocational education and higher vocational education.

Secondary vocational education is provided by general secondary schools, secondary schools for adults, higher vocational schools, and technical schools, which mainly admit junior middle school graduates or people with corresponding educational backgrounds. The length of education is typically 3 years. Graduates of secondary vocational schools can continue to receive a junior college education, undergraduate education, and post-graduate education.

Higher vocational education includes junior college education, undergraduate education, and beyond. It mainly admits graduates of secondary vocational schools, general senior high schools, and those with corresponding educational backgrounds. The duration of education at this level is generally 3 years for junior colleges and 4 years for colleges.

### *8.1.3 The Current Status of Vocational Education in China*

Currently over 4,500 secondary and higher vocational schools have supported primary and middle schools in carrying out technical education and practice as well as vocational enlightenment education. Nearly 110,000 primary and middle schools have been involved, with the participation of over 15 million students every year (*ibid*).

In 2022, there were altogether 7,201 secondary vocational schools (excluding technician training schools) in China. The number of newly admitted vocational students was 4.85 million and the total number of vocational student enrollment was 13.39 million, accounting for 33.85 and 33.04% of newly admitted students and total enrollment in the upper secondary sector respectively. At the higher vocational education level, there were altogether 1,521 institutions (including 32 vocational colleges), with an enrollment of 5.47 million and 16.74 million students. In 2022, the number of students newly admitted to higher vocational education institutions (including both vocational undergraduate and junior college students) accounted for 53.88% of total undergraduate admissions, while student enrollment at higher vocational education accounted for 46.29% of the total undergraduate enrollment in China (MOE, 2023b).

## 8.2 Highlighting Data

Many countries strive for excellence in the design and delivery of vocational education programs. There has been increased interest in recent years in evidence-based policy-making in vocational education and the use of valid and robust evaluation and monitoring instruments and indicators (Inter-Agency Group on Technical and Vocational Education and Training [IAG-TVET], 2014). Comparative data and indicators provide insights into the purposes and design features of vocational programs, underpinning the monitoring and assessment of vocational education systems (Kis, 2020). However, the IAGtVET also notes that there are several longstanding problems relating to monitoring and evaluating VET. In this section, most indicators are selected from the literature and proposed by the schemes of OECD's 2020 working paper on comparative data and indicators on vocational education (*ibid*), especially focused on the scale, structure, resources, and outcome of vocational education, to highlight the key features of vocational education development and challenges encountered across different contexts. Additionally, a few features have been selected with Chinese data only to reflect the importance of vocational education development in China, namely the teachers' quality and the students' learning outcomes.

*Vocational Education Scale*. It is important to understand how national vocational education systems are structured and fit within national skills systems. Entrance rates in vocational education are one of the recommended indicators of the attractiveness of vocational education systems (European Center for the Development of Vocational Training [Cedefop], 2014). Moreover, the distribution of entrants to different levels of vocational education also indicated the development of VET.

*Vocational Education Structure*. Kis (2020) stated that there is wide variation across countries in how vocational programs are organized and delivered. Data can provide a picture of the range of vocational programs offered within a country and how these are connected to other programs in terms of pathways. In particular, the existence of pathways from vocational education to further learning matters for the attractiveness of vocational programs. Moreover, it is challenging to ensure that vocational education systems are flexible and responsive to changing labor market needs; while, at the same time to avoid the instability and complexity of vocational education (Kis, 2020). Therefore, the distribution of fields of study is reported.

*Vocational Education Resources*. This section focuses on the teaching workforce, as one of the important resources of vocational education; since teachers have an immediate and positive influence on learners' skills development, employability management, and career advancement (OECD, 2022). However, when compared to general academic programs, there is limited evidence on the characteristics of teachers and institutional leaders in vocational education and the policies and practices of attracting and preparing them (OECD, 2021a). Countries use different strategies to ensure an adequate supply of well-prepared vocational education teachers and trainers (OECD, 2022). In this chapter, the educational attainment of teachers is reported to indicate the attractiveness of the vocational education profession. Moreover, the proportion of full-time teachers in China is reported to reflect the stability of the teaching workforce, as it was a challenging issue in the development of vocational education in China.

*Students' Learning Outcomes*. Among the diverse purposes of vocational education, one universally recognized outcome is the acquisition of targeted skills.

This section focuses on the features of vocational education in China and several other countries, notably the United States (U.S.), the United Kingdom (U.K.), Australia, Germany, Norway, Finland, Japan, Brazil, and Israel, representing different continents. Most of the data are collected from OECD's (2023a) *Education at a Glance* and from the Ministry of Education (MOE) in China (2021). Due to the scope of the study, this chapter focuses only on upper secondary education (equivalent to ISCED 3) level. For comparable reasons, this chapter includes data from formal education only, which excludes the informal and nonformal education (such as the apprenticeships in U.S.) and online education in China.

### *8.2.1 Vocational Education Scale*

In this section, both the entrant's ratio and distribution of education levels are reported. The former reported that students in upper secondary vocational education as a share of all secondary levels. The latter reported that students in upper secondary vocational education as a share of all vocational education students. In practice, the boundary between vocational and general programs can be blurred and it may be hard to classify programs that contain a mix of general and vocational education and allow direct access to tertiary education (Kis, 2020). This chapter distinguishes between the vocational and general orientation of education programs based on the ISCED definitions.

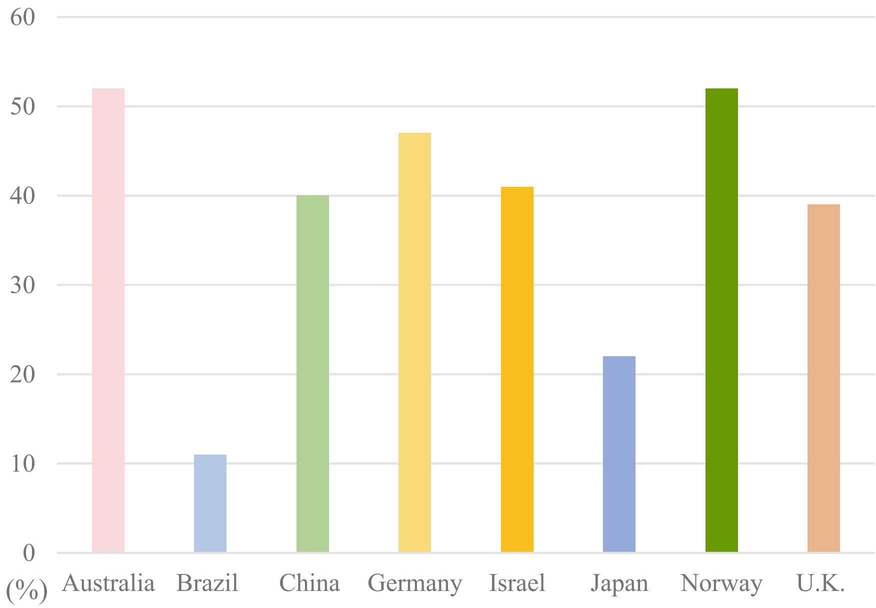


**Fig. 8.2** Vocational education entrants as a share of all upper secondary students. *Source* OECD (2023a), MOE (2021)

### *8.2.2 Entrant Ratio*

The entrants of vocational education in the most studied countries are less than 50% of all upper secondary entrants, with the OECD average at 44%. Except, Australia and Norway have more than 50% of upper secondary students enrolled in vocational education. Brazil has the fewest students entering vocational education with only 11%. Japan also has a low proportion of students in vocational education at 22%.

China has 40% of upper secondary students entering the vocational education system. According to the *Manufacturing Workforce Development Guidance* (MOE et al., 2017), China encourages the development of upper secondary vocational education and training (VET) to address the labor force shortage in certain areas (Fig. 8.2).

### *8.2.3 Education Level*

The data show the distribution of vocational education students at different educational levels. Vocational education students in most countries are at upper secondary and short-cycle tertiary levels. Comparatively, Germany and Brazil have

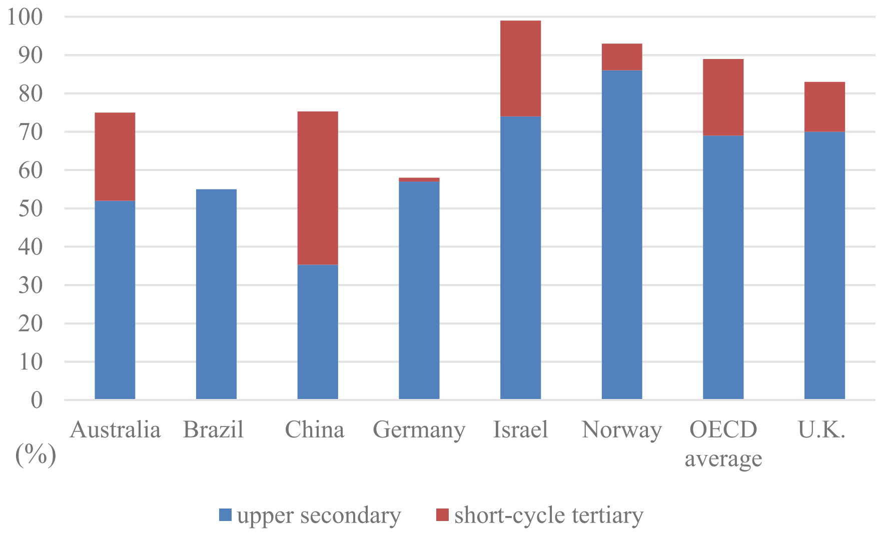


**Fig. 8.3** The proportion of vocational students at various levels compared to the total number of vocational education students. *Source* OECD (2023a), MOE (2021). *Notes* The data from China are calculated from the entrant data in MOE (2021). The total vocational students include the upper secondary and short-cycle tertiary VETs, as well as regular vocational tertiary courses, adult short-cycle courses, web-based short-cycle course, and vocational junior secondary vocational education courses in China

more vocational education students enrolled in other educational levels, such as lower-secondary level or undergraduate level (see Fig. 8.3).

In this figure, except in China, the share of students in upper secondary is much larger than at the short-cycle tertiary level. Norway has the highest proportion of vocational education students at the secondary level. Brazil even does not have any students at the short-cycle tertiary level, while Germany has only 1% of vocational education students at the short-cycle tertiary level.

China is different. China has more vocational education students at short-cycle tertiary institutions than at upper secondary schools. The figure also shows that there are more students at other educational levels in China than the OECD average. In China, there are 0.002% of students at the lower-secondary level, and 25% of students enrolled in adult short-cycle courses and web-based short-cycle courses. There are also growing numbers of vocational universities in China, so the share of students at the undergraduate level is expected to grow.

### *8.2.4 Vocational Education Structure*

The tracks of courses and fields of study are reported to indicate the structure of VET. If students and their parents perceive vocational education as a dead-end, those who are not sure about their career plans may want to keep their options open by pursuing academic education. The existence of vertical pathways from vocational education to higher levels of education or training helps enhance the attractiveness of vocational programs (OECD, 2020a). The number of vocational tracks offered and whether lead to tertiary education is reported. Moreover, constrained by the available comparative data, the graduates' distributions of selected fields of study are reported to map the diversity of the courses offered by different countries.

### *8.2.5 Tracks of Courses*

This indicator investigates how many vocational tracks are offered, especially access to the tertiary education level. According to OECD (2023a), a country is considered to have multiple vocational tracks if it offers at least two tracks (programs associated with a particular access arrangement) with each enrolling at least 5% of upper secondary vocational education students. The below shows the scale of the upper secondary vocational education students and the educational routes offered to students. The share of upper secondary vocational education students enrolled in vocational education is measured here by the percentage of upper secondary students aged 15–19 who pursue a vocational program (small—up to 25%; medium—25–49%; large—50% or more) (OECD, 2023a).

The data show that most countries offer multiple vocational tracks in initial upper secondary education, some of which lead to tertiary education and some of which do not. Together with Israel and Germany, China has medium-size of vocational education upper secondary education, and multiple tracks (Table 8.1). China in recent years has offered special routes from upper secondary school to tertiary education (Xu, 2020).

**Table 8.1** Tracks of upper secondary vocational education programs

| Share of vocational education students at upper secondary level (ISCED 3) | | | |
|---|---|---|---|
| | Small | Medium | Large |
| No (or limited) vocational education in upper secondary initial education | U.S | U.K | Australia |
| One vocational track (one access arrangement) | | | Norway |
| Multiple vocational tracks (multiple access arrangements) | Brazil, Japan | Germany, Israel, China | |

*Source* OECD (2023a)
*Notes* This only includes programs leading to full completion of upper secondary education (ISCED 3)

### 8.2.6 Fields of Study

Vocational education needs to balance the timely preparation for the future workforce and the stability of the course development. The latest data are from the OECD (2019), reporting the fields of study of vocational education students in 2017. The figure shows the variance of distributions among the countries.

It is interesting to find that according to the OECD average, engineering, manufacturing, and construction subjects dominate the fields of study at secondary vocational schools in most of the countries (Fig. 8.4). However, in Brazil and the U.K., the number of graduates from business, administration, and law majors is more than that from engineering, manufacturing, and construction. Norway, Australia, and Finland have the most vocational education graduates majoring in health and welfare among the ten countries. The proportion of graduates from these three fields of study in total over all vocational education graduates is highest in Japan, followed by Germany and Norway, while it is low in the U.K.

The distribution of upper secondary vocational graduates in China shows the stable design of vocational education courses (Fig. 8.5). Over the past decade, vocational education in China has proactively adapted to the adjustment of economic structures and industrial transformation, with more than 70% of disciplines being updated (Ding, 2022). For example, although under the umbrella term of engineering, manufacturing, and construction, the discipline changed its name from Energy Resources and New ER in 2017 to Energy Power and Materials in 2022, and from Resources and Environment in 2017 to Resources Environment and Security in 2022. Currently,

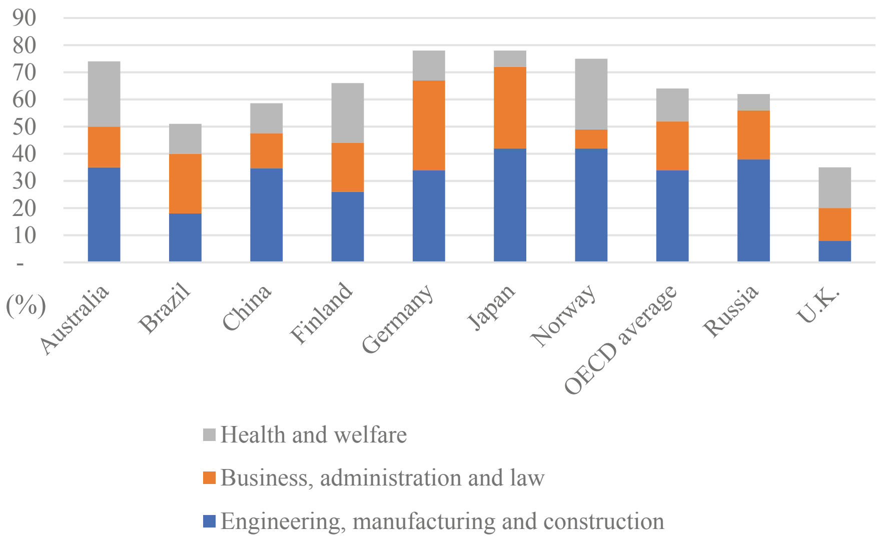


**Fig. 8.4** Distribution of upper secondary vocational graduates by selected field of study (2017). *Source* OECD (2019), MOE (2017). *Notes* The data from Australia were from 2016 instead of 2017

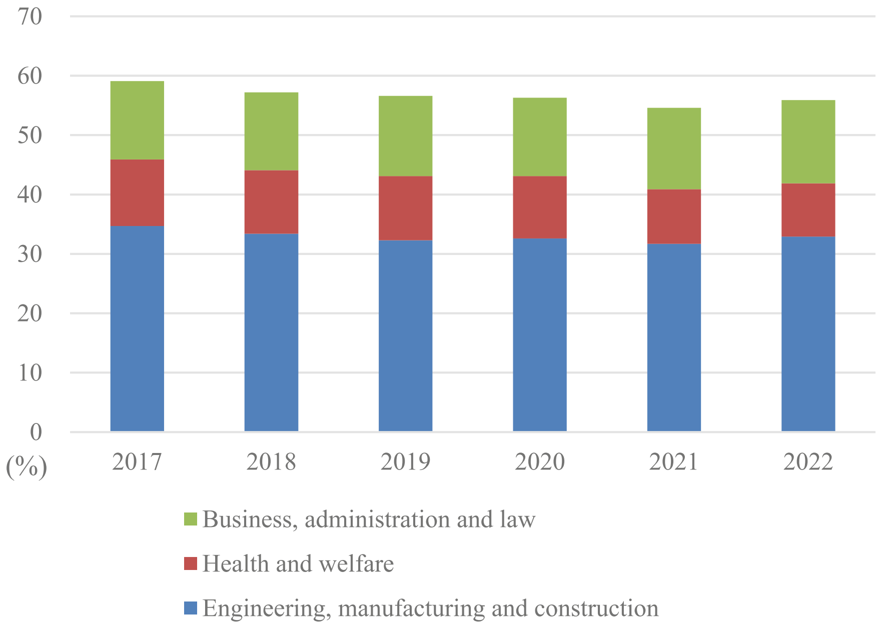


**Fig. 8.5** Distribution of upper secondary vocational graduates by selected field of study in China. *Source* MOE (2017, 2018, 2019d, 2020, 2021, 2022)

there are over 1,300 disciplines established in national vocational schools. These robust educational programs have significantly supported China as the only nation in the world to have such a robust array of industrial categories (Xinhua, 2023). In areas such as modern manufacturing, strategic emerging industries, and the modern service sector, more than 70% of the new frontline workforce are vocational education graduates (Ding, 2022).

### *8.2.7 The Resources of Vocational Education*

The quality of the teaching workforce is critical to effective learning in vocational programs. According to Smith and Tuck's (2023) survey of over 500 teachers and trainers in the Australian vocational education sector, those with pedagogical qualifications above the regulatory minimum are more confident overall and are more able to deal with the demands of different teaching contexts and diverse learner groups. Therefore, the proportions of teachers with a master's degree and above are reported.

Moreover, there is a lack of teachers in vocational education schools in China. In a national survey conducted in 2018, it was found that the student–teacher ratio in over 1,400 secondary vocational schools exceeded 20:1, and more than 1,600 secondary vocational schools did not meet the standard requirement of "having no less than 60 fulltime teachers" (MOE, 2019c). The numbers of full-time and part-time teachers in secondary vocational education schools are reported.

### 8.2.8 Teacher Qualifications

According to OECD (2021a), the proportion of teachers with a bachelor's degree and above in vocational education is much less than in general education in OECD countries. In China, 94% of vocational education teachers had a bachelor's degree and above in secondary vocational schools which is higher than the OECD average (MOE, 2021). Since there is no comparative data on the ratio of vocational education teachers with a master's degree, Chinese data are reported below.

Figure 8.6 shows the ratio of teachers with a master's degree and above qualifications in secondary vocational education schools has increased in the last 5 years in China. However, the rate of increase in vocational education is lower than in general education.

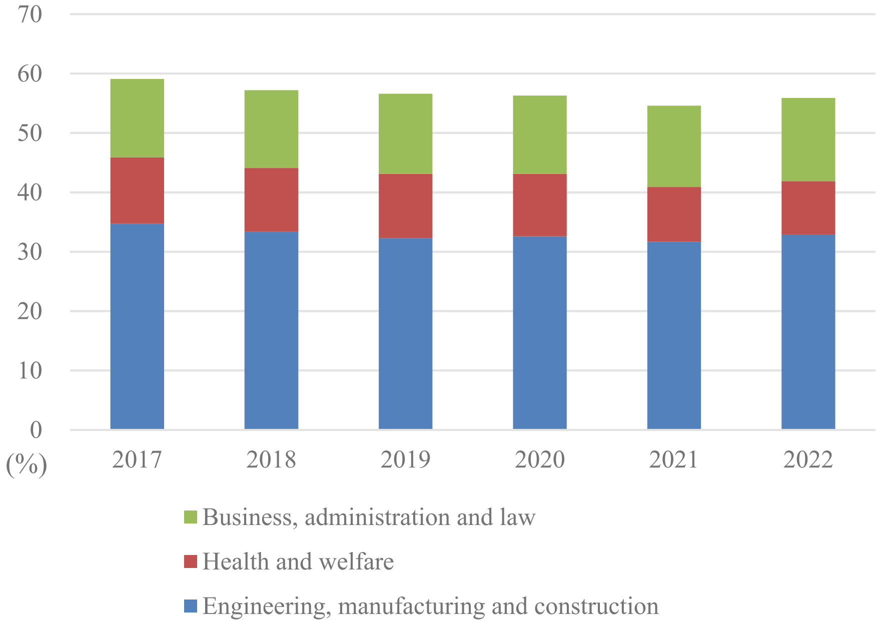


**Fig. 8.6** Ratio of teachers with a master's and above in secondary vocational schools' personnel. *Source* MOE (2017, 2018, 2019d, 2020, 2021, 2022)

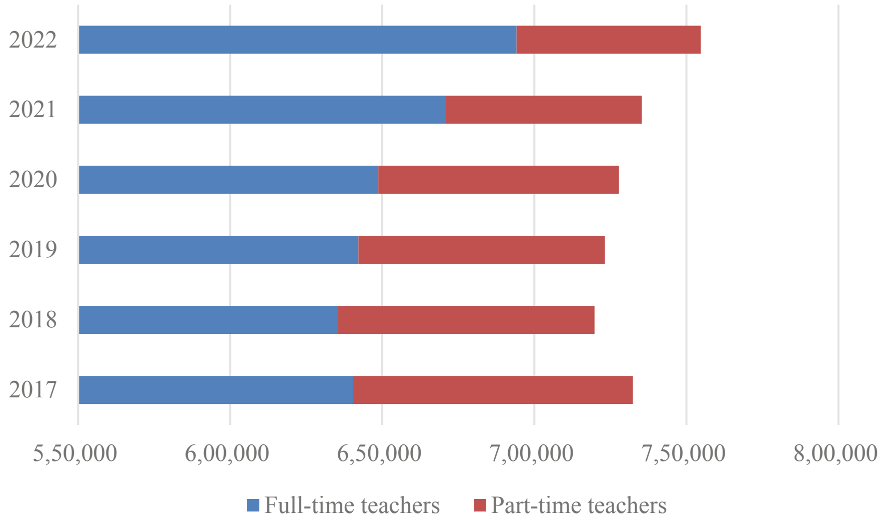


**Fig. 8.7** Numbers of fulltime and part-time teachers in secondary vocational schools. *Source* MOE (2017, 2018, 2019d, 2020, 2021, 2022)

### *8.2.9 Ratio of Full-Time Teachers*

Figure 8.7 shows the number and proportion of fulltime teachers have both increased in the recent 5 years in China in secondary vocational education schools, which indicates the stability of the teaching workforce in upper secondary vocational education schools. However, a survey on VET instructors conducted in 2023 (Sun et al., 2023) reveals that despite an increase in the proportion of fulltime teachers, vocational educators still face challenges in professional development and are prone to occupational burnout.

### *8.2.10 Learning Outcomes of Vocational Education*

This chapter reports the graduates with vocational certificates in China as the learning outcomes of vocational education. It shows the ratio of upper secondary vocational education graduates with vocational qualifications decreased in the past 6 years in China. This trend may be associated with the introduction of the "1 + X" policy.[1] The ratio of graduates with vocational skills level certificates is increasing from 24.8% in 2021 to 25.9% in 2022 (MOE, 2021, 2022).

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[1] Since 2019, China promoted the "1 + X" policy to encourage the VET graduates to obtain "1" academic degree as well as several professional qualifications ("+ X").

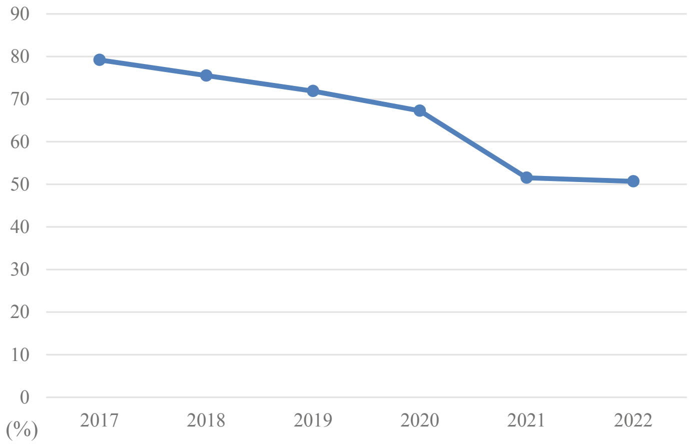


**Fig. 8.8** Share of graduates with vocational certificate at upper secondary level. *Source* MOE (2017, 2018, 2019d, 2020, 2021, 2022)

This may also be associated with the increase of students enrolled in the tertiary level of education. For example, there are more than half of the graduates from upper secondary vocational schools progressed to short-cycle tertiary programs (associate degree) or undergraduate studies for further education (MOE, 2023c). The ratio of graduates of short-cycle vocational skills level certificates is 12.3% in 2021 and 16.3% in 2022 (MOE, 2021, 2022) (Fig. 8.8).

### *8.2.11 Limitations*

The highlighting data show diverse features of vocational education within selected countries and also identify some common issues. Nevertheless, more comparable data are needed.

The number of vocational education schools could be compared. According to OECD (2023b) research, the number of vocational education schools has decreased while some schools have merged in recent years, but the decline of vocational education enrolments in some European countries is stalled due to the increasing needs of skilled labor force and slow-down of the higher education expansion. The number of vocational education schools offer the different perspective of VET development, complement to enrolment ratio.

Moreover, more data are needed to describe the teaching workforce. Firstly, work-experience is important for vocational education teachers. Vocational education teachers require a mix of pedagogical skills and occupational knowledge and experience, and need to keep these up to date to reflect changing skill needs in the labor market and evolving teaching and learning environments (OECD, 2021a). In China, the government encourages teachers to seek both academic degrees and professional qualifications, and certifies them as "dual qualified" teachers (known as *shuang shi xing*). The proportion of dual-qualified teachers in upper secondary vocational education schools increased from 30.87% in 2020 to 56.18% in 2022 (MOE, 2020, 2022). It would be meaningful to have similar/comparable data from other countries. Secondly, the payment for vocational education teachers is also important. OECD (2021a) reports vocational education teachers are underpaid compared to their counterparts in general education programs.

Furthermore, there is also a need to compare vocational education curricula, teaching methods, and assessment systems. Kis (2020) proposed that data on the balance between general and vocational content in programs needs to be collected. The OECD (2023b) reported the increase of general education components in some vocational education courses or the merge of schools combined vocational education and general courses in some countries. It is important to compare the actual curricula, pedagogies, and assessment of vocational education among different countries to understand better how vocational education responses to changing social and economic contexts.

Limited by the scope of research, this section mainly focusses on secondary vocational education and on initial VET, while OECD reminds the importance of continued vocational education, especially in response to the digitalization and rapid development of AI, the frequent and small volume of training is needed. Europe has developed vocational education micro-credentials in recent years (*ibid*).

## 8.3 Excellence Index

This chapter intends to develop an excellence index with a set of excellence indicators to compare features of vocational education in China and other countries, including the U.S., Germany, the U.K., Norway, Japan, Australia, Chili, Brazil, Russia, and Israel. As stated by Kis (2020) in the OECD working paper, the inter-national landscape of vocational education is incredibly diverse, posing challenges to establish comparative data on vocational education across countries. The paper acknowledges the challenges in finding comparative data across countries and argues that the complexity of vocational education adds further difficulties in selecting indicators. Similarly, OECD (2023b) confirmed the complexity of VET and especially stated the development of VET is not linear or unidirectional, but "more like a pendulum driven by various factors, such as changing society, climate threats and digitalization change, as well as diverse purposes of VET in different countries". It is difficult to compare or identify a particular stage of development of VET. Nevertheless, effective vocational education systems must offer high-quality learning options to students and provide pathways for progression to higher levels. IAG-TVET has identified finance, access, and participation, quality, and relevance as indicators for monitoring and evaluating vocational education policies and reforms (IAG-TVET, 2014). The key features were selected from the proposed schemes outlined in the OECD working paper on comparative data and indicators on VET (Kis, 2020). Specifically, the structure, learning outcomes, and resources of vocational education were measured. The details of the indicators are listed in the Table 8.2.

*Structure.* Kis (2020) stated that the organization of vocational education systems, in terms of institutions of delivery, programs, and qualifications makes a big difference to the capacity of the system to respond to changing needs. One of the proposed features of vocational education is to offer working experience along with academic learning. Many vocational education systems emphasize and include work-based learning, in recognition of the many benefits that workplace exposure can have for school-to-work transitions and employer engagement in the overall vocational education system. For example, Cedefop (2023) stated the trend of vocational education in Europe is increasingly emphasizing the relevance of work-related and practice-based learning.

*Outcome.* As the purpose of VET is to prepare for the future workforce, both academic performance and professional skills are used as indicators of excellence learning outcome. In general, students with weaker school performance are often guided into or opt for vocational programs (Kis, 2020). Completion is especially challenging for vocational students, compared to general education. It is noticed that 2 years after the end of the theoretical duration, the average completion rate increases from 72 to 82% (OECD, 2023b). As an excellence indicator, we used the completion rate of the theoretical year. Also, medals obtained in the WorldSkills Competition are used as indicators of excellence in professional skills.

*Resources.* As for all education and training programs, financial resources are key in steering the system, but many of the challenges and policy tools are specific to vocational programs (Kis, 2020). The teaching workforce is another important resource in the vocational education system. In particular class sizes and student–teacher ratios are among the determinants of the demand for teachers (OECD, 2021a), which indicates the shortage of vocational education teachers in some countries.

**Table 8.2** The excellence indicators of vocational education

| Indicators | | Definitions |
|---|---|---|
| Structure | Work-based learning | The ratio of work-based learning program of all vocational education courses |
| Outcome | Completion rate | Completion rates of secondary vocational schools |
| | World Skills Competition | Total medal points of the countries in the WorldSkills Competitions |
| Resources | Investment in every student | The average investment in each vocational education student |
| | Teacher/ student ratio | Teacher-student ratio of upper secondary vocational education |
| | Age of teachers | The age distribution of teaching workforce |

Moreover, the age distribution of the teaching workforce can also indicate potential teacher shortages.

### *8.3.1 Structure*

Work-based experience and learning are critical for vocational education. Kis (2020) stated that how work placements are regulated and organized determines whether students will systematically participate in quality-assured placements, allowing them to develop useful skills and connect to employers—or work placements remain an optional add-on and of limited value. This section shows the ratio of work-based learning programs in all upper secondary vocational programs. The ISCED mappings were updated in 2022 to provide further details on the type of work-based learning used in each vocational program. It defines apprenticeship as mandatory work-based learning which accounts for at least 50% of the curriculum and is paid. Apprenticeships are the dominant form of upper secondary vocational education in Germany (88.7%), while the OECD average shows 44.96%. The U.K. and Australia are just under the OECD average. The numbers in Chile, Israel, and China are much lower. In China, the public data only state the share of modern apprenticeships, here counted as work-based learning programs of all vocational education programs.

Increasing apprenticeship participation has been one of the focal points of EU and national policies on vocational education and training since 2013, following the launch of the European Alliance for Apprenticeships (EAfA) (Cedefop, 2021). A similar emphasis has been seen in China. In 2014, China's MOE issued Opinions of the Ministry of Education on Carrying Out Pilot Work for the Modern Apprenticeship Program to promote the pilot of modern apprenticeships (MOE, 2014). A total of 572 upper secondary vocational education schools participated. However, the practices (Hu & Li, 2018) showed the need to improve the governance among different stake holders, to access disadvantaged groups, and to attract more industry and company participation. These challenges are also acknowledged by their counterparts in Europe. For example, Cedefop et al. (2022) specifically addressed the challenges due to the economic crisis and COVID-19 and proposed to reach a consensus on the vision and purposes of apprenticeship among the state holders, and innovate collaborative governance mechanisms, as well as empowering teachers and trainers (Fig. 8.9).

Nevertheless, more collaborative research is needed in this area. CEDEFOP (2021) reported the total number of apprentices who are enrolled in apprenticeships in a country in a specific year within Europe Union countries to inform the policy makers. CEDEFOP (2023) also advocated that shares or ratio of numbers to the population size could enhance the comparability. However, it is difficult to obtain, due to the complexity and diversity of apprenticeship mechanisms in every country.

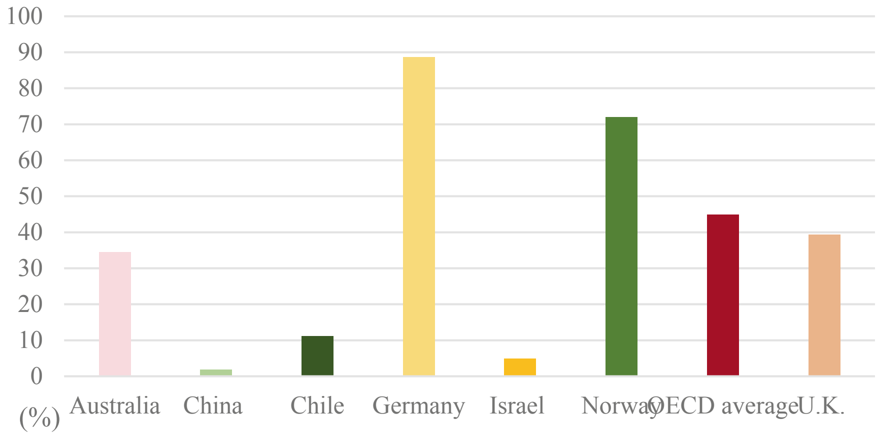


**Fig. 8.9** Share of upper secondary vocational students enrolled in combined school-and work-based programs (2021). *Source* OECD (2023a), MOE (2021)

## 8.3.2 *Outcomes*

The excellence indicators of learning outcome include both academic performance and professional skills, showing the feature of VET. VET program completion rate and the total medals achieved in the WorldSkills Competitions are reported separately below.

### 8.3.2.1 Program Completion Rate

Ensuring students complete their upper secondary education is a challenge in several countries, especially in vocational programs. The completion rate for both true cohort and cross-cohort methods is calculated as the number of graduates divided by the number of entrants N or N + 2 years before (where N is the theoretical duration of the program). In China, it is N = 3 (Fig. 8.10).

Completion rates among vocational students are relatively high in Israel and Japan exceeding 90% at the end of theoretical duration. China is about the same as the average of OECD countries. OECD (2023a) reported that less than 50% of vocational upper secondary students in the French Community of Belgium, Iceland, Luxembourg, Norway, and Spain complete their studies by the end of the theoretical duration. Comparatively, there is much less cross-country variation in the case of general programs. Completion rates in general upper secondary education exceed 70% in all countries.

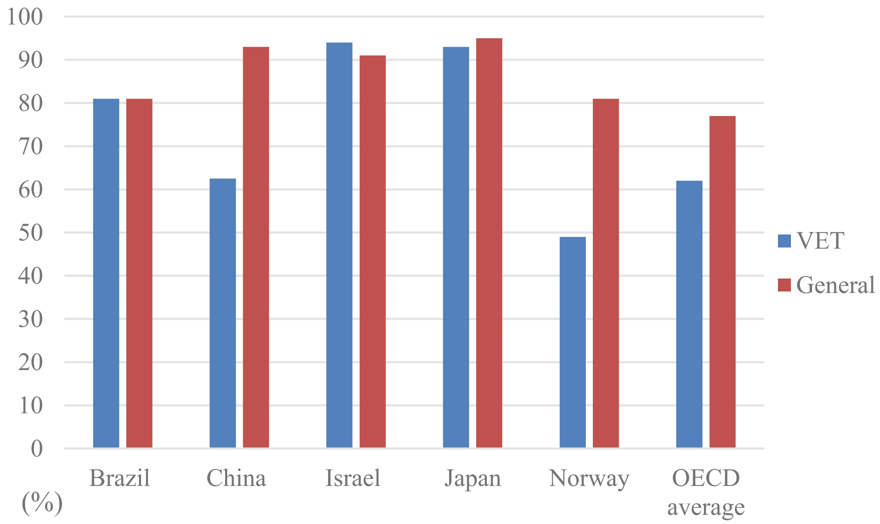


**Fig. 8.10** Completion rates of entrants to upper secondary education (2021). *Source* OECD (2023a), MOE (2019d, 2020, 2021). *Notes* 1. Chinese vocational education data published in MOE (2021) were different from previous years, so all the secondary vocational students are counted for completion rates (which include adult programs and distance programs). If counted the regular secondary vocational schools' completion rates, in 2020, was 89.4%. 2. The OECD data presented here come from an ad-hoc survey and only concerns initial education programs. The reference year (2021, unless noted otherwise) refers to the year of graduation 2 years after the theoretical duration

#### 8.3.2.2 WorldSkills Competition Achievement

The WorldSkills Competition is the highest-level international vocational skills event for youth (depending on the skills, the attendance is not older than 22 years old or 25 years old). Since its very first competition held in Madrid, Spain in 1950, the WorldSkills Competitions have held a high standard of skills excellence, committed to raising the profile and recognition of skilled people. It competes on 56 official skills, including specific skills in construction and building technology, creative arts and fashion, information and communication technology, manufacturing and engineering technology, social and personal services, and transportation and logistics. The competition is known as the most prestigious, largest scale, and most influential vocational skills competition in the world today, hailed as the "Olympics of World Skills". This indicator reports the total medal points of each country achieved in the competitions. Figure 8.11 reveals China achieved the highest points among the countries. Russia increased greatly in 2019 and surpassed Brazil. In 2022, despite the pandemic, a special event was held. Japan achieved better than in previous years. Norway and the U.S. scored a low number of medal points, while Israel had no records for the medal points for those competitions.

Since 2011, China has participated in six WorldSkills Competitions. Cumulative data show that the Chinese competitors have won a total of 57 gold medals, 32 silver

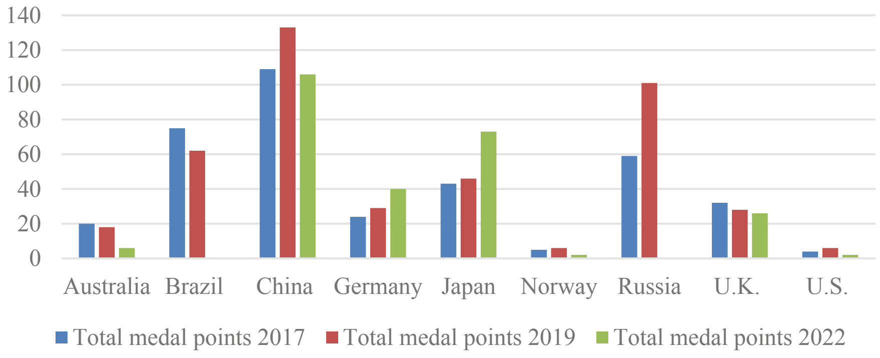


**Fig. 8.11** Total medal points. *Source* WorldSkills (2017, 2019, 2022)

medals, 24 bronze medals, and 63 medallions for excellence. Notably, at the special WorldSkills Competition in 2022, China sent 36 competitors to participate in 34 skill events, achieving an outstanding outcome of 21 gold, three silver, four bronze, and five medallions for excellence. The proportion of gold medals reached 62%, and the proportion of medal-winning was 97%, which set the best historical record.

In 2022, the Chinese government issued *Opinions on Strengthening the Development of Highly Skilled Talent Team in the New Era*, which emphasizes on development of vocational skills and improvement of performance in competitive work.

Moreover, the Ministry of Human Resources and Social Security of the People's Republic of China organized the inaugural World Vocational College Skills Competition in 2022. This competition was focused on the students at vocational colleges. The competition featured 293 institutions from 107 countries and regions across continents.

## *8.3.3 Resources of Vocational Education*

The resource of vocational education is measured by financial investment and teaching workforce.

### 8.3.3.1 Government Investment in Each Student

Vocational education programs often require specific equipment and infrastructure, and typically cost more per student than general programs. Figure 8.12 shows the total government expenditure for each fulltime student at upper secondary in public schools by educational programs in USD. All data are from 2020. On average across OECD countries, government expenditure per student was about USD10,687 in general upper secondary pro-grams, compared to about USD12,329 in vocational

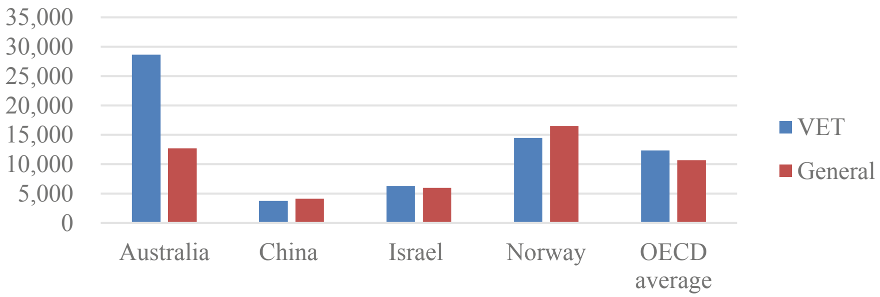


**Fig. 8.12** Total government expenditure per full-time equivalent upper secondary education student (USD adjusted for PPP). *Source* OECD (2023a), MOE (2020). *Notes* The PPP conversion rate is sourced from OECD (2020b)

programs. It shows Australia had much higher government investment in secondary vocational students than the OECD average. However, in Norway and China, the government actually spent more on general education than VET. Both Israel and China spent much less than the OECD average.

#### 8.3.3.2 Government Investment in Vocational Education and General Education

Figure 8.13 shows the government expenditure on different programs as a percentage of total government expenditure in 2020. The data show that average, the OECD countries spent evenly on vocational education and general education, while Norway actually spent more on VET. On the contrary, Israel, China, the U. K. and Australia spent much more on general education. On average, Brazil, China and Israel actually spent more on education than other countries. In China the proportion invested in vocational education was low. In total, Chinese government spent 14.78% of government expenditure on education, most of which was on compulsory education and Higher Education. The average investment invested in education was 4. 22% of GDP and decreased to 4. 01% in 2021 and 2022 in China.

#### 8.3.3.3 Student/Teacher Ratio

Figure 8.14 illustrates the ratio of students to teaching staff in upper secondary education. Vocational programs might be expected to have lower student-to-teaching staff ratios than general programs because of this hands-on nature, driving the expenditure per student upwards. However, both the U.K. and China suffer a higher student-to-teacher ratio than the OECD average. In most countries, the student–teacher ratio of vocational education is higher than general education. The exception is Brazil where the ratio of students to teaching staff is much higher in general education than in

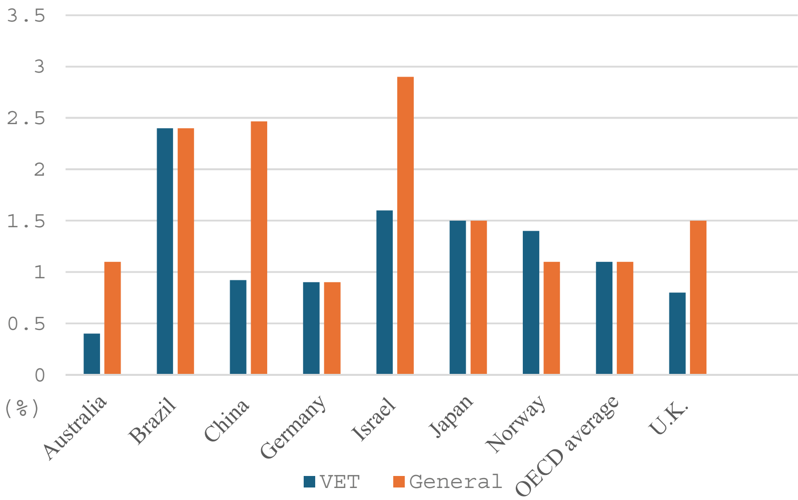


**Fig. 8.13** The government expenditure on education as a percentage of total government expenditure (2020). *Source* OECD (2023a, 2023b), MOE (2020). *Notes* The Chinese government's spending on each level of education was not reported directly. Instead, the author calculated it by multiplying the reported government expenditure per student by the actual number of enrolled students at each level. Then, the proportions for each level of education relative to the total expenditure were determined

VET. Conversely, in Norway, the ratio remains the same, while in the U.K., the ratio in vocational education is much higher.

#### 8.3.3.4 Age of Teachers

Many countries are facing a wave of retirements among teachers in vocational education (OECD, 2020a). It is important to investigate the age distribution of the vocational teaching workforce, which is notably aging. On average across the 25 OECD countries with available data, 43% of teachers in upper secondary vocational education programs were 50 years old or older in 2021, compared to 41% in 2013 (*ibid*). The figure shows that the U.K. and Germany suffer an even higher percentage of teachers who are 50 years old or older than the OECD average. Korea, Brazil, and China have a much younger and more robust teaching force in VET. In particular, China has the most young teachers who are less than 30 years old (with 18.2%) (Fig. 8.15).

#### 8.3.3.5 Limitations

The excellence indicators highlight the diverse characteristics of VET across different countries. China excels in most areas, but lags behind other countries in investment

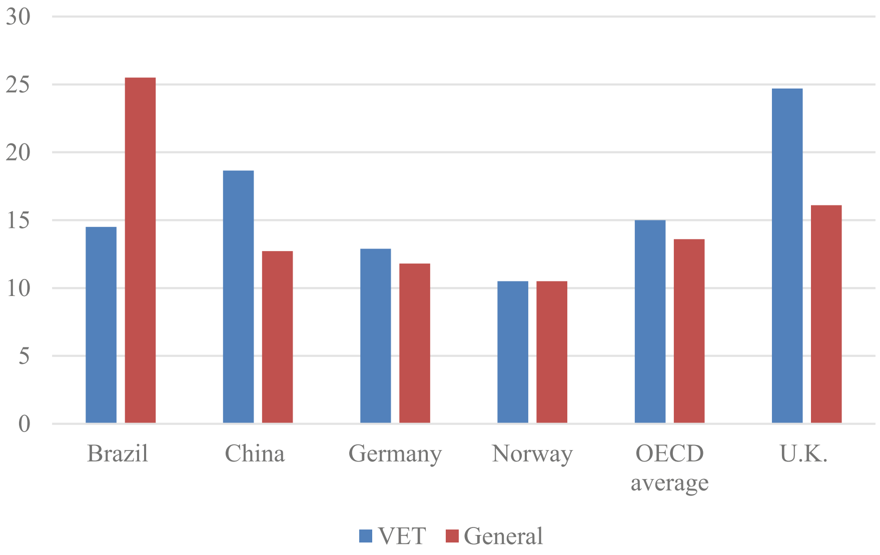


**Fig. 8.14** Ratio of students to teaching staff in upper secondary education, by program orientation. *Source* OECD (2023a), MOE (2021)

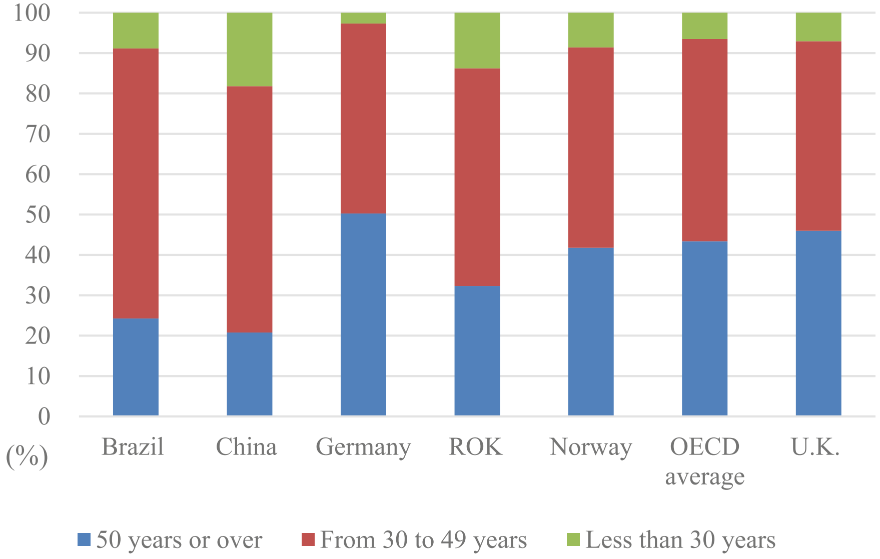


**Fig. 8.15** Age profile of teachers in upper secondary vocational programs. *Source* OECD (2023a, MOE (2021)

in VET education. However, more comparable data will be needed to explore how vocational education is responding to rapidly evolving technologies and changing requirements from labor markets and societies. OECD (2023b) stated that VET is increasingly embracing broader goals not limited to preparing young people for labor market entry, but a broader, transversal skills. For example, several studies have explored the links between skills and innovation (Andrews et al., 2018; Moso-Díez, 2019).

More educational levels will be included in future comparative studies. As Cedefop (2023) identified, one of the features of vocational education in Europe is that the institutions and structures supporting the delivery of VET are diversifying and expanding. The increase need for upskilling and reskilling (lifelong learning) promotes the higher qualifications levels (EQF 5-8).

## 8.4 Best Practices

### *8.4.1 Developing National Teaching Resource Database for Vocational Education*

With the rapid development of digital technology, the global education sector is undergoing an unprecedented digital transformation. The United Nations Educational, Scientific and Cultural Organization (UNESCO) released the *Beijing Consensus on Artificial Intelligence and Education* in 2019 (UNESCO, 2019), and OECD published *Digital Education Outlook* in 2021 (OECD, 2021b).

The Chinese government places a high priority on the informatization construction of vocational education, striving to establish a "Smart Education of China" with high-quality service and resource sharing. As part of these initiatives, a teaching resource database is developed as a comprehensive application platform of vocational education digital resources led by MOE. Its aim is to realize the national sharing of high-quality teaching resources, support teachers in their instructional endeavors, enable independent learning for all learners, and then promote the development of teaching resources in related vocational fields. Ultimately, it seems to promote the reform of vocational teaching, and elevate the overall quality of vocational education.

Since 2010, MOE has set up 203 teaching resource databases for vocational education majors, and promoted 582 provincial ones, covering 19 major categories of vocational education. The number of schools and enterprises involved in the construction of the resource pool reached 2,154 and 2,838, respectively (Sun, 2023). The National Teaching Resource Databases for Vocational Education Majors has undergone four stages: (1) initial exploration, (2) connotation promotion, (3) application reinforcement, and (4) service transformation. So far, a set of standardized construction methods has been formed in the aspects of leadership mechanism, construction logic, construction tasks, and quality monitoring system.

#### 8.4.1.1 Establishing a Governance and Construction Mechanism with Multi-party Participation

The management system of vocational education in China exhibits distinct features of centralized top-down control, offering a robust institutional framework that ensures the effective implementation of educational reforms throughout the country. The National Teaching Resource Databases for Vocational Education Majors has established a three-tier management and operational system, involving MOE, provincial-level governments, and individual schools. This framework has established a working pattern characterized by "independent construction, provincial co-ordination, selection and warehousing, preferential support, concurrent construction and utilization, process monitoring, and continuous application" (MOE, 2023b). The MOE plays a leading role in policy-making, fund allocation, and overall management. The ministry also promotes the selection, project approval, acceptance, reward, and issues normative documents to guide the construction and improvement of resource databases. The National Teaching Resource Databases for Vocational Education Majors are mainly oriented to the fields with many specialties, a large number of students, and urgent needs of industrial enterprises, while the provincial education administrative departments coordinate the construction of regional resource database, mainly for the regional industrial needs and fields with industrial characteristics.

The construction units of the resource databases include the presiding unit and participating units. The presiding unit is an independent vocational school, which is generally responsible for the construction planning, application promotion, maintenance, and management of the resource databases. Additionally, it bears the primary responsibility for reviewing the content of these databases. The participating units can be vocational schools, ordinary universities, industries, enterprises, and scientific research institutes, all of which are required to actively engage in the construction of the databases and integrate their own advantages into the process. The multiparty participation in governance and construction promotes the sharing and application of high-quality teaching resources and promotes the digital transformation of vocational education and the improvement of the quality of talent training (*ibid*).

#### 8.4.1.2 Establishing Fundamental Principles for Developing Teaching Resource Databases

The resource databases are positioned as "enabling to learn, assisting to teach, promoting to reform" to serve the training of technical and skilled personnel. "Enabling to learn" means that learners of all kinds can independently conduct systematic and personalized learning through the resource base. "Assisting to teach" means that teachers can use the resource databases to flexibly organize teaching and training content and assist teaching implementation. "Promoting to reform" refers to the use of vocational schools' resource database to promote the reform of learning methodologies and curriculum design in the digital age, and to innovate more personalized, precise, and customized teaching methods.

Based on the functional orientation, the construction of resource databases follows the principle of “integrated design, structured curriculum, granular resources, and multi-scenario application” (*ibid*). “Integrated design” refers to that the construction of resource databases should focus on the standard majors and corresponding industries, and coordinate resource construction, platform development, and the establishment of joint construction and sharing mechanisms, so as to form the top-level design for the overall system. “Structured curriculum” involves incorporating standardized curriculum into professional talent training programs, covering the core curriculum of the major and basic curriculum of the major, and meeting the needs of online and offline mixed teaching. “Granular resources” means that the smallest unit of resources in the databases must be independent knowledge and skill points or complete media materials, which is convenient for users to learn and organize lessons. “Multi-scenario application” means that the resource databases should introduce new technologies such as learning assistants and digital teachers to create diversified application scenarios to meet the diversified learning needs of different user groups. In general, this idea puts more emphasis on the overall layout and planning of the database, the learner-centered design concept, and the diversification of application scenarios for resource databases.

#### 8.4.1.3 Establishing Multifaceted Construction Tasks for Teaching Resources Databases

According to *Guide for the Construction of the Teaching Resource Databases for Vocational Education Majors*, the main tasks of the resource data-bases include professional talent training program, curriculum system, teaching resources, evaluation and assessment resources, digital teaching materials, characteristic training projects, virtual teaching team, resource audit mechanism, and application and promotion mechanism (*ibid*).

The professional talent training plan should follow the principles of vocational education, the growth of technical and skilled talents, and the physical and mental development of students. It should be aligned with the national professional teaching standards, develop professional talent training programs that meet the industrial needs, and clarify the training objectives, curriculum setting, credit hour arrangement, practice links, graduation requirements, and other contents (*ibid*).

The curriculum system should methodically break down the knowledge, ability, and quality requirements of the training objectives. It should systematically design the core curriculum system and its teaching content, building a visual curriculum system framework based on a knowledge graph. It should also clarify the knowledge and skill, as well as the corresponding professional positions that the course must be mastered (*ibid*).

Regarding course teaching resources, it is recommended to make rational use of video, animation, virtual simulation, and other resources. For the construction of evaluation and assessment resources, it is imperative to establish a comprehensive test question bank for each core course, ensuring coverage of the standard course content.

Additionally, it is recommended to reduce the proportion of objective questions and increase questions that assess comprehensive practical abilities. Furthermore, it is encouraged to collaborate with enterprises to develop vocational ability assessment and evaluation standards, as well as conduct vocational ability training and testing (*ibid*).

Enterprises are encouraged to collaborate in the construction of digital teaching materials, focusing on the development of integrated media or innovative digital materials tailored to real-world production scenarios and aligned with the core curriculum of respective majors. This collaboration should aim to explore digital publishing techniques and integrate various technologies, ultimately enhancing the learning experience by making it more engaging, interactive, and personalized (*ibid*).

In terms of the establishment of training projects, there exists an incentive for cur-rent employees and members of the broader community to collaborate in the development of training initiatives that align with the demands of the industry and enterprises. These endeavors strive to integrate cutting-edge production technology with authentic enterprise scenarios, conduct technical skills training, and facilitate the enhancement of enterprises' technical proficiency and sustainable development capabilities (*ibid*).

Regarding the construction of a virtual teaching team construction, it is encouraged for database host units to collaborate with other vocational colleges, national industry organizations, and leading enterprises within the industry to establish a dynamic and open virtual teaching team. This initiative aims to facilitate educational research activities, improve teachers' digital teaching ability, and foster digital professional teaching research and practice (*ibid*).

At the same time, an audit mechanism for resources is established to ensure that the resource content is scientifically accurate, applicable, and standardized. Schools participating in the construction of the resource pool should guide teachers and students to use the resource databases and provide services for them so as to realize high-quality resource sharing (*ibid*).

#### 8.4.1.4 Establishing Quality Monitoring System for Teaching Resources Data-Bases

In the process of resource library construction, the database quality monitoring system pays attention to five key dimensions: resource construction, platform function, application promotion, characteristic innovation, and security (*ibid*).

In terms of resource construction, the quality monitoring system not only emphasizes the integrity and coherence of resources, but also focuses on the quantity, quality, and updating of resource construction. For quantity, the quality monitoring system focuses on the number of courses and digital resources. For quality, the quality monitoring system focuses on the political, scientific, and richness of resources. For updating, the quality monitoring system focuses on the frequency of resources and the introduction of new technologies, new processes, and new norms (*ibid*).

The platform possesses a diverse array of functionalities that empower managers to conduct thorough audit resources. It also facilitates learner autonomy in selecting courses, encourages online interaction, fosters independent learning, offers prompt feedback, caters to personalized customization, and aids teachers in analyzing teaching behaviors (*ibid*).

In terms of application and promotion, the quality monitoring system prioritizes the promotion and application of school-based, interschool, school-enterprise, and interprovincial resource databases, as well as the beneficiaries and coverage. It also focuses on establishing incentive mechanisms for learning and use (*ibid*).

Concerning characteristic innovation, the quality monitoring system focuses on how construction units leverage regional industries, industry characteristics, strengths of colleges and universities, and application innovation (*ibid*).

Regarding institutional guarantee, the quality monitoring system examines the relevant institutional documents issued in the construction and application of the resource base. It also ensures adherence to principles such as integrity, teacher ethics, compliance with laws and regulations, discipline, and network security, among others (*ibid*).

### *8.4.2 Local Government's Role in Aligning Industry-Education*

The integration of industry and education signifies the close collaboration between vocational education institutions and industrial enterprises, aiming at improving the quality of talent development. It includes the connection between majors and industries, schools and enterprises, course content and professional standards, as well as the teaching process and production process (Chen et al., 2014). The integration of industry and education is an essential way for vocational education to achieve excellence, and an important symbol to measure the effectiveness of vocational education reform. Despite the Chinese government's continual emphasis on the integration of industry and education in vocational education, practical challenges persist. These challenges are mainly manifested in the "wishful thinking" of vocational colleges, and enterprises have failed to deeply participate in the process of talent training in vocational colleges (Chen & Yan, 2023). In response, six government departments including the National Development and Reform Commission proposed to pilot the development of 20 industry-education integration cities in selected provinces, autonomous regions, directly-administered municipalities, and cities specifically listed in the plan.

Subsequently, The Implementation Plan for the Integration of Industry and Education in Vocational Education (2023–2025) was jointly issued by eight government departments providing further clarity. By 2025, the plan aims to expand the number of national industry-education integration pilot cities to around 50 (National Development and Reform Commission [NDRC] et al., 2023). The goal is to form a development pattern of integrated education and active interaction with industry, solve the major structural contradiction between the supply and demand of talents, and significantly enhance the contribution of education to economic development and industrial upgrading (NDRC et al., 2019). Among them, Guangzhou in Guangdong Province, as the first pilot city, has developed a series of best practices in the system and model of industry-education integration.

#### 8.4.2.1 Giving Priority to Top-Level Planning and Promotion of Industry-Education Integration Pilot Initiatives

The Guangzhou municipal government actively responded to the national policy call for industry-education integration by incorporating it into the government's agenda and introducing the Guangzhou Pilot Scheme for Building a National Industry-Education Integration City. The scheme, in alignment with the Guangzhou-Shenzhen-Hong Kong and Guangzhou-Zhuhai-Macao Science and Technology Innovation Corridor, seeks to build three clusters in the northern, central, and southern regions, and build a spatial layout of industry-education integrated development in industrial parks. Simultaneously, the scheme has formulated goals, reform tasks, policy lists, key project lists, and annual work plans for the construction of industry-education integration pilot sites. The Guangzhou Development and Reform Commission, along with five other departments, jointly established a coordinated mechanism for industry-aligned education, characterized by the Government setting the stage, colleges and universities participating, and enterprises promoting. Additionally, the Guangzhou Industry-Education Integration Association has been formed to guide and develop industry-education integration enterprises in the region. It has successfully established the coordination mechanism of industry and education docking, realized the normalization and institutionalization of industry and education integration and docking activities, and actively supported the growth of industry and education integration enterprises. In 2023, the number of association members reached 80 (Guangdong Provincial Development & Reform Commission, 2023).

#### 8.4.2.2 Formulating and Implementing Comprehensive Enterprise Support Policies

Guangzhou actively implements policies promoting industry-education integration, vigorously seeking support from national and provincial policies. In collaboration with various departments, innovative approaches are adopted to enhance support in key areas such as fiscal and tax policies, financial investment, land resources, industry, and education. The list of pilot policies for industry-education integration in Guangzhou outlines 34 supporting measures, implementing combined incentives for industry-education integration enterprises, pilot enterprises, and major projects (*ibid*).

State Administration of Taxation Guangzhou Nansha District Taxation Bureau has taken the lead in issuing the Policy Guidelines on Further Implementing Policies to Support the Development of Industry-Education Integration in Nansha New District, including the Offset of Education Surcharges. This ensures the policy is effectively executed at the operational level. Additionally, substantial financial investment has been made to boost the integration efforts. From 2016 to 2021, Guangzhou invested 43.92 billion yuan in the field of vocational education. The city has actively strived to secure financial support at both national and provincial levels, receiving 80 million yuan from the central budget for one project, 7 million yuan for two provincial major projects, and more than 8.3 billion yuan in local government special debt to support the construction of vocational colleges and training bases. The cultivation of industry-education integrated enterprises has achieved remarkable results. Four Guangzhou enterprises, such as China Southern Power Grid, China Southern Airlines, Baiyun Electric Appliance, and Guangzhou CNC, have been selected as national industry-education integration enterprises (*ibid*).

#### 8.4.2.3 Vigorously Building Vocational Colleges Training Bases and Public Training Bases

The fundamental difference between vocational education and general education is that the former has distinct practicality, and the training base integrating training equipment, facilities, tools, materials, environment, and other elements is essential to carry out practical training. The Guangzhou municipal government supports colleges and universities to build training bases and actively build sharing platforms to realize resource sharing and the integrated development of industry and education.

First, efforts have been put to build the Guangzhou science and technology education city with high standards. The first phase of the education city, with a total investment of 34.4 billion yuan, is planned to accommodate 13 vocational colleges, with an area of 437,000 square meters, and can accommodate about 129,000 students. The plan includes building at least nine colleges leading integration training bases within vocational colleges, fostering close collaboration, and promoting resource sharing. Upon completion, this education city intends to serve as an international hub for VET, covering vocational training, skill appraisal, research and development, career guidance, and business incubation. Ultimately, the city aims to become a premier destination for VETs in the southern region. Guangzhou Railway Polytechnic and Guangzhou Normal School of Preschool Education have been settled in Guangzhou Science and Technology Education City since September 2022 (*ibid*).

Second, Guangzhou actively supports the construction of public practical training bases. The city has eight national high-skilled personnel training bases and 17 training bases for the World Skills Competition in China. It is home to one National Teacher Training Center for Technical Colleges, one Curriculum Research Center for Technical Education, and one China (Guangzhou) Research Center for World

Skills Competition. According to the layout of "One Center, Three Zones and Seven Points", Guangzhou is promoting the construction of a public training base system, including one main base of the public training center, three regional sub-bases of Panyu, Nansha and Guangzhou Development Zones, and seven sub-bases of technician colleges. Upon completion, about 20,000 training and appraisal stations can be provided at the same time. By 2023, the three Zones and seven sub-bases have been built and put into operation (*ibid*).

Third, the city has begun developing the first batch of demonstration bases for integrating industry and education. In 2022, Guangzhou carried out the construction and selection of the first batch of demonstration bases for industry-education integration training, and determined 63 demonstration bases, which have been included in the key construction project plan and financial support of Guangzhou. In addition, Guangzhou is speeding up the construction of sharing platforms such as Guangzhou Artificial Intelligence and Digital Economy Pilot Zone (University Town Park), Guangzhou University Town Zhongguancun Qinghui, Zhonglutan Town Vocational Park, and China Singapore Knowledge City, to provide an important carrier for the training base and resource sharing (*ibid*).

#### 8.4.2.4 Continuing to Deepen University-Enterprise Collaboration

University-enterprise cooperation is both the focus and challenge of vocational education. Guangzhou has made remarkable progress in the integration of industry and education in VET. By actively exploring the industry-education integration reform of the shareholding system and mixed ownership, vocational colleges in Guangzhou collaborate closely with government, schools, enterprises, and other stakeholders, forming a variety of school-enterprise cooperation modes and platforms. At present, 33 vocational education groups (alliances) have been established in regional vocational colleges in Guangzhou, among which two have been selected as national model vocational education groups and four have been selected as provincial model vocational education groups, realizing the full coverage of municipal colleges and universities. Guangzhou Technician College and Guangzhou Electromechanical Technician College have been identified by the Ministry of Human Resources and Social Security as the demonstration Technician Education Alliance (Group), two of the first 32 institutions in China (*ibid*).

In addition, the Guangzhou municipal government actively promotes the "1 + X" certificate modern apprenticeship pilot. From 2021 to 2022, eight city-owned higher vocational colleges in Guangzhou organized about 20,000 people to participate in 166 "1 + X" skill certificate training, 31 secondary vocational schools in Guangzhou participated in the "1 + X" certificate pilot, and about 19,000 people participated in 85 vocational skill level certificate training. Modern apprenticeship system and new apprenticeship system have been promoted, with all higher vocational colleges participating in the pilot of the modern apprenticeship system. Among these, four colleges have been selected as the first modern apprenticeship pilot colleges by MOE (*ibid*).

## 8.5 Inspiring Stories

### *8.5.1 Li Dexin: "Young Lu Ban" Ascending the World Podium*

WorldSkills Competition, known as the WorldSkills Olympics, is regarded as representing the world's advanced level of vocational skill development. The impact of WorldSkills Competition on players is reflected in many aspects, such as professional foundation, professional ethics, professional ability, and professional development, to mold players into highly skilled professionals (Lu et al., 2023). In the 2022 WorldSkills Competition, the Chinese delegation ranked first in the gold medal count and total team score. Li Dexin, 22, won the gold medal in the furniture production project in the Swiss division competition. He was the first gold medal winner of the Chinese delegation in the WorldSkills Competition and the first gold medal since China entered the competition. He is considered to be a real "young Luban".[2] He has witnessed the transformation and upgrading of the furniture industry in his hometown and is a practitioner and transmitter of the spirit of craftsmanship (Liu & Xiao, 2022).

#### 8.5.1.1 Witnessing the Transformation and Upgrading of the Furniture Industry in Nan Kang

Li Dexin is from Ganzhou city, Jiangxi province, China. His hometown, Nan Kang, is known as "the hometown of carpenters" and "the capital of China's solid wood furniture" with a developed furniture industry. When Li was 12 years old, there were more than 6,000 furniture enterprises registered in Nan Kang, and many of his relatives and friends were engaged in the furniture industry. As a child, he often played in his neighbors' and relatives' furniture factories, was influenced by his family and the environment, and developed a strong interest in furniture making. After graduating from high school, Li chose to enroll in the furniture art design major of Jiangxi Environmental Engineering Vocational College. At first, he considered that he could get a better job after graduation and stay close to his family. However, with his learning journey progressing, Li became increasingly convinced that the furniture industry in his hometown should have a better development, which must move towards standardization, high-end, and internationalization. He hoped to use what he had learned to make contributions to the transformation and upgrading of the furniture industry in Nan Kang (*ibid*).

Li has witnessed the historical transformation of the furniture industry in his hometown from extensive production to strategic upgrading during his growth. Initially,

[2] Lu Ban was a famous carpenter and inventor in ancient China and a symbol of the wisdom of the ancient working people.

the factory environment was dirty, chaotic, and of poor quality, leading many furniture enterprises into vicious competition marked by homogeneity. Later, under the guidance and regulation of the local government, the Nan Kang furniture industry gradually underwent transformation and upgrading. Li's early career coincided with the flourishing "golden period" of the furniture industry in Nan Kang. During this period, Nan Kang district relied on household towns and Ganzhou International land port. It strategically developed its furniture industry with a focus on high-end, high-quality production processes. The district shifted its emphasis from traditional manufacturing to intelligent manufacturing, from labeling to brand creation, from single domestic trade to global trade, constantly promoting Nan Kang's furniture industry from big to strong. Through these efforts, Nan Kang became the output scale reached 200 billion yuan for industrial cluster (*ibid*).

#### 8.5.1.2 Practitioners and Transmitters of Spirit of Craftsmanship

Spirit of Craftsmanship is a kind of professionalism, covering a sense of dedication, precision, focus, and innovation. It is a key factor to ensure high-quality, high-precision products and services, and is also an important force to promote scientific and technological progress and industrial upgrading. Li's ability to stand out in the WorldSkills Competition largely stems from the inspiration of artisan spirit. Li states, "it is not easy to win the WorldSkills Competition. For example, when making a cabinet at the competition site, there are as many as 144 scoring points, and the error of each angle cannot exceed 0.5 mm, which is extremely strict" (Huang, 2023). In order to reach the ultra-high technical level, in the past 4 years, Li has trained more than 300 days a year, more than 10 h a day, and the calluses on his hands from the palm to the fingertips. His coach, Zhang Fuhua, mentioned, "Since he knew that there was no lunch break during the final, he began to get rid of his habit of taking a nap in the afternoon, only to adjust his biological clock and still maintain abundant physical strength and energy during the noon period" (Liu & Xiao, 2022). During this competition, the judges watched Li making the difficult detail of "double swallowtail tenon" and gave him a thumbs up after watching.

Li is becoming a transmitter of artisan spirit. In recent years, Jiangxi Environmental Engineering Vocational College has issued a series of policies to cultivate and retain talents. High-skilled talents who meet certain conditions can stay in the school to teach. Li is one of the beneficiaries. After obtaining the professional qualification of senior skilled craftsman in manual carpentry, and the titles of national skilled craftsman and national youth skilled craftsman, he meets the conditions for staying in the school and decides to stay in the school as a teacher.

Li caught up with the golden era when the country attached great importance to the construction of skilled personnel and vigorously developed vocational education and technical education. He believes, "The release of a series of national policy dividends has made talents committed to the development of vocational and technology more useful, and the 'Spirit of Craftsman' has been better passed on from generation to generation. In the future, I will continue to stick to my vocational education post and train more industrial workers with my heart. I believe that more Great Craftsmen will emerge in the future" (*ibid*). Not only that, Li's exemplary journey is becoming the "spokesperson" of vocational education enrollment. Li's coach Zhang Fuhua said: the "champion effect" is the best recruitment attraction (*ibid*). Li's story shows that a carpenter can also become a world champion. This will encourage more and more parents to send their children to vocational schools, enabling a large number of students to become highly skilled craftsmen.

### *8.5.2 Lv Jie: The Uncommon Brilliance of Vocational Education Cultivators*

Lv Jie, who used to be the enterprise's technical backbone and formerly a chief technician, has created a lot of value for her company. However, she believes that only by imparting her skills to more people can she create greater value, so she resolutely gave up her lucrative position in 2009, with a beautiful dream, to become a vocational college teacher. It is because of her outstanding contributions in the field of welding and welding education that she has won many honorary titles such as the Outstanding Contribution Award for National Skilled Talent Cultivation (*guojia jineng rencai peiyu tuchugongxianjiang*) and National Model for Teaching and Talent Development (*quanguo jiaoshu yuren kaimo*). Her deeds have been recognized as exemplary by MOE and subsequently featured in promotional reports on China Central Television (CCTV) and the China Civilization Network (MOE, 2019a; Gansu Civilization Office, 2019).

#### 8.5.2.1 Bravely Shoulder the Heavy Task of Welding Practical Training and Education Reform

The practical training system is an indispensable part of vocational education, and the quality of practical training largely determines the technical skill level of vocational education students. As for teachers, "to give students a half-bucket of water, teachers themselves must possess a full bucket". Lv Jie places great emphasis on enhancing her own technical proficiency and has mastered various techniques such as manual metal arc welding, submerged arc welding, and $CO_2$ gas-shielded welding. She has successively obtained certificates for special equipment welding operators, welder technicians, and senior welder technicians.

Based on her own high precision technology, she has implemented reforms in the welding practical training teaching system of the school, taken the practical training teaching plan as the program, developed practical training courses, compiled practical training materials, and undertaken practical training courses. In practical teaching, she formulates practical teaching plans with the guidance of social and market development. She arranges students' internship projects and internship periods reasonably and implements the practical teaching plans gradually to make the students' practical projects gradually improved, so that students can more easily master the operational skills and close to production practice. She focuses on cultivating application-oriented and skilled talents. She has participated in the development and construction of welding inspection courses and has also undertaken experimental tasks such as welding inspection, ultrasonic inspection, magnetic particle inspection, and ray detection test, providing an important experimental basis for welding technology. She has undertaken the work of compiling school-based textbooks such as *Welding Practical Training Outline, Welding Technician Boutique Course, and Welding Technology*. She has also produced courseware for argon arc welding, $CO_2$-shielded arc welding, submerged arc welding, etc. She has also undertaken the teaching, experimental, and practical guidance of courses such as Welding Production Practice, Welding Technology, and Welding Technology for Boiler and Pressure Vessels, as well as the compilation of teaching plans, syllabuses, and examination syllabuses.

#### 8.5.2.2 Exploring a Scientific Method for Training Highly Skilled Welding Professionals

Since beginning teaching, Lv Jie has carefully summarized her unique skills and successful experience in participating in the competition, combined with the specific situation of each student, summed up a set of scientific training methods for high-skill welding talents: One center, two grasp, three attention, four links, namely to the weld quality qualified as the center, grasping physical training, psychological counseling, and found the students technical expertise and summary promotion, targeted in the training process, attaches great importance to the "welding culture" in the art of the process of infection boring skills training specification process on link, perfect performance demonstration link, strengthen tour guidance link, summarizes the teaching feedback link.

Welding skill training is a relatively repetitive and difficult process. In the process of training students, Lv Jie formed and paid attention to the rendering of "welding culture". With her exquisite and perfect demonstration, generous demonstration actions, and beautiful welding techniques, pieces of handicraft-like welds appear in front of students. She puts forward the welding culture of "weld appearance and quality aesthetics", which makes students inadvertently turn boring training into a process of pursuing excellence.

#### 8.5.2.3 Making Contributions to Enterprises and Society by Overcoming Welding Challenges One by One

Lv Jie believes that without the hot land JISCO (Jiuquan Iron and Steel Group Co., LTD) or the world Gansu Metallurgical Advanced Technical Institute, her journey would not be as successful as now. In front of many honors, she feels more gratitude and responsibility. Closely combined with the needs of regional economic construction and industrial upgrading, relying on the national master studio—Lv Jie Welding Innovation Studio.

The team led by Lv Jie has successfully addressed various welding challenges in different projects. They resolved porosity issues in the welding process for carbon steel sheets at Jiugang Steel Thin Plate Plant, tackled welding problems causing leaks in the heating boilers of 29 tanks for a tank brigade stationed in Jiayuguan, assisted in overcoming cracking issues during the lifting process of tower cranes at the construction site of Quanhu Lake in Jiuquan City, addressed welding challenges related to the cathode plates for the Salt Lake Group contracted by Jiugang Western Heavy Industry, and solved welding issues with the bearing seat detachment on the threaded rod of the CY-8013 mobile CNC lathe for Jiugang Transportation Department.

In 2015, the studio collected technical problems in the field of welding for enterprises to serve society. The studio has solved the welding problem of repeated cracking of the inner lining of the carbon steel sheet factory cover furnace, the leakage problem of the electric furnace of the West Heavy Industry of JISCO, the serious corrosion problem of the base material in the welding process of the stainless steel composite plate of the Honghui coal-to-gas desulfurization tower of the new project of JISCO, and repaired the crack of the 60 ton crane drum in the dry quenching coke plant of JISCO. Moreover, the studio joint research and development of welding wire steel with Gansu Province Welding Material Engineering Technology Research Center. In 2016, the welding process of 2205 ship plate steel newly developed by JISCO Stainless Steel Research Institute was studied. In 2018, the welding process qualification of a new steel grade "Zn–Al–Mg alloy coating" steel plate in the JISCO Carbon Steel Sheet Plant was carried out, which contributed to the development of the JISCO steel market. In recent years, the studio has saved equipment costs of nearly 10 million yuan for enterprises to solve welding problems.

Lv Jie is a highly esteemed representative of "dual qualified" teachers, demonstrating proficiency in executing the teaching, research, and service roles of the university. Leveraging her practical knowledge gained from industrial experience, she has dedicated herself to enhancing major construction and teaching reform, ultimately elevating the effectiveness of vocational education personnel training. Additionally, she conducts applied technology research and offers technical support services to the enterprise, further contributing to its growth and development.

## 8.6 Latest Research

### 8.6.1 *An Overview of Research on Vocational Education in China*

After more than 40 years of development and construction, vocational education in China has accumulated vast practical experience and theoretical achievements. Using "vocational education" as the keyword, the latest 5-year Chinese Social Science Citation Index (CSSCI) journal papers (2019.1.1–2023.10.20) are searched on the China National Knowledge Infrastructure (CNKI) website. After removing duplicates and irrelevant literature, a total of 2030 articles were published. Vocational education is a research field that covers multiple levels and types, with an annual publication volume of over 400 articles.

Table 8.3 lists keywords with a frequency of 16 times or more. Excluding words such as vocational education, vocational colleges, vocational education, vocational colleges, and higher education, the top 10 most frequently occurring keywords are integration of industry and education, rural revitalization, school-enterprise cooperation, talent cultivation, ethnic regions, Germany, education poverty alleviation, common prosperity, artificial intelligence, and type education.

On the one hand, vocational education researchers have conducted in-depth research on some stable research issues, such as the integration of industry and education, school-enterprise cooperation, and talent cultivation. On the other hand, keywords such as rural revitalization, artificial intelligence, double high plan (as referred to in the Plan for the Establishment of High-level Vocational Schools and

**Table 8.3** Keywords with a frequency of 16 or more occurrences

| Frequency | Keywords | Frequency | Keywords | Frequency | Keywords |
|---|---|---|---|---|---|
| 521 | Vocational education | 39 | Vocational college | 22 | Craftsmanship spirit |
| 130 | Industry-education integration | 35 | Germany | 19 | Double High Program |
| 122 | Higher vocational college | 35 | Education poverty alleviation | 18 | New era |
| 73 | Rural revitalization | 30 | Higher education | 18 | Education policy |
| 62 | Higher vocational education | 27 | Prosperity in common | 18 | Human capital |
| 58 | School-enterprise cooperation | 25 | Artificial intelligence | 16 | Skill formation |
| 48 | Personnel cultivation | 22 | Type education | 16 | Japan |
| 39 | Ethnic Regions | 22 | Specialty cluster | 16 | Educational equity |

Majors with Chinese Characteristics), and vocational education college entrance examination reflect the sensitivity of Chinese vocational education research to policies and its recognition of vocational education's crucial role in China's socioeconomic development. In addition, there are many studies on vocational education systems in other countries, with Germany being the most studied, followed by Japan, the U.S., Australia, and the U.K.

## *8.6.2 Research Focus*

### 8.6.2.1 Research on Rural Revitalization

The rural revitalization strategy is a major measure to address the contradiction between unbalanced urban–rural development and insufficient rural development in China (Huang, 2018). Vocational education, as a type of education that integrates the four fields of vocational domain, technical domain, educational domain, and social domain (Zhu & Yan, 2020), shoulders the mission of promoting urban–rural integration and stimulating endogenous development momentum in rural areas (Wang & Le, 2022). The stable coupling relationship between vocational education and rural revitalization has been widely recognized (Zhu & Wang, 2021).

Based on the background of rural revitalization strategy, scholars have elucidated the livelihood, living, and ecological values of vocational education in the process of rural revitalization (Xie & Yan, 2019), as well as the intrinsic value of vocational education in cultivating new farmers and the instrumental value in serving rural community construction (Ma & Li, 2020). In terms of path exploration, scholars have explained from different perspectives how vocational education can help achieve the overall requirements of "prosperous industries, livable ecology, civilized rural culture, effective governance, and prosperous life" in rural areas (Jiang et al., 2020; Xu et al., 2020). Chen and Wang (2019) demonstrated the benefits of vocational education in serving economic growth in rural areas based on national panel data. In the future, vocational education in China should serve comprehensive rural revitalization by revitalizing rural cultural resources, empowering local talents in rural areas, enhancing professional integration with industries, creating a harmonious rural ecosystem, and promoting rural organizational governance (Peng & Zhu, 2022).

### 8.6.2.2 Research on the Industry-Education Integration

The integration of industry and education is an essential attribute and connotation feature of vocational education. Chen (2018) pointed out that the integration of industry and education is a talent cultivation model that combines "industry" and "education", "enterprises" and "schools", and "industry" and "learning". It has the characteristics of cross-border, dual subject, and dynamic adaptation. The basis for cooperation in the integration of industry and education is to establish an equal mechanism between enterprises, industries, and universities, and both parties jointly undertake the same mission of cultivating vocational education talents (Wang, 2014). At the theoretical level, scholars have constructed various models to promote innovation in the talent cultivation model of industry education integration in vocational colleges, such as the double helix talent cultivation model proposed by Zou (2021) and the internal–external dual model of talent cultivation constructed by Liu (2022). At the practical level, researchers have evaluated the effectiveness and summarized their experience of exploring the integration of industry and education in Chinese vocational education. Zhu and Zhang (2022) constructed an evaluation index system for the maturity of industry education integration from five aspects: resources, organization, implementation, effectiveness, and reputation. They evaluated 15 vocational colleges using this evaluation index. Liu et al. (2023) analyzed three different vocational education industry education integration models and their effectiveness and proposed that the integration of industry and education in the Chinese path to modernization should provide strong technical support, talent support, and industrial support for the economic and social construction of Chinese path to modernization through the cross-border of vocational education and social parties.

#### 8.6.2.3 Research on College Entrance Examination of Vocational Education

In 2019, the *National Vocational Education Reform Implementation Plan* proposed the concept of a vocational education college entrance examination system. This system is a skilled talent recruitment and selection system that runs parallel to the ordinary college entrance examination and targets secondary vocational school graduates for enrollment (Wang, 2020). While not entirely new, the College Entrance Examination of Vocational Education represents the latest policy of China's current higher vocational school enrollment examination system (Zhu & Yang, 2022).

The College Entrance Examination of Vocational Education system has four objectives: first, to promote the formation of a talent training system for technical application; second, to promote the connection between secondary and higher vocational education; third, to promote the integration of general education and vocational education; and fourth, to ensure equitable access to education for secondary vocational students (Xu, 2020). At the same time, the vocational education college entrance examination can help alleviate the excessive competition caused by traditional examinations, support the selection and cultivation of vocational education talents, and promote the transformation of a skilled society (Jiang & Xu, 2022). It is also conducive to solving the difficulties of enrollment in vocational schools, helping them expand their enrollment scope and improve the quality of student sources (Liu & Feng, 2015). However, some researchers have pointed out that the vocational education college entrance examination may affect the operation of secondary vocational education, which is increasingly focused on further education (Jiang, 2022).

Feng and Liu (2022) emphasized that vocational education should strengthen the assessment of skills in the college entrance examination, highlighting the particularity of vocational education. However, the standards for skill exam scores are difficult to establish and lack universality (Xu, 2020). The vocational education college entrance examination should be based on a scientific and effective evaluation of professional abilities, and adopt qualitative, quantitative, and hybrid methods to measure the vocational education examination model (Zhao & Huang, 2019).

#### 8.6.2.4 Research on Vocational Undergraduate Education

*The National Vocational Education Reform Implementation Plan* issued in 2019 clearly proposed to implement pilot programs for undergraduate-level vocational education, and the growth rate of related research publications surged (Zhang & Zhu, 2023). Zeng et al. (2021) believe that the development of vocational undergraduate education is of great significance. It is not only an urgent need for high-quality economic development, but also an objective requirement for achieving fuller and higher quality employment, a key move to establish the type of orientation of vocational education, and a strategic move to shape the international competitiveness of the industry. Thirty-two vocational undergraduate schools in China have been developed in batches, but their development motivations vary. Some are driven by the school's upgrading impulse, while others respond to practical needs (Kuang et al., 2022). Vocational undergraduate education has the important characteristics of serving the industry, employment oriented, and taking the path of combining industry, academia, and research. It is a practical vocational education that differs from ordinary undergraduate and vocational education (Lu, 2019). A major theoretical and practical issue that urgently needs to be explored is how to construct a distinctive talent cultivation model for vocational undergraduate education. Researchers have conducted theoretical construction and practical exploration in various aspects such as professional construction, curriculum construction, teaching reform, evaluation reform, and teacher team construction (Lu et al., 2021; Yang, 2022). Liang (2021) pointed out that there is an urgent need to strengthen top-level design, improve supporting systems, identify development paths, stabilize the scale of education, strengthen support and guarantee, improve the quality of education, focus on professional construction, promote cooperative education, and focus on promoting stable and far-reaching vocational undergraduate education.

#### 8.6.2.5 Research on Coordinated Development of General Education and Vocational Education

On May 1, 2022, China passed the newly revised *Vocational Education Law*, which changed the original expression of separating general and vocational education to coordinate the development of vocational education and general education. This new expression has prompted a reexamination of the interaction between general and vocational education in society. As a longstanding education policy in China, vocational education integration has the continuity and development of policies (Sun &

Cui, 2022). Jiang et al. (2023) proposed that the coordinated development of general education and vocational education has become a consensus. However, from the current practice, China faces practical difficulties such as a lack of overall institutional design for high school education and difficulty in overcoming obstacles at the level of higher education. Jin and Shi (2022) analyzed the connotation of "coordinated development" from four dimensions: consistent goals, balanced relationships, unique functions, and flexible implementation. The basic premise for the coordinated development of general education and vocational education is tailored to local conditions and coordinated promotion. Various countries and regions have formed customized and unique models in the process of exploration and practice (Zhang & Jin, 2022). The international integration of vocational education has formed three mainstream models: vocational education curriculum penetration (Germany), vocational education mutual transfer (Singapore), and thorough integration (U.S.) (Kuang & Li, 2023), providing reference and guidance for promoting coordinated development of vocational education in China.

## 8.7 National Policies

Since the establishment of New China 70 years ago, China has implemented a diverse range of policies in the realm of vocational education, all of which have significantly contributed to its planning, development, deployment, and reform.8.4 offers a concise overview of key policies in vocational education that have been executed by China over the past 5 years. Collectively, these policies and initiatives have been instrumental in shaping the present landscape of vocational education in China. The subsequent discussion centers on the interpretation of three documents: *Implementation Plan for Deepening the Reform of the "Dual-Qualified" Teaching Force in Vocational Education in the New Era*, and *Implementation Plan for Deepening the Reform of the "Dual—Qualified" Teaching Force in Vocational Education in the New Era* (Table 8.4).

### *8.7.1 Vocational Education Law of the People's Republic of China*

In 2022, the 34th meeting of the Standing Committee of the 13th National People's Congress revised *the Vocational Education Law of the People's Republic of China.* This revision aimed to establish a national modern vocational education system aligned with the demands of economic and industrial development in the new era. The revised *Vocational Education Law* (hereinafter referred to as the new *Vocational Education Law*) has the following characteristics (Deng, 2022).

**Table 8.4** List of selected key vocational education policies for the period 2019 to 2023

| Year | Policy | Issuing department |
|---|---|---|
| 2019 | National vocational Education Reform implementation Plan | State Council |
| 2019 | Implementation Plan for Deepening the Reform of the "Dual—Qualified" Teaching Force in Vocational Education in the New Era | Ministry of Education, National Development and Reform Commission, Ministry of Finance, Ministry of Human Resources and Social Security |
| 2019 | Implementation Plan for Accelerating the Modernization of Education (2018–2022) | General Office of the CPC Central Committee, General Office of the State Council |
| 2019 | Measures for the Implementation of Industry—Education Integration (trial) | National Development and Reform Commission, Ministry of Education |
| 2019 | Action Plan for Enhancing Vocational Skills (2019–2021) | General Office of the State Council |
| 2020 | Action Plan for Improving the Quality of Vocational Education (2020–2023) | Ministry of Education, National Development and Reform Commission, Ministry of Industry and Information Technology, Ministry of Finance, Ministry of Human Resources and Social Security, Ministry of Agriculture and Rural Affairs, State-owned Assets Supervision and Administration Commission of the State Council, State Taxation Administration, State Council Leading Group Office of Poverty Alleviation and Development of China |
| 2021 | Opinions on Promoting the High—Quality Development of Modern Vocational Education | General Office of the CPC Central Committee, General Office of the State Council |
| 2022 | Vocational Education Law of the People's Republic of China | Standing Committee of the National People's Congress |
| 2022 | Opinions on Strengthening the Development of Highly Skilled Talent Team in the New Era | General Office of the CPC Central Committee, General Office of the State Council |
| 2022 | Notice on Implementing the Special Training Program for On-Site Engineers in Vocational Education | General Office of the Ministry of Education, General Office of the Ministry of Industry and Information Technology, General Office of the State-owned Assets Supervision and Administration Commission of the State Council, General Office of the Chinese Academy of Engineering, General Office of the All-China Federation of Industry and Commerce |

(continued)

**Table 8.4** (continued)

| Year | Policy | Issuing department |
|---|---|---|
| 2022 | Opinions on Deepening the Reform of Modern Vocational Education System | General Office of the CPC Central Committee, General Office of the State Council |
| 2022 | Plan for Strengthening and Improving the Modern Apprenticeship System with Chinese Characteristics in the New Era | Ministry of Human Resources and Social Security |
| 2023 | Implementation Plan for Empowering Industry—Education Integration in Vocational Education (2023–2025) | National Development and Reform Commission, Ministry of Education, Ministry of Industry and Information Technology, Ministry of Finance, Ministry of Human Resources and Social Security, Ministry of Natural Resources, People's Bank of China, State-owned Assets Supervision and Administration Commission of the State Council |

*The purpose of vocational education is clearly defined*. China is in a period of transforming its development mode, promoting high-quality economic development, and transforming its industry to the medium and high end, which requires a large number of high-quality technical and skilled personnel. At the same time, employment is the foundation of people's livelihood, and training workers with quality and technical skills is conducive to enhancing workers' employability and promoting the realization of high-quality employment goals. The new *Vocational Education Law* stipulates that the purpose of vocational education is to improve the quality and technical skills of workers, promote employment and entrepreneurship, build a strong education, human resources, and skill-based society, and pro-mote socialist modernization (*ibid*).

*The definition of vocational education is clarified*. The new *Vocational Education Law* defines vocational education as education, including vocational school education and vocational training, implemented in order to train high-quality technical and skilled personnel, so that the students can have professional ethics, scientific culture, and professional knowledge, technical skills, and other vocational comprehensive quality and action ability required for engaging in a certain profession or realizing professional development. This definition emphasizes the combination of vocational school education and vocational training, which helps workers improve their quality and technical skills through different forms and different stages of vocational education (*ibid*).

*The status of vocational education is highlighted*. The new *Vocational Education Law* emphasizes the important position of vocational education in the national education system and human resources development. This law clearly stipulates that vocational education and general education have the same important position, so that vocational education and general education have an equal standing. This change will help to improve the social recognition of vocational education, create a better environment for the development of vocational education, and attract more workers to enter vocational schools and participate in vocational training activities (*ibid*).

*The management level of vocational education is improved*. The new *Vocational Education Law* stipulates that vocational education implements government coordination, hierarchical management, local-based, industry guidance, school-enterprise cooperation, and social engagement. Governments at all levels are required to integrate the development of vocational education into their plans and carry out the overall implementation in conjunction with promoting employment and entrepreneurship, changing the development model, adjusting the industrial structure, and optimizing and upgrading technology. The State Council has established a coordination mechanism for vocational education, strengthening governance and facilitating administrative oversight (*ibid*).

*The structure of vocational education has been optimized*. The new *Vocational Education Law* emphasizes the integration of industry and education, and places equal emphasis on vocational school education and vocational training. It establishes a three-dimensional modern vocational education system that is vertically and horizontally integrated. This addresses the problems of lack of integration between vocational school education, technical education, and vocational training, and the problems of lack of interoperability between vocational education and general education. It provides workers after compulsory education with channels to receive different types and levels of vocational education and general education (*ibid*).

*The vocational education certificate is integrated*. Previously, the learning outcomes of vocational schools, technical schools, and vocational training had not recognized each other, nor were the learning outcomes of vocational education and general education recognized each other, which posed an obstacle for workers to choose education paths. The new *Vocational Education Law* stipulates that the state establishes a mechanism for certification, accumulation, and conversion of credits and qualifications. It promotes the construction of a national credit bank for vocational education and promotes the integration and mutual recognition of learning outcomes of vocational education and general education (*ibid*).

*The main body of vocational education is strengthened*. The new *Vocational Education Law* encourages diversified schools, supports the engagement of social entities in vocational education, and emphasizes the pivotal role of enterprises in vocational education. Enterprises are permitted to establish or jointly establish vocational schools and vocational training institutions. They are required to allocate a certain proportion of their total wages for the education of staff. These regulations will help to address issues such as insufficient participation, low enthusiasm, and disconnection from enterprises' demands, thereby enhancing the quality and effectiveness of vocational education (*ibid*).

*The forms of vocational education are diversified*. The new *Vocational Education Law* emphasizes that vocational education should be market-oriented, serve social and economic development, and focus on the integration of production and education and school-enterprise cooperation. Vocational schools are encouraged to establish collaborative mechanisms with relevant industry organizations, enterprises, and public institutions to enhance students' employability and entrepreneurial skills. At the same time, the implementation of an apprenticeship system with Chinese characteristics is promoted, guiding enterprises to set up apprenticeship positions for training and promoting a close integration of vocational education and industry (*ibid*).

*Equal opportunity in vocational education is reinforced*. The new *Vocational Education Law* has made special provisions aiming at ensuring equal development opportunities and treatment for teachers and students engaged in vocational education. It requires that the professional quality and social status of vocational education teachers be improved, and a sound training system for vocational education teachers be established. For students receiving vocational education, the new law stipulates that they enjoy equal opportunities with students in regular schools at the same level in terms of education, employment, and career development (*ibid*).

*The legal rights and interests of vocational education are strengthened*. The new *Vocational Education Law* stipulates that students' rights and interests are protected by law. Enterprises are encouraged to arrange internships, and internship units should protect students' rights and interests, provide matching positions, and clarify internship content and standards. Units that violate the regulations shall bear legal responsibility. The new law effectively protects the rights and interests of internships, restrains the infringement of rights and interests, and assures internships to fulfill their intended roles (*ibid*).

The newly revised *Vocational Education Law* is a milestone in the reform and development of China's vocational education, which for the first time clarifies the status of vocational education as an independent type of education in the form of a law, providing a solid legal guarantee for the high-quality development of vocational education. The introduction of this law not only marks that China's vocational education has entered a new stage of development, but also reflects the country's great attention to and strong support for vocational education.

### 8.7.2 Implementation Plan for Deepening the Reform of Developing "Dual Qualified" Teaching Force in Vocational Education in the New Era

The teaching workforce is the basis for promoting the modernization of vocational education. However, challenges such as teacher shortages, single source, and poor two-way flow between schools and enterprises persist. In particular, the scarcity of "dual qualified" teachers restricts the reform and development of vocational education. "Dual qualified" teacher refers to a teacher who has both theoretical and practical teaching abilities, stay updated with industry trends and talent demand, and has experience in enterprises or actively engages with a front line of production and service. They understand the relationship between their teaching subjects and the industries, understand the development of industry and demand in professional positions, and integrate new technologies, processes, and specifications into teaching in a timely manner. In order to cultivate high-quality "dual qualified" teachers, the state formulated the *Implementation Plan for Deepening the Reform of Developing "Dual Qualified" Teaching Force in Vocational Education in the New Era* in 2019 (hereinafter referred to as the Implementation Plan) (MOE et al., 2019). The Implementation plan outlines 12 work measures around the overall goal, namely, building a standard system, developing two basic systems of reform and innovation, improving three management guarantee mechanisms, and implementing six measures to improve the quality of teachers (MOE, 2019b).

#### 8.7.2.1 Overall Objective

After 5–10 years, China will establish a teaching body construction mechanism under the overall management of the government and the deep integration of industry, enterprises, and colleges, improve the training system for secondary and higher vocational education teachers, open up the two-way flow channels of school and enterprise personnel, and ensure a sufficient number of "dual qualified" teachers and teaching teams. The "dual qualified" structure will be significantly improved. A distinctive qualification access and appointment assessment system for "dual qualified" teachers will be established. The channel for teachers' career development will be smooth, the treatment and guarantee mechanism will be improved, and the attractiveness of vocational education teachers will be significantly enhanced, leading to a high quality "dual qualified" teaching body with noble ethics, exquisite skills, professional combination, and vitality (*ibid*).

#### 8.7.2.2 Establishing a Comprehensive System of Teacher Standards

The state will establish a professional standard system for teachers with distinct levels of secondary and higher vocational education, covering various courses such as public courses, specialized courses, and practical courses. The state will continuously improve the evaluation standards system for vocational education teachers (*ibid*).

#### 8.7.2.3 Reforming and Innovating the Two Basic Systems

The majority of vocational education teachers transition directly from academic institutions to teaching roles at vocational colleges, resulting in a significant absence of hands-on practical experience. This gap in real-world knowledge has emerged as a significant impediment to enhancing the overall quality of vocational education.

To reform the access system for new teachers, the state will reform the recruitment process for new teachers and improve the examination system for teaching qualifications in vocational education. It will establish an open recruitment mechanism for high-level and highly skilled personnel through direct inspection and explore the establishment of a new teacher education probation and enterprise practice system. Since 2020, individuals with fewer than 3 years of work experience in industry enterprises are ineligible for teaching positions at vocational education institutions (*ibid*).

In contrast to the assessment of general education teachers, the evaluation of vocational education teachers must not solely focus on academic achievement, but rather emphasize the assessment of practical experience. To deepen the reform of teacher evaluation, the "dual qualified" quality is regarded as the core. The state will establish a "dual qualified" teacher evaluation and assessment system involving vocational colleges, industrial enterprises, and training and evaluation organizations. The reform will extend to the teaching rank system, addressing issues such as overemphasis on diplomas, papers, hats, status, and awards. Local institutions will be encouraged to formulate standards for identifying "dual qualified" teachers in light of actual conditions. Teachers' ethics, artisan spirit, technical skills, and educational and teaching achievements should be the main basis for professional title evaluation and recruitment. The state will implement the code of conduct for teachers, establish a negative list system for teacher ethics assessment, and strictly implement the one-vote veto in teacher ethics assessment (*ibid*).

#### 8.7.2.4 Improving Three Safeguard Mechanisms

To strengthen the school leadership over the teacher development, the government will implement the "double leaders" training program for teachers, to improve the education mechanism of combining moral and technical training and combining work with study, and promote the spirit of professionalism, craftsmanship, and model workers.

To implement rights protection and incentive mechanisms to enhance social status, income from university-enterprise cooperation and technical services can be used as the source of performance pay. Moreover, the burden reduction policy for vocational education teachers can be formulated. Local governments will adjust the total amount of performance-based pay in light of regional conditions (*ibid*).

To strengthen the safeguard measures for teacher development, support will be prioritized for high-level vocational colleges and specialized programs. The reform agenda for building a modern vocational education will be geared toward enhancing teaching quality as a strategic focus (*ibid*).

#### 8.7.2.5 Implementing Six Measures to Improve the Quality of "Dual-Qualified" Teachers

To build a multidimensional educational framework with vocational and technical normal colleges as the cornerstone, the state will support high-level engineering universities in conducting vocational and technical teacher education and run a number of first-class vocational and technical teacher colleges and programs.

To improve the teacher resource allocation mechanism, the state will implement the modern industry mentorship plan, and promote a professional teaching system comprising fixed and mobile teaching positions, structured with an academic-industrial teaching approach, and supported by dual-qualified teaching staff (*ibid*).

To establish close collaboration between academic and industry professionals, the state will normalize a reciprocal flow mechanism for university and enterprise personnel. This will help to develop a system to encourage teachers to engage in enterprise practices and promote participation in various forms of enterprise practices and training programs on a regular basis (*ibid*).

To meet the needs of the pilot "1 + X" certificate system and vocational education and teaching reform, the state will explore a multitiered teacher training model that adapts to the requirements of vocational skills training and cultivate a group of teachers capable of delivering certification training of vocational skills (*ibid*).

To create a high-level structured teacher-teaching innovation team, the state will develop 360 national vocational education teaching innovation teams and send 1,000 teachers to study abroad every year (*ibid*).

To strengthen the construction of high-level talents with the guidance of the "National Master Craftsmen", the state will implement the plan to improve the teaching quality in vocational schools, and create a team of esteemed teaching masters, major leaders, and emerging teachers with noble ethics, exceptional skills, and advanced education. This effort will create a group of "National Master Craftsmen" covering key professional fields to meet the needs of strategic emerging industries and advanced manufacturing talents. China will build 1,000 national-level "dual qualified" teaching master studios and 1,000 national-level teacher artistry and skills inheritance and innovation platforms (*ibid*).

### *8.7.3 Implementation Plan for Empowering Industry-Education Integration in Vocational Education (2023–2025)*

In order to promote the integration of industry and education, optimize the supply structure of human resources, and provide strong support for the socialist modern country, eight departments including the National Development and Reform Commission and MOE jointly issued the *Implementation Plan for Empowering Industry-Education Integration in Vocational Education (2023–2025)* (NDRC et al., 2023). The plan proposes that by 2025, the national pilot cities for the integration of industry and education will reach about 50, cultivate more than 10,000 enterprises for industry-education integration, improve the enterprise system for such integration and the combined incentive policy system, steadily increase the investment of various capital channels in vocational education, and realize the development pattern of overall integration and reinforce interaction between education and industry. To achieve these objectives, the program sets out five priorities.

#### 8.7.3.1 Promoting Some Cities, Industries, and Enterprises to Play an Exemplary Role in Industry-Education Integration

First, the state will review the practice of the first batch of national pilot cities on industry-education integration and select another 30 national pilot cities. Second, industry-education integration will be further promoted in strategic emerging industries, such as next-generation information technology, integrated circuits, and artificial intelligence. Third, the state will start the second-round selection of industry-education integration enterprises at the national level, from a pool of state-owned enterprises, outstanding private enterprises, national manufacturing innovation center, leading manufacturing enterprises, and specialized emerging enterprises (*ibid*).

#### 8.7.3.2 Laying a Solid Foundation for Developing Vocational Colleges

First, the state will conduct a midterm evaluation of the project. The evaluation will help to enhance educational capacity and make timely adjustments to the project planning. Second, as part of the 14th Five-Year Plan, the government will add about 200 higher vocational colleges, apply for undergraduate colleges, and give key support to qualified vocational education industry-education integration projects. Third, the state will encourage and guide vocational colleges to prioritize the development of emerging majors, speed up the construction of majors in short supply, transform, and upgrade traditional majors, and eliminate those with excessive supply and low employment rates (*ibid*).

#### 8.7.3.3 Building a Training Base for Integrating Industry and Education

First, the state will allocate investments from the central budget to support the construction of integrated industry and education training bases, accomplishing the goal of building 100 high-level, specialized, and open integrated industry and education training bases. Second, when arranging investment within the central budget, priority will be given to the construction of training bases in advanced manufacturing, new energy, new materials, biotechnology, artificial intelligence, and other fields, as well as in nursing, health care, childcare, home economics, and other fields. Third, the central government will support qualified localities to establish a "green channel" for joint approval by multiple departments, optimize the approval process for vocational school project construction, strengthen factor guarantees, and facilitate the construction of vocational school projects (*ibid*).

#### 8.7.3.4 Deepening University-Enterprise Cooperation in Integrating Industry and Education

First, the state will support vocational schools to jointly build key laboratories, engineering research centers, technological innovation centers, entrepreneurship and innovation centers, enterprise technology centers, and other innovation platforms. These platforms will serve the technological upgrading and product development of local small, medium, and micro enterprises. Vocational schools will be encouraged to establish internship and training bases in enterprises, while enterprises will be encouraged to build cultivation and training bases in vocational schools. Vocational schools and enterprises will be encouraged to jointly build and manage industrial colleges and enterprise colleges (*ibid*).

Second, enterprises are encouraged to actively engage in the professional planning of vocational colleges, textbook development, teaching design, curriculum development, practical training, the implementation of school-enterprise joint enrollment, commissioning training, order training, and apprenticeship training. The state will support enterprises in accepting students for practical training and guide enterprises in setting up apprenticeship positions (*ibid*).

Third, the state will support establishing mixed-ownership branch schools or industrial colleges through collaborations between industrial parks, vocational colleges, and universities. This will promote the reform of joint stock and mixed-ownership in vocational colleges, and allow enterprises to participate in running schools with capital, technology, management, and other factors in accordance with the law (*ibid*).

Fourth, the country will build city-wide industry-education integration consortiums based on industrial parks and create industry-education integration communities in key industries and fields. The role of vocational education groups (alliances), city-wide industry-education integration consortiums, and industry-education integration communities will be brought into play to improve the quality of talent training and promote high-quality employment (*ibid*).

#### 8.7.3.5 Improving Incentives and Support Measures

First, the government will review the existing policies on industry and education integration in vocational education, explore innovative incentives, form guiding documents, improve the "financial + fiscal + land + credit" combined incentives, and support local governments to introduce practical policies (*ibid*).

Second, the National Development and Reform Commission will put its efforts into recommending medium- and long-term loan projects for the integration of vocational education and industry into financial institutions. The state will encourage banking institutions to support the development of industry-education integration projects and industry-education integration enterprises in accordance with the principle of risk control and commercial sustainability, guide insurance institutions to develop insurance products related to industry-education integration, and support eligible enterprises with financing and special bonds to build practical training bases (*ibid*).

## 8.8 Summary

This chapter examines the development of VET in China and some other countries. The Highlighting data section selects representative basic data and describes the characteristics of the development of secondary vocational education in China and major countries in the world from the dimensions of scale, structure, resources, and outcomes of VET. In the context of resource allocation, the percentage of secondary vocational education teachers in China with advanced degrees has been gradually increasing each year, albeit it remains generally below that of their counterparts in secondary general education. Additionally, there has been a noticeable decline in the proportion of secondary vocational education graduates obtaining professional certifications in China. This trend is attributed to a growing preference among students for pursuing higher education opportunities instead of entering the workforce directly.

When it comes to instructional effectiveness, as demonstrated by the WorldSkills competitions, China has consistently excelled in the field of professional skills development, surpassing other countries in the past three years. However, in terms of resource allocation, China's fiscal commitment to vocational education per student remains comparable to that of regular high schools. While the proportion of national input for vocational education relative to the overall education budget remains the same, the practice-oriented nature of vocational education necessitates greater investment. Consequently, the resources allocated to secondary vocational education in China are inadequate. Furthermore, the student-to-teacher ratio in China's secondary vocational schools surpasses that of regular high schools, similar to the situation in other countries.

After more than a decade of continuous exploration, digital teaching resource databases have effectively promoted the development of vocational education (Fang & Guo, 2019). A number of pilot cities have been established for integrating industry and education (MOE, 2023a). However, some resources in these databases lack quality, and there has been insufficient attention to protecting intellectual property rights (Zhang et al., 2021). The policy of integrating industry and education relies too much on authoritative tools while ignoring other types of policy tools, such as capacity tools, symbolic and persuasive tools (Xu & Zhang, 2022).

For a long time, vocational education in China has been mired in the “stigma” evaluation, and even regarded as inferior to general education (Yang et al., 2023). Li Dexin’s story tells us that vocational education focuses on cultivating proficient operational skills and the spirit of craftsmanship, which is more suitable for students who are good at practical operation. Lv Jie’s story tells us that excellent “dual qualified” teachers can balance and integrate their roles in teaching, research, and social services. With such practices, the social recognition and attractiveness of vocational education are anticipated to improve.

The newly revised *Vocational Education Law* of the People’s Republic of China considered the cornerstone of China’s vocational education reform and development, clearly defines vocational education as a distinct form of education for the first time in legal terms. It provides a solid legal guarantee for promoting high-quality vocational education. The implementation plan for developing quality vocational teaching explicitly outlines specific measures for enhancing “dual-qualified” teaching teams in vocational education in China. However, the effectiveness of these measures in cultivating high-quality teaching personnel requires further evaluation.

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