

China's Achievements in Digital Education in the Wake of Education Informatization 2.0 Action Plan

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Abstract: This article is a survey of the major achievements China has made in digital education since the introduction of the Education Informatization 2.0 Action Plan. Drawing on the existing research literature and relevant reports from the Ministry of Education of China, the study looks at the outcomes of digital education in China in six dimensions: digital infrastructure, digital educational resource platforms, teacher and student digital competence, innovative teaching modalities, digital educational administration, and educational equity. It finds that Chinese education has undergone significant advances in the coverage of internet connection and digital equipment, construction of the national smart education platform, popularization of the smart campus, digital competence development in the teaching and learning community, and application of digital technologies in instruction and administration in the wake of the Action Plan, which have contributed to the enhancement of educational equity and quality in this country.

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IN RECENT decades, policy support has accelerated digital education development in China. The release of 2012's *Ten-Year Education Informatization Plan 2011-2020* marked the entry of Chinese education into the era of Educational Informatization 1.0 (Ministry of Education of China, 2012) and resulted in salient outcomes, including the development and application of the “three links and two platforms” (the school's link to a broadband network, the class's link to outstanding teaching resources, and the individual's link to an online learning space; the state's public educational resource and education administration platforms), increased IT application capacity in teachers, improved levels of educational technology, and magnified effects of educational technology in transforming education (Wang, 2018). Nevertheless, the Education Informatization 1.0 initiative is not without its challenges. Many school leaders had only a superficial understanding of IT application in education, focusing on its use in school management system improvement with disregard for the integration of technology into pedagogy (Lei, 2018). To sustain digital education development and cultivate talent that meets the needs of the digital era, the Ministry of Education (MOE) of China put forward the Education Informatization 2.0 initiative in 2018 (Zhu & Wei, 2018).

The *Education Informatization 2.0 Action Plan* (hereinafter referred to as the Action Plan) sets out the overarching goal and specific actions for China's digital education development in the new era. The Action Plan calls for building an internet-based, smart educational system that facilitates individualized and lifelong learning and emphasizes the integration of artificial intelligence into education, following the national “Internet plus” strategy (Ministry of Education of China, 2018). It is deemed a pivotal policy in the transition from the era of Education Informatization 1.0 to that of Education Informatization 2.0, with vital significance for enhancing the quality and equity of Chinese education.

This article delves into the implementation process of the Action Plan, aiming to summarize China's chief achievements and experiences in digital education development in its wake. Using the method of literature analysis, the study reviews relevant journal articles and monthly work reports on digital education and network security by the MOE (hereinafter referred to as MOE's Monthly Report), published after the release of the Action Plan in 2018. The literature selected provides credible evidence for this research, enabling a comprehensive analysis of the results of the Action Plan.

The Action Plan's Overarching Goal and Chief Actions

The Action Plan aims to accelerate the modernization of Chinese education and build China into a powerful country in education by leveraging

technology to transform its education system in the new era. Surrounding this goal, it proposes the following actions: (i) *Popularizing digital educational resource services*: to make digital resources generally accessible and promote equity in education by establishing a national public educational resources center. (ii) *Expanding the online learning space*: to afford the easy-to-use experience to teachers and students in their adoption of online learning spaces by standardizing their construction and application. (iii) *Narrowing the digital divide*: to assist underserved areas in improving digital education levels to bridge the disparities between advantaged and disadvantaged schools. (iv) *Optimizing digital education governance*: to upgrade the education administration information system to promote the coordination of public education institutions and enhance the levels of governmental decision-making and services in public education. (v) *Emphasizing the demonstration of exemplary models*: to offer guidance for nationwide digital education development by establishing a hundred pilot zones, a thousand model schools, and ten thousand demonstration courses. (vi) *Standardizing the construction of smart campuses*: to ensure that schools of all types at all levels develop an up-to-par smart teaching environment. (vii) *Innovating instructional paradigms using educational technology*: to elevate educational standards and efficiency by creating novel teaching modalities. (viii) *Boosting digital competence of the educational community*: to enhance the digital literacy and skills of teachers and students across the board.

These actions are intended to heighten the quality and equity of Chinese education as well as cultivate a pool of creative talent adaptive to societal digital transformation. The Action Plan has instigated the active participation of the governmental organizations and educational institutions in the digital transformation of education. The following sections of the article are devoted to a survey of the outcomes of digital education development in China in the era of Education Informatization 2.0 in the dimensions of digital infrastructure, digital educational resource platforms, teacher and student digital competence, innovative teaching modalities, digital educational administration, and educational equity.

Digital Infrastructure and Facilities

The Schools' Network Infrastructure

The construction of the schools' network infrastructure is the bedrock of digital education development. Recent years have witnessed a leap-forward advancement in basic digital infrastructure deployment in Chinese schools.

From 2018, China made a lot of efforts to popularize the deployment of IPv6-based internet infrastructure and upgrade application systems for its

education system (MOE's Monthly Report, October 2018); the satellite transmission technology was adopted to ensure the access of remote teaching sites to internet connection (Shen, 2019). As of the end of 2021, 99.95% of primary and secondary schools (including teaching sites) in China had access to a 100 megabytes-class bandwidth connection, and 19 of Chinese provinces had full coverage of this connection in all their schools. There were 216700 schools equipped with wireless networks in this country (MOE's Monthly Report, March 2021). In addition, 99.5% of primary and secondary schools have multimedia classrooms, with a total number of 4.08 million; among these schools, 87.2% had multimedia teaching equipment in all their classrooms. Together, approximately 28.49 million terminal computers were installed for teachers and students in schools at all levels (MOE's Monthly Report, March 2021). These figures reveal that the digital teaching environment is highly universalized in Chinese basic education.

The deployment of network infrastructure lays the groundwork for digital education, enabling the sharing of high-quality educational resources among various schools, efficient use of online platforms by teachers and students, and further development of online and distance education.

Digital and Smart Campuses

On a digital campus, IT and other technologies are used to create a supportive learning and working environment for teachers and students to improve the school's outcomes in instruction, administration, research, and other aspects (Li et al., 2025). The concept of the digital campus can be traced back to the "E-campus" program advanced by the Massachusetts Institute of Technology in the 1970s and was introduced in China in 2000 or so (Li et al., 2025).

To drive the construction of digital campuses, the MOE has released a series of documents, including the *Building Regulations for Primary and Secondary School Digital Campuses (Trial)* (Ministry of Education of China, 2018), *Building Regulations for Vocational College and School Digital Campuses* (Ministry of Education of China, 2020), and *Building Regulations for University and College Digital Campuses (Trial)* (Ministry of Education of China, 2021), to specify the objectives, standards, and basic components of digital campuses, as well as the procedures of their construction. In the meantime, the MOE launched pilot digital campus projects and selected demonstration schools to explore effective pathways for digital campus construction. For example, it initiated pilot digital campus projects in Shanxi Province's basic education in 2018, and by the end of 2023, a total of 31 schools were selected as municipal-level demonstration digital campuses (He et al., 2022), which produced valuable models for the construction of digital campuses across the province's primary and secondary schools.

Built on the digital campus, a smart campus emphasizes the use of more recent technologies, such as artificial intelligence, big data, and the internet of things, to realize personalized learning and intelligent school management (Shen, 2024). Compared to digital campuses, smart campuses are more permeated by technology and are of more significance for the development of the digital education ecosystem (Xiao, 2019). The smart campus places a higher value on the deep integration of technology and education for more advanced teaching and education management, representing the direction for future school improvement.

Higher education institutions are at the forefront of the smart campus movement. AI, 5G, big data, and other technologies have been heavily used to increase their intelligent capabilities. For instance, Zhejiang University began to introduce the 5G communication technology into its campuses in 2018, developing application scenarios of the technology regarding teaching support, evaluation mechanism optimization, and campus management (Shen, 2024). At the same time, upgraded campus networks, updated classroom digital equipment, and unified teaching resource and management platforms have propelled the improvement of smart classrooms.

Currently, China has achieved salient results in digital and smart campus construction. Particularly, the widespread application of the smart classroom has significantly increased education productivity while also elevating the intelligent level of school management and strengthening school safety and administration efficiency via applications like intelligent guard, intelligent access control, and intelligent attendance check.

Digital Educational Resource Platforms

The National Smart Education Platform

The National Platform of “Smart Education of China” aims to pool high-quality educational resources to serve the diverse needs of different learners. “Application, Service, Efficiency and Security” are the core focuses of “Smart Education of China,” as the MOE emphasized at its inaugural ceremony in March 2022 (MOE’s Monthly Report, March 2022). To further elevate the platform’s performance, the MOE’s General Office issued the *Regulations on the Management of Addition and Deletion of Digital Resources on the National Platform of “Smart Education of China”* (Ministry of Education of China, 2024a) and *Regulations on Review of the Content of Digital Educational Resources on the National Platform of “Smart Education of China”* (Ministry of Education of China, 2024b) in June 2024.

In December 2024, the MOE announced the inclusion of the national smart lifelong education platform in “Smart Education of China” to make it

span basic, tertiary, vocational, and lifelong education (MOE's Monthly Report, March 2024). The smart basic education platform of "Smart Education of China" provides high-quality course resources for subjects at primary, junior secondary, and senior secondary levels, supporting before-class preparation and after-class practice of students and classroom instruction of teachers. The smart vocational education platform supplies digital resources that serve vocational college and school curricula, supporting vocational skills training and practical education. The smart tertiary education platform provides college course resources and serves the teaching and research of the higher education community. The smart lifelong education platform offers courses for a wide variety of areas, such as scientific literacy, workplace skills, cultural literacy, interests, and hobbies, supporting adult recurrent education and lifelong learning. Primary and secondary school teachers and students have the highest recognition of "Smart Education of China," as revealed by relevant survey results (Wang et al., 2024a; Wang et al., 2024b). This category typically perceives the national platform as valuable because of its convenience to use, abundance of information, and resource accessibility.

The National Platform of "Smart Education of China" has won multiple accolades, with the most significant one being the UNESCO King Hamad Bin Isa Al-Khalifa Prize for the Use of Information and Communication Technology (ICT) in Education (MOE's Monthly Report, June 2023), a prize rewarding projects and programs of individuals or institutions, governmental organizations, and non-governmental organizations for the creative use of ICT. "Smart Education of China" stood out among 98 projects submitted by 58 UNESCO member states, marking China's extraordinary advancement in digital education.

Building of Digital Resources

To equip China's public education service systems like "Smart Education of China" with high-quality resources, the Chinese educational authorities have invested heavily in the development of digital educational resources.

Digital textbooks are an important component of digital educational resources. The development of digital textbooks at the basic education level is planned and organized by the MOE, engaging universities and educational publishing houses. As of December 2021, in the area of unified textbooks compiled by the MOE, 265 new digital textbooks have been created, and 20 existing ones revised for the "three central subjects" (Chinese, mathematics, and foreign languages) at the compulsory education level; 255 new digital textbooks have been created, and 74 existing ones revised for the "three central subjects" at the senior secondary level. For textbooks published by other publishing houses, such as the People's Education Press, 143 new

digital textbooks have been created, and 269 existing ones revised (MOE's Monthly Report, December 2021). On the other hand, the development of digital textbooks at the higher education level remains immature due to its involvement of many disciplines and majors and numerous textbooks, as well as a lack of standards for developing digital textbooks at this level. Most digital textbooks for college students serve as supplements to print textbooks in the form of embedded digital devices (such as QR codes in print textbooks, which students can scan to obtain additional audio or video materials), complementary online reading materials, etc. (Song & Wang, 2024).

In the meantime, the development of online courses has drawn much attention in the education community in China. "iCourse," a platform specializing in higher education curricular resources, is funded by the MOE and Ministry of Finance of China and operated by the Higher Education Press. As of February 2022, the number of open courses available on this platform was 63,900 (MOE's Monthly Report, February 2022). Also, "iCourse," in collaboration with "NetEase Cloud Classroom," created "China University MOOCs" to provide high-quality MOOCs for higher education teachers, students, and the popular public. By 2024, there were more than 76,800 online courses available on Chinese university MOOCs (MOE's Monthly Report, May 2024).

Despite the achievements in the field of digital educational resources, current provision cannot meet the huge demand for high-quality digital resources in the era of Education Informatization 2.0 due to a lack of sufficiently effective collaboration and sharing mechanisms. Certain researchers proposed the idea of establishing a co-building mechanism for digital educational resources based on a knowledge construction modeling map (He et al., 2023), which has the potential to pool funds, resources, and expertise to build a well-structured repertoire of high-quality digital educational resources.

Digital Competence of the Education Community

Student Digital Literacy

Student digital literacy entails the ability to acquire, process, and apply digital information, involving multiple aspects including digital awareness, ethics, self-efficacy, and more. In the context of the digital transformation, digital literacy is key to students' academic success in a digitized society. According to Xuan et al.'s (2021) study, digital literacy has a significantly positive effect on academic performance in students; it is also beneficial to their development of all-round competences, serving to be a steppingstone to future academic and professional advancements. The Action Plan

emphasizes student digital literacy development as an essential component of basic education.

Educational departments and schools in China have taken active measures to boost students' digital competence. The National Center for Educational Technology (NCET) annually updates its guidelines on student digital literacy education to direct schools' training practices. At the same time, the NCET conducts research into these practices, summarizing and introducing model cases to diffuse successful experiences nationwide. Furthermore, the IT course is included in the national curricula at various educational levels in China, and schools work to disseminate digital culture through a variety of on-campus activities (Liu, 2018). Also, teachers of non-IT subjects are required to encourage students to apply their IT skills in day-to-day study. In addition, regional educational agencies organize digital literacy competitions of various forms to raise digital awareness in local schools, such as the "Digital Navigation Cup" College Student Digital Literacy and Skills Competition hosted by Jiangsu Province's Department of Education (MOE's Monthly Report October 2024) and the Digital Maker Competition sponsored by Zhejiang Province's Department of Education (MOE's Monthly Report November 2024). Competitions like these aim to foster students' interest in digital skills and innovative mentalities while also providing them with opportunities to showcase their digital competences.

Teacher Digital Skills

Enhancing teachers' digital competence is of vital significance for the digital transformation of education. Digital proficiency is crucial for the teacher's instructional outcomes in the digital era. As per Yu's (2019) study, teachers with proficient digital skills can deliver classes of better quality in a more efficient manner by harnessing technology; they can also achieve more desirable professional development with higher competitiveness in the teaching force. More importantly, teacher digital proficiency is positively related to student digital competence; digitally proficient teachers act as ideal role models for students, piquing their interest in building knowledge about cutting-edge technologies.

The MOE has taken a range of moves to bolster teachers' digital skills. First off, it specified standards and requirements for teachers' digital proficiency through relevant policy documents. For example, its *Opinions on the Program 2.0 for Enhancing Information Technology Application Ability in Primary and Secondary Teachers* stipulate concrete criteria for assessing teachers' digital literacy and digital education competences, providing guidelines for teacher digital literacy training at all education levels (Ministry of Education of China, 2019). Additionally, the MOE sponsored a series of thematic training programs for elevating the digital competence

level in teachers. For instance, its “Teacher Digital Literacy Enhancement Program Based on Yuncheng of Shanxi’s Smart Education Demonstration Zone” in 2021 provides teachers from around the country a valuable platform for exchanging ideas on digital skill training (MOE’s Monthly Report, October 2021). In the meantime, researchers have conducted extensive studies on the development of the teacher digital competence evaluation framework. Drawing on research findings of prior studies on this topic, Chen et al. (2020) created a systematic framework of indicators for assessing digital competence of primary and secondary teachers. Li et al. (2020) established a valid index model for digital literacy evaluation in pre-service teachers, based on existing theoretical research and specialist advice.

Technology-Assisted Teaching and Evaluation

Change in Teaching Modalities

Under the Educational Informatization 2.0 initiative, Chinese researchers and educators have actively explored innovative teaching modalities to meet the requirements for talent cultivation in the new era.

Blended Teaching: This modality is a mixture of flexible online learning and interaction-laden offline teaching, optimizing the instructional process by combining before-class online self-study, in-class in-person conversations, and after-class online extended learning. Xie et al. (2023) explore the impacts of hybrid teaching on students majoring in printing engineering and discover that this teaching approach is effective in fostering students’ ability to analyze and solve problems and to manage their own learning. According to Wu’s study (2023), blended teaching can significantly improve students’ English writing scores, primarily due to its effects in increasing instant feedback and student cognitive engagement.

Smart Classroom-Based Instruction: The smart classroom environment, which is built on digital devices and network technology, can bring highly efficient and productive teaching and learning experiences to classroom actors. To explore deeper integration of technology and instruction, Chinese researchers and educators have experimented with many smart classroom-based teaching patterns, among which feedback-driven teaching and negotiation-based teaching are the most representative ones (Wang, 2020). Feedback-driven teaching emphasizes using technological devices to gather and analyze student learning data in real-time and giving prompt feedback to the teacher and students to facilitate their adjustment of the class progress and learning methods. Negotiation-based teaching is a learner-centered instruction pattern. With this model, the teacher and students are working in a learning community where there are no pre-determined procedures for a learning task; but instead, learners construct

knowledge and develop core competences through peer conversations and collaboration, as well as communication with the teacher, when working together to solve a problem or complete a project.

AI-Assisted Teaching: In AI technology-assisted instruction, devices like the intelligent tutoring system and personalized learning path recommendation are applied to give students precise support. The Chinese educational authorities place a high value on AI application in education. A considerable number of AI education bases have been established for basic education students (MOE's Monthly Report, February 2024); application scenarios of the "AI plus Higher Education" initiative have been developed and introduced to higher education institutions. Many empirical studies have been conducted to validate the effectiveness of AI-assisted teaching. For example, Wu's study (2024) reveals that generative AI-assisted oral English teaching has a positive effect in improving lexical diversity, syntactic complexity, and fluency in students as EFL learners.

Shifts in Teaching Evaluation

Teaching evaluation is an essential component of instruction, playing an important role in improving teaching and learning by presenting feedback on instructional activities. Reforming the traditional evaluation methods is of vital significance for education in the digital era, enabling a comprehensive assessment of student all-round development.

Driven by the Action Plan, the education research community has endeavored to innovate teaching evaluation methods and has achieved valuable results. For example, Zheng et al. (2023) advanced an IT-based performance evaluation model, which employs technology to transform the entire process of academic performance evaluation, from learning outcome representation to data collection and data analysis, for reaching accurate and effective academic assessment. Xia and Zhu (2024), in their English writing teaching, experimented with a mixed evaluation method that combines teacher grading with intelligent system-based assessment, with the view to providing personalized writing guidance and prompt feedback for students. Studies like these show that technological backing available in the era of Educational Informatization 2.0 can assist the transition from traditional to intelligent assessment and instigate innovation in teaching evaluation.

Digital Educational Administration

To adapt educational administration to digital education, educational agencies and schools in China have made efforts to promote digital management in education, including building educational information

systems, heightening protection of educational data security, and strengthening the regulation of educational applications (apps).

Since 2018, the National Student Enrollment Information Management System, National Education Funding Management Information System, National Student Grants Management Information System, National Teacher Administration Information System, and Educational Institution Coding Management Information System (MOE's Monthly Report, August 2019) have been progressively established. The application of these systems enables efficient input, search, updating, and sharing of information on student enrollment, education funding, grants, teacher staffing, etc., significantly improving management efficiency and accuracy.

The ongoing advancement of digital education has resulted in the proliferation of educational data. The ever-increasing scale and complexity of these data have posed higher requirements for their storage and management. To address this issue, provincial governments in China have developed their respective measures for educational data management under the direction of the *Guidelines for the Development of the Data Security Industry*, issued by the central government in 2022 (State Council of China, 2022).

At the same time, the development of mobile technology has spawned a diverse variety of educational apps, which are of varied quality. To supervise the content of educational apps to prevent the dissemination of low-quality, misleading, or harmful materials and to regulate the order of the market to ensure developers comply with relevant laws and regulations when collecting, storing, and using user data, the MOE introduced a regulatory system for the registration of basic information of all educational apps in use, examination of their content, and evaluation of their technical and operational security. As of the end of 2024, there were over 3000 apps registered in the system (MOE's Monthly Report, December 2024).

Technology-Informed Educational Equity

Educational disparities between urban and rural areas and the subpar education standard in impoverished areas have been chronic challenges faced by China. There exist significant gaps in educational resources, teaching staff supply, and educational facilities between urban and rural areas, leading to the less-than-ideal quality of education in rural and underserved regions. Particularly, teaching staff shortages are the most pronounced issue in a portion of rural schools, where the students cannot have all the subjects stipulated in the national basic education curricula because of the schools' inability to recruit teachers for certain subjects (Chen & Qin, 2024).

In the IT era, technology has been seen as a key vehicle for addressing these challenges. Under the Education Informatization 2.0 initiative, the Chinese government has made multiple endeavors to promote educational equity by leveraging modern technologies, such as:

Implementing the “Distance Education Program for Rural Primary and Secondary Schools”: The program aims to transfer high-quality educational resources (including learning materials for students and in-service training courses for teachers) to compulsory education schools in rural areas by deploying classrooms equipped with teaching CD players, satellite internet, and computers, in addition to improving digital infrastructure there.

Augmenting the provision of digital teaching equipment and educational apps for underserved schools through multi-agency efforts: For example, the NCET and the China Federation of Internet Societies jointly launched the “Precision Poverty Alleviation through Digital Education Program,” calling on businesses to donate digital products to schools in impoverished regions, such as electronic whiteboards, smart blackboards, and other materials for building smart classrooms. Since its initiation in 2020, a total of 58 companies have participated in the program, donating 129 types of digital products (MOE’s Monthly Report, April 2020).

Introducing the “Collaborative Teaching Research Community”: This program is led by the NCET, targeting schools with deficits in teacher in-service training (MOE’s Monthly Report, December 2019). It focuses on boosting collaboration between teaching forces from developed and underdeveloped areas through building collaborative teaching research communities, which host a wide variety of teaching improvement activities, such as asynchronous or synchronous cooperative teaching research, teaching demonstrations, and remote lessons for subjects that understaffed schools fail to run. The program is impactful in enhancing the instructional levels of teachers in backward regions and assisting their schools in solving pressing issues.

Actions like these have had considerable positive effects in narrowing the gaps between rural and urban education and improving the education standard in underdeveloped regions. As per Cai et al.’s (2024) study, every additional 100 CNY input in the education of a rural student can result in a 12.80% reduction in the academic gap between them and their urban peers, as evidenced by the results of the Distance Education Program for Rural Primary and Secondary Schools. At the same time, teachers in rural and remote areas have improved their professional competence through online training and teaching research programs. Nevertheless, challenges remain, such as the incompatibility of certain online courses with the rural education setting, inadequate digital skills in rural teachers, and new digital

divides. In the future, more potent measures are warranted to further reduce educational inequalities.

Conclusion

This article is a review of China's achievements in digital education in the wake of the *Education Informatization 2.0 Action Plan*, focusing on areas of digital infrastructure, online education platforms, teacher and student digital competence, technology-assisted teaching modalities, digital educational administration, and educational equity. The limitations of the study should be acknowledged. It looks at a broad range of areas related to digital education but without sufficiently thorough analysis of them individually. Also, the study is based on existing literature and governmental reports, with a lack of empirical analysis. We suggest future research on the Action Plan should focus on the following aspects: (i) Empirical studies of the outcomes of the Action Plan. Investigate the implementation and results of the Action Plan in distinct regions and schools through field and case studies. (ii) New trends in digital education. Explore innovative patterns of integration of technology and pedagogy to enhance teaching outcomes. (iii) Long-term mechanisms for supporting educational equity. Develop sustainable mechanisms within the framework of the Action Plan to further close the educational gaps between rural and urban areas, between developed and underdeveloped regions, and between schools.

Note:

The monthly work reports on digital education and network security by the Ministry of Education of China referenced by this article are from the MOE's website (http://www.moe.gov.cn/s78/A16/gongzuo/gzzl_yb/).

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