Digital Transformation of Education in China: A Review Against the Backdrop of the 2024 World Digital Education Conference

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Abstract*: The flourishing digital technologies are impacting intensively on all facets of education development. How to promote the digital transformation of education by leveraging emerging digital technologies has become a highly concerning topic among educational researchers throughout the world. The Chinese government organized the 2024 World Digital Education Conference in Shanghai on January 30-31 to advance the digital transformation in education. The conference summarized China's achievements in digital education and laid out a vision for building an international exchange and cooperation platform for global digital education development. This article is a review of China's explorations and experiments in the digital transformation of education.*

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TECHNOLOGY and education are two major driving forces for human society's advancement. Digital technology is catalyzing an intense educational transformation. Amid the new wave of technological and industrial revolutions, the digital transformation of education has become a global consensus. "Digital learning and transformation" were made one of the five thematic action tracks for the UN's Transforming Education Summit in 2022 (United Nations, 2022). Nations around the world have launched a variety of digital education development strategies to leverage digital technology to promote inclusive, equitable, and quality education.

The 2024 World Digital Education Conference (WDEC), co-hosted by the Ministry of Education of China, the Chinese National Commission for UNESCO, and the Shanghai Municipal People's Government, was held in Shanghai on January 30-31. With the overarching theme of "Digital Education: Application, Sharing, and Innovation," the conference focused conversations and exchanges on the following topics: the improvement of teacher digital literacy and competence; the building of digital education and a learning society; the evaluation of global trends and indices in digital education development; artificial intelligence and digital ethics; the challenges and opportunities of digital transformation for basic education; and the digitalization of education governance and digital education governance (Ministry of Education, 2024a). In his keynote speech at the conference, Minister of education Huai (2024) set forth China's national strategy for digital education, which includes transitioning from the "3C" philosophy of "Connection, Content, and Cooperation" to an "3I" approach of "Integration, Intelligence, and Internationalization"; prioritizing application-oriented services, expanding the sharing of quality resources, and promoting educational reform and innovation; and positioning Chinese digital education as a practical platform to implement the Global Development Initiative, the Global Security Initiative, and the Global Civilization Initiative, providing effective options for the development and transformation of global digital education.

The Digital Transformation Has Become an Inevitable Trend in Education Development.

China's societal development has entered a brand-new digital era, where the digital transformation of education is underway. In digital education, modern technologies, including computers, multimedia, big data, artificial intelligence (AI), and Internet-based communication, are comprehensively adopted to adapt education and instruction to the new requirements posed by the digital society (Liu & Liu, 2022). The processes of transforming educational paradigms, instructional methods, and management systems, as well as educational research patterns use educational technology (Chen & Liu, 2023). It

is not simply about collecting data and upgrading systems and equipment, but more about the overall enhancement of the digital awareness and competencies of all stakeholders. Digital education is fundamentally and systematically transforming the established educational system (Li, 2024).

From the perspective of technological development, with their constantly amplifying power, emerging technologies such as 5th Generation communication, AI, big data, blockchain, and metaverse are bringing substantial impacts on people's learning methods and thinking patterns (Zhang, 2020). Driven by new technologies, digital education infrastructure has significantly improved, the foundation of AI computing power and data centers is strengthening, and the digital ecosystem for educational innovation is in formation, all of which provide strong support for the digital transformation of education. (Du, 2020)

From a social development standpoint, the need to increase people's capacities to adapt to digital life calls for digital education development. The demand for intelligent education that facilitates autonomous learning, individualized learning, and lifelong learning is growing. In the digital era, learners pursue more flexible and convenient learning styles and blended instruction models for a better learning experience (Wang, 2023). Furthermore, the new era necessitates the development of key competencies that are different from those in the past, such as diverse thinking and complex problem-solving, instigating the need for a new wave of educational transformation (Xia et al., 2023).

Within the educational system, the digital transformation of education supports the achievement of the goal of "quality, equitable, and highly efficient education" by upgrading teaching and learning modalities. The integration of digital technology into education not only generates new instructional models such as flipped classrooms and online and offline-blended teaching, but also breaks down the constraints of traditional schooling by changing the organizational formats of education (Zhu & Hu, 2022a). Additionally, practical issues that arose in the development of education, such as path dependence and the lack of prompt reactions to emergencies, also make it necessary to build a more robust, digitalized national education system (Zhou et al., 2020).

The Significance of Digital Transformation in Education

Promoting the Improvement of Teacher Professional Competence

For teachers, information technology (IT) serves not only as an aid in teaching but also as a vehicle for professional development. According to the" *Education Informatization 2.0 Action Plan*," building a teaching force that can adapt to technological advancement in the new era and utilize technology to enhance their educational and teaching abilities is a key component of digital education development (Ministry of Education of China, 2018). New-generation information technologies like AI offer teachers possibilities for long-range career development. The Ministry of Education of China (2022) issued the "Digital Literacy of Teachers" as a part of teacher professional criteria, which defines teacher digital literacy in five dimensions. This paper provides evaluation standards and training directives for teacher digital literacy, marking Chinese education's entry into a new stage in digital transformation.

With improved digital literacy, teachers can more easily adapt to the digital education settings, have a more reasonable use of digital tools and resources, and are more ready to update the notion and methods of education evaluation, achieving greater teaching outcomes (Zhang et al., 2023). Regarding individualized teaching, teachers with adequate digital literacy can make better use of digital resources to administer tailored instruction, such as by digitally diagnosing students' learning circumstances, adjusting teaching strategies in a timely manner, and utilizing online learning platforms to customize learning materials for each student (Zhang, R., 2023). Furthermore, digitally competent teachers have more choices in their teaching approaches. For example, they can create a hybrid classroom that integrates online and offline teaching, dismantling the restrictions of space and time in instruction and practicing a more learning-centered education; they can also utilize multimedia resources, virtual reality tools, online collaboration instruments, social media platforms, and other resources to create an intelligence-assisted learning scenario to foster students' ability to use technology to solve problems (Wu, 2018). Furthermore, the improvement in digital literacy helps the teacher implement more scientific student evaluation. First, by using digital technology, teachers can expand the evaluation scope to cover students' higher-order abilities such as innovation awareness, collaboration skills, and critical thinking ability (Dai, 2023). Second, they can use intelligent technology to successfully realize formative assessment and track students' learning progress and performance in real time so as to direct them to carry out more personalized and effective learning. Third, they can adopt big data-based learning analytics and human-machine collaboration to obtain precise evaluation results to support legitimate educational decision-making (Ma, 2019).

Optimizing Student Learning Outcomes

The primary goal of digital education is to develop students' key competences that are crucial for their lives in the information age, which includes core capabilities and essential qualities being progressively cultivated throughout various levels of education and aligned with the requirements of an informatized society (Zhu & Hu, 2022b). Digital tools and technologies in education can significantly boost student learning outcomes through intelligence-assisted study, personalized learning, and ubiquitous study.

Intelligence-Assisted Study: Openness is the most distinctive feature of digital education. Smooth information flow between schools, families, and society; data sharing; interconnectivity of knowledge; sharing of collective wisdom; and coordination between digital devices under the digital education paradigm all contribute to the more effective learning of students (Zeng & Zhou, 2022).

Personalized Leaning: In digital education, the use of AI, big data, and learning analytics makes personalized learning practical. Based on educational technology-supported analyses of student learning foundations, styles, and progression, as well as the learning challenges they face, personalized learning strategies can be formulated, and personalized learning materials and resources can be determined for each individual student (Qiao, 2024).

Ubiquitous Study: As a result of the improved digital infrastructure, popularized access to the Internet, cumulative digital resources, and increased smart learning platforms and terminals, mobile learning emerged as a new mode of study. It significantly expands student learning venues, allowing learning to occur at any time and in any place. It opens up new possibilities for students' convenient access to information and self-directed learning (Ren, 2015).

Diversifying educational scenarios

With the application of new technologies in education, such as AI and virtual reality (Li, 2023), novel education patterns emerge. The use of digital content, information technology, and intelligent equipment will result in more diverse learning scenarios. Outstanding future educational settings include the blending of physical and virtual environments, the provision of both formal and non-formal education opportunities, and the in-depth collaboration among education actors (Xing et al., 2022).

Hybrid of Reality and Virtuality: Educational AI is instigating the formation of a human-machine collaborative learning community, which distinguishes itself with a blend of virtuality and reality, enabling more open, autonomous, and immersive learning processes (Jiang et al., 2016).

*Combination of Formal and Non-formal Education Opportunitie*s: Digital education dismantles the temporal and special boundaries typical of traditional education, giving students more non-formal learning options to satisfy their individual needs. Free access to educational resources also assists them in restructuring fragmented learning materials from prescribed disciplines in formal schooling (Ye et al., 2016).

In-depth Collaborative Learning: In digital education, online platforms and intelligent devices help increase the frequency of teacher-student and inter-student interactions in resource sharing, conversation, and inquiry, as well as diversify the formats of collaborative learning, thus enhancing student communication and collaboration skills (Zhao et al., 2021).

Strategies for Advancing the Digital Transformation of Education

China, among many countries, advances digital transformation in education under the basic action framework of "policy support, resource backing, practical explorations, and technology-enabled evaluation" (Yang et al., 2023). Top-level policies provide directives for actions in the digital transformation of education. Resource backing entails the creation of digital education resources and infrastructure. Practical explorations of educational technologies emphasize the engagement of all digital education actors and the effectiveness of technological applications. Technology-enabled evaluation supports policy-making and practical adjustments by providing relevant data and evidence. There are intrinsically logical connections and interdependent relationships between these dimensions (Jing & Lyu, 2023).

Policy Support: Top-Level Strategic Planning

Policy support serves as the cornerstone of the digital transformation of education. The government has the responsibility to provide institutionalized guarantees by formulating strategic plans for digital education, developing norms and standards for educational technology, and establishing effective management and operation mechanisms (Sui, 2023).

In recent years, the Chinese government has strived to advance the strategic action for digital transformation in education and published a number of plans to propel digital education. 2010's "Strategy for National Medium- and Long-Term Education Reform and Development (2010–2020)" emphasizes that a high value must be placed on educational technology, which has a revolutionary impact on education development and should be harnessed to drive the realization of educational modernization (State Council of China, 2010). In 2012, the Ministry of Education issued the "Ten-Year

Development Plan for Education Informatization (2011-2020)" to set forth the goals and responsibilities of various educational sectors in developing digital education, including the building of digital campuses with necessary digital teaching resources, tools, and simulation laboratory software in all levels and types of schools, the initiation of the "Three Links and the Two Platforms" program, and more (Ministry of Education of China, 2012). To improve the IT application level of schools, enhance the digital literacy of teachers and students, and build a uniform "Internet plus education" platform, 2018's "Education Informatization 2.0 Action Plan" put forth the goal of realizing "three popularizations" by 2022: the popularization of teaching applications among teachers; the popularization of learning applications among all school-age students; and the popularization of digital campuses among all schools (Ministry of Education of China, 2018). In 2019, the State Council issued the paper "Modernization of Chinese Education 2035," reaffirming the strategic action of accelerating the digital transformation of education by building intelligent campuses, developing intelligent teaching, management, and service-integrated platforms to change the methods of education governance, and establishing a modern educational management and monitoring system to facilitate precision management and scientific decision-making (State Council of China, 2019). At the 2024 World Digital Education Conference, Yingli Li, Deputy Director of the Vocational Education and Adult Education Department of the Ministry of Education of China, delivered a speech on the theme of "the construction of digital technology-enabled learning society," in which he explained China's top-level efforts for building a learning society, including issuing the "Implementation Plan for the Construction of a Learning; publishing "Key Undertakings for Building a Learning Society"; and formulating specific measures for building learning cities and learning communities in the county regions as well as for the reform of further education for academic qualifications and the innovation of non-academic education (Ministry of Education of China, 2024b). All the said policies are aimed at clarifying strategic goals and phased pathways for the digital transformation of education, underscoring the important position of digital education in the national development strategy (Xue et al., 2023).

Resource Backing: Boosting Digital Education Resources

Digital education resources, which are guarantees of sustainable digital transformation in education, span all supportive conditions such as digital infrastructure, equipment, software tools, teaching and learning resources, and more. They play a central role in improving schools' digital and intelligent teaching, management, and service (Dai & Zhu, 2023).

In 2021, the Ministry of Education of China released "Guiding Opinions on Promoting the Construction of New-Generation Educational Infrastructure and Building a High-Quality Supportive System for Education." The paper put forward specific pathways to accelerating the construction of a new-generation educational infrastructure system that is structurally optimized, highly efficient, economically applicable, intelligent and green, and safe and reliable. It provides directions for building a world-class digital education base, which encompasses information networks, platform systems, digital content, smart campuses, and innovative applications. At present, the framework of new-generation educational infrastructure in China is taking shape and transitioning from an emphasis on "quantity" to a focus on "quality." A mature system of new-generation educational infrastructure will provide solid foundations for more equitable, inclusive, and high-quality digital education (Zheng & Zhou, 2021). Shanghai's practice is an exemplary experiment in building digital education infrastructure, according to the speech by Hao Wang, Deputy Director of the Education Commission of Shanghai, at the 2024 WDEC. The municipal government of Shanghai has worked to realize a universal upgrade of digital facilities in all primary and secondary schools in the city in the current wave of digital transformation in education. The program "Strengthening All Basic Education Schools" was launched to give special support to underprivileged schools to make up their gaps in digital infrastructure that is essential for their success in digital transformation (Ministry of Education of China, 2024b).

At the conference, Dawang Zhou, Director of the Department of Science, Technology, and Information Technology of the Ministry of Education of China, presented China's achievements in the construction of the National Smart Education Platform. The platform has been upgraded and iterated five times to date, now with the National Smart Reading Platform and three provincial-level smart education platforms from Guangxi, Yunnan, and Gansu provinces being incorporated. It developed and launched the "Intelligent Education" app. Its resource bank has gathered approximately 88,000 primary and secondary education resources, over 10,000 high-quality online vocational education courses, and roughly 27,000 high-quality MOOCs for higher education. It also provides special services such as "2023 Summer Educational Research and Training," "Network Security Education," and studying abroad. It has become more functional with the improved user registration process, unified search engine, and features of likes, favorites, and shares, and friendlier to special groups like the elderly. The National Smart Education Platform will continue to enhance its capacity to support personalized learning and lifelong learning for all by expanding the coverage of high-quality education resources (Ministry of Education of China, 2024b).

Based on prior achievements, Minister of Education Huai (2024) described China's prospective endeavors in the development of digital educa-

tion resources by claiming that China would continue to converge and integrate domestic and overseas high-quality resources to expand the overall resource pool on the national smart education platform; focus on increasing resource supply through various means with an emphasis on courses in STEM education, information technology, arts education, and vocational skills; enrich resource formats by developing digital textbooks and extensively collecting teaching aids, lesson plans, courseware, teaching designs, virtual simulation experiment resources, etc.; innovate resource evaluation mechanisms using the massive and dynamic data aggregated by the National Education Big Data Center, to promote the full lifecycle management of resource development, storage, updating, and removal. In sum, China is committed to building its National Smart Education Platform into a system that expands horizontally and connects vertically, leveraging collective wisdom from across the country and around the world.

Trials of Applications: Optimizing Educational Technology Application

Application is the touchstone for the effectiveness of educational technology. To apply educational technology to digital education, China has invested heavily in the construction of pilot and demonstration projects under the initiative of "Internet plus Education" and in the innovation of application scenarios drawing on successful experiences at home and abroad (Dai, 2023). Important experiments include establishing mechanisms for cross-grade collaboration to ensure data consistency across all educational phases and settings; diversifying instructional patterns by driving the shift from traditional in-class teaching to mixed classroom learning that combines online and offline instruction and in-class and after-school activities; and developing dedicated platforms for the dissemination and promotion of high-quality teaching practices (Gao, F., 2021).

According to Huai (2024), China will conduct large-scale application demonstrations to amplify service efficiency in digital education. To achieve this, it will deepen ongoing digital education pilot programs to facilitate the nationwide application of the national platform, in an effort to expand the coverage of quality resources and transform pilots into exemplars. Schools will be encouraged to integrate platform resources and services into their educational practices to deepen their application. Furthermore, China will innovate policies and mechanisms to promote application, guided by the principle that "effective utilization is true proficiency, and indispensability is essential." Through thematic teacher training, model case selection, assessment incentives, and evaluation reforms, the usage of the smart platform will become a habit for both teachers and students.

Digital Empowerment: Enhancing Educational Actors' Digital Competency

The digital advancement has brought new requirements for education; improving digital literacy and competence of educational actors is an imperative in the new era. Teachers and students cannot harness complex technological systems and tools without proper digital literacy training, and consequently, the reform of teaching paradigms will be unattainable (Dong & Yang, 2023).

First, it is important to develop a thorough and workable mechanism for teacher digital literacy training. The Ministry of Education's "Digital Literacy of Teachers" can be used as a framework of reference in developing action plans and innovative training programs. It is advisable to experiment with the integration of pre-service and in-service digital literacy training for teachers. Also, schools in various regions should organize high-quality digital training sessions tailored to local conditions, along with engaging teachers in the national training programs during summer and winter breaks. Minister of Education Huai (2024) cited the practice of No. 3 Affiliated Primary School of the Chongzuo Normal University in Guangxi Zhuang Autonomous Region as an exemplar, where teachers utilize resources from esteemed educators in Beijing, Shanghai, and Tianjin for collaborative lesson preparation and online teaching research. This approach has accelerated their professional development and revitalized the distinctively Chinese teaching research system.

Second, fully leverage all digital resources to facilitate teachers' and students' digital growth. Working on smart campuses with high-performance facilities, omnipresent digital terminal networks, innovative classroom environments, and IoT intelligence, teachers and students can spontaneously accumulate digital literacy and skills (Li, 2015). The use of educational applications such as the National Smart Education Platform, "intelligent teaching assistants," and "AI teachers" should be encouraged among them to promote innovation in teaching methods, integrate digital technology into diverse areas including physical, aesthetic, and labor education, and transition from the single-subject-based use of technology to the interdisciplinary and multiple scenario-based application (Zhong et al., 2021). Huai (2024) visited an "Agricultural Microbiology" class assisted by the National Smart Education Platform at Ningxia University and found that teachers and students there "interacted frequently within the smart system, quickly and precisely addressing knowledge gaps and experimental doubts, and greatly enhancing the classroom experience."

Third, integrating technology into learning and teaching activities to innovate instructional patterns is an effective way to improve the digital lit-

eracy of teachers and students. Infusing digital literacy development into the curricular objectives, content, and structure is essential (Zhao & Lu, 2021). Huai (2024) called for promoting "intelligence-assisted learning" by developing intelligent learning companions and implementing intelligent tutoring systems, empowering each student to reach their full potential. Likewise, "intelligence-assisted teaching" should be popularized by means of developing intelligent teaching assistants in support of lesson preparation, workload reduction, and efficiency enhancement for teachers, thereby allowing them more energy for creative teaching activities.

Digital Evaluation: Strengthening Digital Education Monitoring and Assessment

Digital technology is transforming the educational evaluation system. The use of new technologies, such as big data and AI, in performance assessment can effectively solve issues with traditional evaluation methods, such as the lack of uniform standards. Through the convergence of broad-scale evaluation data and multimodal data analytics, a comprehensive evaluation system capable of real-time feedback can be established to trace the process of digital transformation in education over a longer period of time (Ji, 2023). Empowering educational decision-making by developing standardized, consistent evaluation indicators and powerful databases has become a globally recognized practice (Yu, 2022).

Despite certain progress in evaluation processes such as model construction, impartial data collection, and intelligent data processing, the digital evaluation of education in China is still in its infancy. However, the use of technology has not fundamentally eliminated the limitations inherent in the established educational evaluation system. Outstanding issues include the low-level coupling between evaluation and technology, insufficiently legitimate evaluation indicators, and one-sided evaluation methods (Jing & Lyu, 2023). Due to the vast territory of China, a "one-size-fits-all" evaluation model is not a reasonable approach. Inter-regional, urban-rural, and inter-school disparities must be considered in the evaluation of the digital transformation of education in China. In the meantime, it is necessary to examine the emotional factors in digital education evaluation from a humanistic perspective, continuously optimizing assessment methods to mitigate the negative emotional burdens on key stakeholders (Zhang, 2021).

Educational data is of strategic value for the digital transformation of education. To effectively collect and utilize educational data, it is necessary to improve the security measures of data safety, strengthen the regulatory capacity for the collection and use of data by teachers and students, and establish ethical norms for the application of AI in education. The Chinese

government adheres to the principle of "digital for good," emphasizing the importance of research on AI and digital ethics, the scientific assessment of the impacts of intelligent technology on education, and the rational application of intelligent technology (Huai, 2024).

Conclusion

In the AI era, the digital transformation of education is an innovative and highly complex undertaking. It is a systematic and fundamental change in the domain of education, providing new opportunities for educational advancement. Globally, there is a growing consensus about the significance of digital education development; countries are advancing digital education more forcefully. The global exploration of digital transformation in education is becoming increasingly active. China is leveraging digital education to promote educational equity and quality, as well as to support the development of a learning society. The deep integration of digital technology and education is to be accelerated to comprehensively enhance students' learning, teachers' instruction, schools' management, and the nation's overall educational innovation. The digital transformation in education will substantially increase the nation's digital competency across the board, further modernize Chinese education, and contribute to its high-quality socioeconomic development.

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