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The evolution and outlook of China's educational digitalization policies in a gradualist perspective

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Abstract. Against the backdrop of the rapid development of the digital economy and the continued implementation of the strategy of building China into a leading country in education, education digitalization has become a key force for advancing educational reform and enhancing national competitiveness. However, given the complex interplay of accelerating technological change, demographic shifts, tightening fiscal constraints, and mounting ethical risks, an aggressive approach to advancing education digitalization is neither feasible nor sustainable. Building on the strengths of the incrementalist decision-making model, which acknowledges the complexity of real-world conditions and seeks to optimize policies through gradual improvements, this study applies the model to examine the evolution of education digitalization in China. The findings indicate that China's education digitalization has progressed through four stages: early exploration and the laying of an infrastructure foundation; educational resource sharing and platform development; technological integration and the development of new infrastructure; and comprehensive advancement and strategic upgrading. Policy objectives have gradually evolved from usability to empowerment, while policy content has followed a trajectory from "hardware foundations" to "resource integration", "governance upgrading", and "ecosystem openness". Meanwhile, policy actors have shifted from a predominantly single-actor structure toward greater multi-actor collaboration. Looking ahead, education digitalization policies will follow the logic of incrementalism by maintaining policy continuity, responding to changing circumstances, and achieving system-level transformation through small-scale, gradual reforms.

Keywords: education digitalization, incrementalism, educational informatization, policy evolution

1. Introduction

China is currently at a critical stage of achieving the Second Centenary Goal and advancing the great rejuvenation of the Chinese nation through Chinese modernization. In the 1990s, China began to promote educational informatization, with the primary objectives of improving the efficiency of teaching, learning, and educational administration and narrowing disparities in educational resources across regions and schools. Educational informatization represents the initial form and practical foundation of education digitalization, while education digitalization constitutes an iterative upgrade and comprehensive transformation of educational informatization in terms of its technological architecture, application paradigms, and strategic positioning. With the continued implementation of the strategies of Digital China and building China into a

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leading country in education, education digitalization has evolved beyond a technological and instrumental upgrade aimed at promoting educational equity and optimizing resource allocation. It has also been entrusted with the strategic mission of advancing the integrated development of education, science and technology, and talent, as well as enhancing national competitiveness, and has become a major force in building a high-quality education system. In recent years, research on education digitalization policies has gradually shifted from a "technology–instrument" perspective toward an "institution–governance" perspective, emphasizing that education digitalization is a systematic, long-term, and complex strategic undertaking [1]. Ronghuai Huang points out that the digital transformation of education is a gradual process that should adapt to changing circumstances, local conditions, and broader trends. A transition from quantitative to qualitative change should be achieved through the setting of phased objectives and continuous institutional adjustment [2]. Zhongying Shi et al. argue that the practical logic of the digital transformation of education should follow the principles of "problem-driven approaches + conceptual guidance", "system evolution + innovation breakthroughs", and "value assessment + iterative optimization", reflecting a reform approach that seeks progress while maintaining stability. Other scholars have likewise emphasized that education digitalization cannot be accomplished overnight. Rather, it should develop and improve progressively on the basis of existing conditions, constituting a continuous process of exploration and advancement from quantitative to qualitative change. Although existing studies have examined the policy logic underlying education digitalization, a systematic theoretical framework is still lacking to explain why digitalization policies tend to be adjusted incrementally on the basis of existing arrangements and how these adjustments progressively build upon one another. In the face of a complex and uncertain external environment, how can education digitalization policies strike a balance between the urgency of reform and systemic stability? How can policies be both forward-looking and operationally feasible? These questions call for a more explanatory decision-making theory to provide an analytical framework for understanding the evolution of education digitalization policies.

2. The connotation of the incrementalist decision-making model

Rationalism and incrementalism are two fundamental and foundational models in decision-making theory [3]. Rationalism was initially proposed by Herbert A. Simon and includes the comprehensive rationality model and the bounded rationality model. Both rational models assume that ideal decision-making outcomes can be achieved through systematic analysis, and hold that perfect or satisfactory policy alternatives can be obtained as long as decision-makers make the maximum possible effort. In reality, however, decision-makers often face problems such as incomplete information and cognitive limitations. It was against this backdrop that C. E. Lindblom, following an in-depth study of political decision-making processes, proposed the incrementalist decision-making model. This model emphasizes the inseparability of policy objectives and policy instruments and advocates making gradual adjustments on the basis of existing policies through a process akin to "crossing the river by feeling the stones". Lindblom argued that the essence of incrementalism lies in acknowledging the complexity of reality and optimizing policies through gradual improvements. Accordingly, policymaking is a dynamic process in which objectives and means are continuously adjusted to one another.

There are three important principles underlying incremental decision-making in the processes of policy formulation and implementation. The first is proceeding step by step. Decision-makers consistently base their subsequent policy arrangements on existing institutional baselines and accumulated experience, designing the next stage through small-scale, reversible, and monitorable marginal adjustments. In this way, policy updating proceeds as a smooth transition over time rather than through abrupt discontinuities. During this process, rules, procedures, and cognitive frameworks that have proven effective in the past are selectively retained and

modified, thereby ensuring continuity throughout the decision-making chain and avoiding the sharp increases in information costs and uncertainty that may result from "starting all over again". The second is achieving major changes through cumulative small improvements. This principle emphasizes that gradual adjustments at the micro level can accumulate into structural changes at the macro level after repeated iterations. Each incremental adjustment creates new policy space for the next round of reform, generating a positive feedback cycle of increasing returns. Once a series of seemingly trivial incremental improvements accumulates beyond a certain critical threshold, the policy system may undergo a qualitative leap at a moment that external observers did not anticipate. Although such a transformation may appear "revolutionary" or "discontinuous", it is essentially the natural outcome of the long-term accumulation of gradual quantitative changes. This mechanism is illustrated in Figure 1. The third is seeking change while maintaining stability. The essence of this principle is to embed "change" within "stability". Rather than completely replacing the existing institutional arrangements, a new policy retains those elements of the old system that continue to serve useful functions while providing stakeholders with a window of time for adaptation and learning. This, in turn, reduces resistance to reform and systemic risks. These three principles reinforce one another and jointly shape the distinctive logic of incremental decision-making: seeking change amid continuity and maintaining stability amid change. This logic not only responds to the practical constraints of incomplete information, pluralistic interests, and limited cognition in complex governance contexts, but also provides a sustainable operational pathway for deeper institutional transformation.

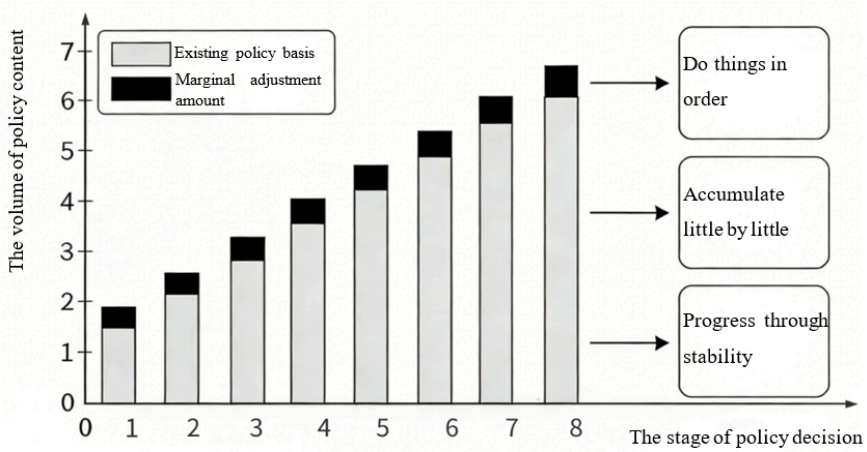

Figure 1. Core mechanism of the incrementalist decision-making model

From an incrementalist perspective, China's digital transformation of education is a gradual evolutionary process rather than a revolutionary change accomplished in a single step. Overall, the historical evolution of education digitalization policies represents a combination of linear and nonlinear change, involving the integrated application of gradual adjustments in the form of relative increments, absolute increments, and newly added increments. Among these, policy incrementalism through relative and absolute increments achieves linear policy change by revising existing policies, whereas newly added policies generate nonlinear policy change by replacing old policies with new ones [4]. Throughout the process of adjusting policy objectives and content, changes in technology, policy initiatives, and social needs have continuously interacted with one another, giving rise to a pattern characterized by gradual advancement and continuous deepening. By analyzing the evolutionary trajectory of education digitalization policies, this study seeks to anticipate future trends and directions in education digitalization, with the aim of providing a theoretical basis and decision-

making reference for the forward-looking planning and sound policymaking of China's education digitalization policies [5].

3. Development and evolution of China's education digitalization policies

Changes in external conditions drive shifts in development objectives. The formulation and implementation of education digitalization policies have proceeded incrementally through the dynamic interplay of time and space, reflecting the active interaction and deep integration between the development objectives of education digitalization and the prevailing circumstances in different periods. The objectives of each subsequent stage have constituted an extension and deepening of those established in the preceding stage. Viewed from the perspective of its overall trajectory, China's digital transformation of education has been a long-term evolutionary process that has undergone four stages: early exploration and the laying of an infrastructure foundation; educational resource sharing and platform development; technological integration and the development of new infrastructure; and comprehensive advancement and strategic upgrading. Through this process, the forms and models of education have been continuously reshaped, while powerful momentum has been injected into educational modernization.

3.1. Early exploration and infrastructure foundation-building stage (before 2010)

From the latter half of the 20th century to the beginning of the 21st century, the widespread adoption of computer and Internet technologies created a critical opportunity for educational informatization. Computers evolved from equipment used primarily for scientific research into common tools in ordinary schools, initiating early explorations of digital transformation in education. As the nascent stage of educational informatization, this period was characterized by a national top-level design approach. Through systematic policy planning and project-based implementation, efforts focused on addressing the fundamental challenges involved in developing education digitalization from the ground up. Three major policy orientations were particularly prominent: prioritizing infrastructure development, achieving urban–rural coverage, and leveraging standards to strengthen capacity. Together, these measures rapidly established the foundational conditions for the subsequent digital transformation of education.

The central task during the early exploration stage was to overcome the hardware bottlenecks of having neither adequate equipment nor network connectivity, making infrastructure development the primary vehicle for digital transformation. The Ministry of Education implemented the "School-to-School Connectivity" project, establishing a hybrid access model combining satellite and terrestrial networks. Through low-cost deployment, more than 90% of primary and secondary schools nationwide were connected to the Internet. By the end of 2003, 76,000 campus networks and 1.82 million networked computers had been established, while schools in cities at the county level and above in eastern China had achieved an average bandwidth of 10 Mbps. This created a digital backbone for basic education spanning both urban and rural areas [6]. The approach of "building the channels first and filling them with content later" incorporated quantifiable targets such as "90% of schools connected to the Internet" into policy objectives, thereby establishing a binding chain of responsibilities from the central government to local authorities. Concentrated investment through national projects enabled longstanding hardware deficiencies to be addressed rapidly, providing the physical infrastructure necessary for the subsequent application of digital resources and the development of online teaching. This demonstrated the necessity of giving priority to infrastructure development at this stage.

In response to the persistent imbalance in educational resources between urban and rural areas, digital development during this period was consistently guided by the principles of "universal coverage and inclusive

sharing", with particular emphasis on addressing the lack of digital resources in rural areas. The "*Modern Distance Education Project for Rural Primary and Secondary Schools*" received RMB 11.1 billion in central government funding and adopted three delivery models tailored to local conditions: teaching CD playback sites, satellite-based teaching reception sites, and computer classrooms. The project covered 360,000 rural primary and secondary schools in central and western China, enabling more than 100 million rural students to gain systematic access to digital educational resources for the first time and facilitating the dissemination of digital education resources to remote areas [7]. The project innovatively introduced the model of "daytime schools plus evening schools, turning one school into two", which served not only students' regular educational needs but also extended educational services to rural Party members, government officials, and farmers. Rural schools thus became county-level learning centers, effectively narrowing the digital education gap between urban and rural areas. This strategy of "prioritized support combined with universal coverage" reflected the policy commitment to educational equity while also accumulating practical experience in large-scale digital applications by expanding the scope of coverage, thereby laying a solid social foundation for the subsequent comprehensive advancement of education digitalization.

While rapidly advancing hardware construction, this stage also established a standardized institutional framework to ensure that development and regulation progressed in parallel and to prevent digitalization from becoming overly focused on quantity at the expense of quality. At the policy level, the *Standards for Educational Technology Competencies of Primary and Secondary School Teachers (Trial)* incorporated teachers' information technology competencies into institutionalized management [8]. The *Technical Specifications for the Development of Modern Distance Education Resources for Rural Primary and Secondary Schools (Trial)* established, for the first time, unified standards for resource metadata, content packaging, and copyright management, thereby creating a national framework for the governance of digital educational resources [9]. At the implementation level, the "*National Plan for Developing Educational Technology Competencies among Primary and Secondary School Teachers*" adopted an integrated "training–examination–certification" mechanism. A total of 11.2 million teachers participated in the training. The combination of large-scale Internet-based computer examinations, process-based assessment, and competency examinations not only ensured the quality of teacher digital competency development but also generated valuable experience for subsequent digital assessment. The establishment of standardized institutions integrated infrastructure development, digital resource provision, and teacher competency enhancement into a coherent whole. It addressed not only the question of "whether resources and infrastructure were available", but also established standards for "how good they should be", providing institutional safeguards for the sustainable development of education digitalization.

3.2. Educational resource sharing and platform development stage (2010–2016)

From 2010 to 2016, emerging technologies such as mobile networks, cloud computing, and smart terminals rapidly penetrated the education sector, while innovative educational concepts continued to emerge. These developments drove educational informatization from an emphasis on hardware deployment toward greater emphasis on resource application. Guided by the national "Three Connectivities and Two Platforms" strategy, this stage focused on addressing the problems of fragmented resources and insufficient application. Characterized by three major features—quantifiable targets, platform hubs, and coordination mechanisms—it marked a transition from construction-driven development to application-driven development and laid the foundation for the large-scale sharing of digital educational resources.

Unlike the broad-coverage orientation of the earlier infrastructure-building stage, policies during this period used measurable quantitative targets to determine the depth of resource application. In 2012, the *Ten-*

Year Development Plan for Educational Informatization (2011–2020) proposed for the first time the goals of "connecting every school to broadband networks, connecting every class to high-quality digital resources, and providing every person with an online learning space". These goals transformed questions such as "when to connect" and "how to use" into concrete performance indicators. By the end of 2016, the Internet access rate among primary and secondary schools nationwide had reached 90%, multimedia classrooms accounted for 83% of all classrooms, and the number of online learning spaces for teachers and students exceeded 63 million [10], thereby establishing a closed-loop management process of "target setting–implementation–acceptance". This indicator-driven approach helped prevent resource development from becoming disconnected from actual application, ensuring that digital resources were brought into classrooms and put to practical use by teachers and students. It thus reflected the stage-specific need to prioritize application.

To address the problems of dispersed resource storage and redundant development that had characterized the earlier period, this stage focused on establishing two major national hubs: the Public Service Platform for Educational Resources and the Public Service Platform for Education Management. Through the *Guidelines for the Development of Public Service Platforms for Educational Resources (Trial)*, unified standards for resource metadata, copyright management, and interface specifications were established for the first time, enabling the integration and interconnection of educational resources across five levels: national, provincial, municipal, county, and school. The "One Teacher, One Excellent Lesson; One Lesson, One Excellent Teacher" initiative, launched in 2014, relied on these platforms to produce more than 13 million high-quality lessons and reach more than 14 million teachers, forming a digital closed loop encompassing "classrooms–resources–assessment". The hub function of these platforms transformed fragmented resources into schedulable digital assets and provided an institutional prototype for the subsequent integrated development of smart education platforms.

To address the challenge of coordinating central planning with local implementation in resource sharing, this stage established a three-tier coordination mechanism characterized by "ministry-level coordination, provincial-level leadership, and county-level implementation". At the policy level, the *13th Five-Year Plan for Educational Informatization*, issued in 2016, clarified the responsibilities of governments at different levels: the central government was responsible for standard-setting and resource coordination, provincial governments for regional resource integration, and county-level governments for promoting applications in schools [11]. At the implementation level, tasks such as teacher training and resource promotion were progressively carried out through a four-level system spanning the national, provincial, municipal, and county levels. For example, the "*National Program for Improving Primary and Secondary School Teachers' Information Technology Application Capabilities*" provided training to nearly 10 million teachers and established a four-level assessment and certification system. This coordination mechanism prevented policies from remaining merely declarative, transforming resource sharing from a national initiative into concrete local practice and ensuring the effective implementation of the objectives of this stage.

3.3. Technological integration and new infrastructure development stage (2017–2021)

After 2017, technologies such as artificial intelligence, big data, and 5G underwent accelerated development, and educational informatization entered the 2.0 era, with the core demand shifting from resource application toward integrated innovation. Guided at the top level by the "Three Comprehensives, Two Improvements, and One Major Platform" strategy, this stage was characterized by four major features: upgrading development objectives, restructuring the digital foundation, redefining capacity requirements, and demonstrating application scenarios. These efforts propelled education digitalization from widespread access and coverage

toward quality enhancement and established an integrated "cloud–network–terminal" digital education ecosystem.

Compared with the emphasis on practical resource application during the resource-sharing stage, the development objectives of this period were to extend teaching applications to all teachers, learning applications to all school-age students, and digital campus development to all schools; to generally improve the level of information technology application and the digital literacy of teachers and students; and to build a comprehensive "Internet + Education" platform. The *Education Informatization 2.0 Action Plan*, issued in 2018, adopted "all teachers" and "all schools" as core quantitative benchmarks, driving 99.5% of primary and secondary schools nationwide to establish multimedia classrooms and achieving a breakthrough from partial pilot applications to nationwide coverage of technology use. This upgrading of objectives reflected the stage-specific demand for a qualitative leap following the accumulation of quantitative progress and provided a clear direction for the deeper integration of technology and education.

As the demand for technological integration increased, the early "satellite network + terrestrial network" infrastructure could no longer adequately support application scenarios requiring low latency and high reliability. Accordingly, this stage incorporated new educational infrastructure into the national strategy. The *Guiding Opinions on Promoting the Development of New Educational Infrastructure* proposed six major tasks: "new networks, new platforms, new resources, new campuses, new applications, and new security". By the end of 2021, 100% of primary and secondary schools had Internet access, 99.9% of schools had access bandwidth of 100 Mbps or above, wireless networks covered more than 75% of schools, and the total number of terminals used by teachers and students exceeded 28 million. An integrated "cloud–network–terminal" digital foundation was thus established. This restructuring of the digital foundation provided the technological support required for intelligent regional resource allocation and the implementation of personalized learning scenarios, constituting the hardware basis for integrated innovation [12].

People remained at the core of technological integration. During this stage, teachers' digital literacy was upgraded for the first time from merely "being able to use technology" to "being able to use technology effectively". Through the "Teacher Information Technology Application Capacity Improvement Project 2.0", a three-level certification system encompassing the national, provincial, and school levels was established. The program went beyond technical skills training and focused instead on teachers' practical capacity to integrate technology with subject teaching, providing targeted training to more than 10 million teachers. Meanwhile, relevant standards on *Teachers' Digital Literacy* incorporated competencies in digital teaching, research, and assessment into professional requirements, facilitating the transition of teachers from technology users to innovators in technology-enabled education and providing the human-capital foundation for bringing technological integration into the classroom [13].

To prevent technological integration from becoming an exercise in unfocused experimentation, this stage adopted a dual-driven approach combining "standardization and coding" with "scenario-based demonstration". In higher education, the *Specifications for the Construction of Digital Campuses in Higher Education Institutions (Trial)* incorporated infrastructure, data governance, network security, and other areas into national standards for the first time. At the regional pilot level, drawing on the pilot districts for education digitalization in Shanghai, a three-tier data platform spanning the municipal, school, and college levels was established, with more than 30 scenario-based applications implemented, including cross-institutional credit recognition and the sharing of scientific research instruments [14]. Standards clarified "how it should be done", while pilot programs demonstrated "how it can be done well", thereby creating a replicable and transferable governance model based on digital twins and providing practical reference for the integrated development of education digitalization nationwide.

3.4. Comprehensive advancement and strategic upgrading stage (2022–present)

Since 2022, technologies such as 5G, artificial intelligence, and computing infrastructure have entered a stage of mature application. Education digitalization has evolved from integrated innovation into a national strategy, with the core objective of "driving the development of a leading country in education through digitalization". Guided by the *National Education Digitalization Strategy Action*, this stage has been characterized by four major features: systematic development, global dissemination, deeper application scenarios, and exploration of emerging challenges. These efforts have propelled education digitalization from domestic practice toward global leadership and from technology-enabled improvement toward systemic transformation.

Unlike the fragmented development model of previous periods, this stage has focused on building a national smart education public service platform system featuring "three horizontal dimensions and four vertical dimensions". Horizontally, the system connects basic education, vocational education, higher education, and lifelong education; vertically, it integrates the five dimensions of education—moral, intellectual, physical, aesthetic, and labor education. Within just two years of its launch, the platform had aggregated 110,000 resources for primary and secondary education, 11,000 high-quality vocational education courses, and 31,000 Massive Open Online Courses (MOOCs) for higher education. It had also registered 163 million users and recorded 60.8 billion visits, making it the world's largest educational resource center by scale [15]. At the same time, 32 provincial-level platforms were integrated with the national portal, forming a service system characterized by vertical connectivity and horizontal coordination among the ministry, provinces, and schools. This systematic development transformed educational resources from isolated points of provision into an interconnected ecosystem and provided a replicable nationwide approach to promoting educational equity.

As China's practices in education digitalization matured, this stage incorporated international leadership into its strategic objectives for the first time. The National Smart Education Platform received the 2022 King Hamad Bin Isa Al-Khalifa Prize for the Use of ICT in Education from UNESCO. While the "MOOC Westward Journey" initiative delivered 207,000 courses to central and western regions, China also disseminated its experience in "platform development, resource sharing, and teacher training" globally through multilateral mechanisms such as the World Digital Education Alliance [16]. This pathway of "domestic practice–international dissemination" marked China's transition from following international developments to taking a leading role in education digitalization and established China as an important participant in global governance of education digitalization.

During this stage, technology applications were no longer confined to supporting classroom instruction but extended throughout the entire educational process. Artificial intelligence enabled precision teaching and the planning of personalized learning pathways; big data analysis provided insights into students' learning behaviors and knowledge gaps; virtual reality and augmented reality created immersive learning environments; and blockchain technology supported the secure and trusted sharing of educational data. The Ministry of Education selected 184 primary and secondary schools as artificial intelligence education bases, promoting the transformation of teachers from curriculum implementers into curriculum designers. Guangdong, Hainan, Ningxia, and other provinces launched pilot programs for region-wide applications and introduced new instructional scenarios such as interdisciplinary integration and project-based learning. The deepening of application scenarios reflects the systemic transformation of education digitalization from the instrumental level to the institutional level, enabling technology to genuinely serve the people-centered essence of education.

While rapidly advancing strategic upgrading, this stage has also directly confronted the core challenges arising from digital transformation: How can technological efficiency be balanced with the fundamental

purposes of education while strengthening emotional connections between teachers and students? How can the sustainable development of education digitalization be ensured while avoiding an excessive emphasis on technology at the expense of teaching? How can data ethics and privacy protection be properly regulated to ensure the security of educational data? Exploring these questions does not constitute a rejection of digitalization. Rather, it reflects the stage-specific characteristics of rational advancement: recognizing the driving role of technology in educational modernization while seeking a dynamic balance among innovation and equity, as well as technology and ethics. This approach lays an intellectual foundation for the long-term and healthy development of education digitalization.

4. Characteristics of the incremental evolution of China's education digitalization policies

China's policies for the digital transformation of education have undergone multiple stages of development. Although each stage has had its own specific objectives and tasks, policy development has consistently maintained continuity and coherence, evolving from early infrastructure development and exploration of digital educational resources, to promoting the deep integration of technology and education, and ultimately to elevating digitalization to the level of a national strategy. This policy evolution has been a process of incremental adjustment grounded in the socioeconomic context, technological limitations, and practical conditions for implementation, and it has profoundly reflected the continuous deepening of the transformation process.

4.1. Policy objectives: progression from usability to empowerment

China's education digitalization has undergone four stages of development, with the nature of its policy objectives gradually evolving from "usability", "accessibility", and "applicability" to "empowerment", as shown in Table 1. This dynamic transformation is not simply a succession of isolated stages. Rather, it reflects a progressive logic in which the supply-side provision of digital infrastructure has been upgraded into value creation and systemic transformation in education. It thus clearly illustrates the trajectory of China's education digitalization, from addressing initial shortages in basic provision to driving the restructuring of the educational ecosystem, and demonstrates the deep coupling between policy objectives and the process of educational modernization.

Table 1. Policy objectives across the four stages of education digitalization

Stage	Core Policy Objective	Representative Policy Statement	Objective Attribute
Early Exploration and Infrastructure Foundation-Building	Achieve "school-to-school connectivity" and address the question of "whether digital technology can be used"	The *Action Plan for Revitalizing Education toward the 21st Century* proposed "popularizing information technology education in primary and secondary schools"	Usability
Educational Resource Sharing and Platform Development	Promote the sharing of high-quality resources and advance educational equity	The development goals of "Three Connectivities and Two Platforms" proposed "full coverage of digital educational resources at teaching points"	Accessibility

Table 1. Continued

Technological Integration and New Infrastructure Development	Achieve the deep integration of information technology and education and support personalized teaching	The *Education Informatization 2.0 Action Plan* proposed the development goals of "Three Comprehensives, Two Improvements, and One Major Platform"	Applicability
Comprehensive Advancement and Strategic Upgrading	Build a digital education system to support the development of a leading country in education and a learning society	The *Education Digitalization Strategy Action* proposed a development pathway characterized by "integration, intelligence, and internationalization"	Empowerment

From the perspective of the internal evolutionary logic of these objective attributes, each stage not only embodies the core tasks of its particular period of development but also forms a progressively upgraded chain of functions. Usability focuses on the tasks of the initial phase of education digitalization, with "school-to-school connectivity" and the "popularization of information technology" as its core priorities. Its purpose was to address the fundamental lack of digital tools through the construction of hardware infrastructure and the provision of basic technological equipment, thereby establishing the physical framework and technological foundation for education digitalization. In essence, this approach sought to achieve universal access to digital educational infrastructure through government-led supply-side intervention. Accessibility corresponds to the needs of the resource allocation optimization stage. With "Three Connectivities and Two Platforms" and "full coverage of resources at teaching points" as its principal instruments, it sought to break down resource barriers between regions and schools and extend the provision of high-quality digital educational resources from localized supply toward universal sharing. Its central objective was to safeguard educational equity through the balanced allocation of resources, reflecting the principle of inclusiveness in public education services. Applicability focuses on the stage of deep integration between technology and education. Guided by "Three Comprehensives, Two Improvements, and One Major Platform", it emphasizes the transition of digital technology from simple application toward adaptation to educational contexts. Through practices such as personalized teaching and precision-based management, it seeks to achieve deep alignment between technological capabilities and educational needs, essentially facilitating the adaptive application of technological rationality within educational practice. Empowerment, by contrast, represents the stage of strategic upgrading in education digitalization. Following a pathway of integration, intelligence, and internationalization, it elevates digitalization into a core driver of building a leading country in education. Rather than being confined to optimizing individual elements, it seeks to drive fundamental changes in educational models, governance systems, and talent-development paradigms through system integration, intelligent transformation, and global collaboration, thereby demonstrating the strategic empowerment of educational system transformation through the value rationality of digitalization.

From the perspective of the dynamic evolution of policy objectives, China's education digitalization policies demonstrate a dialectical unity between macro-level stability and micro-level adjustment. At the macro level, policy objectives have consistently remained anchored in the core direction of the national education strategy. From "educational revitalization" to "building a leading country in education", education digitalization has consistently served as a key support for achieving national educational objectives. Its fundamental positioning as a means of promoting high-quality educational development has therefore exhibited strong continuity and stability, ensuring that the strategic anchor of policy evolution remains consistent. At the micro level, policy objectives have continuously responded to changes in the external environment on the basis of problem-oriented and demand-oriented approaches. As technologies have evolved

from information technology to artificial intelligence, big data, and the metaverse; as social demands have advanced from universal access to education and personalized learning toward lifelong learning; and as China has moved from domestic digitalization toward greater participation in global educational governance and intensified international competition, policy objectives have undergone continuous marginal adjustments and localized optimization. Examples include the shift from resource sharing toward intelligent resource innovation and from domestic balancing toward international resource connectivity. Through the cumulative effects of repeated small-scale adjustments, such incremental reform has ultimately produced a qualitative transformation from instrumental application to systemic empowerment, demonstrating the unity of policy adaptability and forward-looking orientation.

From the perspective of the continuity of the policy objective system, the development objectives of education digitalization in different periods have not replaced one another in a fragmented manner. Instead, they have exhibited the intertwined characteristics of backward compatibility and forward expansion, together with a trajectory of spatial extension and substantive deepening. On the one hand, the objectives of each subsequent stage have consistently incorporated the core achievements of the preceding stage. The empowerment stage has not abandoned the infrastructure-building objectives of the usability stage or the resource-sharing objectives of the accessibility stage; rather, it has built upon them through integrated upgrading. On the other hand, the objective system has continuously expanded in both breadth and depth. Spatially, it has extended from domestic educational settings to international educational cooperation, contributing to the development of a global system for providing digital public goods in education. In terms of substance, it has progressed from applications at the instructional level to the digitalization of the entire chain of educational governance, forming an expanded objective structure that develops from "points" to "lines", "areas", and ultimately an integrated "system". This pattern of integrated and progressive development has not only avoided resource waste resulting from policy discontinuities but has also ensured the systemic coherence and completeness of education digitalization.

From the perspective of coordination mechanisms in policy implementation, the effective linkage between new and existing policies constitutes a key foundation for improving the effectiveness of education digitalization policies. Through the iterative refinement of objectives, coordination among policy measures, and integration of resources, policies at different stages have generated cumulative policy synergies. The integrated approach adopted during the empowerment stage not only builds upon the technological integration achieved during the applicability stage but also incorporates the resource and platform foundations established during the accessibility stage, thereby creating full-chain coordination encompassing "infrastructure–resource provision–technological application–systemic empowerment". At the same time, policy continuity has further promoted collaborative governance among multiple actors, including governments, schools, enterprises, and research institutions. By developing coordinated policy responses to emerging problems in the digitalization process, it has effectively mitigated the risk of policy fragmentation and strengthened policy precision and implementation capacity. Ultimately, this has improved the efficiency with which education digitalization policies are translated from objective setting into concrete outcomes and has provided institutional safeguards for the continued deepening of education digitalization.

4.2. Policy content: from hardware to an open ecosystem

Over more than two decades of development, the content of China's education digitalization policies has evolved along a clear trajectory of "hardware foundation-building–resource integration–governance upgrading–ecosystem openness". The policy focus has progressively shifted from instrumental applications toward systemic transformation, technological forms have evolved from standalone devices toward intelligent

ecosystems, and the scope of governance has expanded from individual schools to international cooperation, while remaining consistently centered on the fundamental objectives of promoting educational equity and improving educational quality.

The policy focus has evolved from instrumental applications toward systemic transformation. The policy trajectory has progressed from addressing infrastructure deficiencies, to building integrated systems, to improving governance, and ultimately to fostering innovative ecosystems, while consistently remaining aligned with the core objectives of educational equity and quality enhancement. At the outset, the principal challenge facing education digitalization in China was the lack of basic hardware. Policies therefore focused on infrastructure development, using a funding model combining central government coordination with local matching investment to establish hardware infrastructure where none previously existed. Through the Modern Distance Education Project for Rural Primary and Secondary Schools in Western China, satellite reception equipment was installed in 15,000 rural schools in the western region [17], enabling students in remote areas to access digital teaching resources for the first time and initially breaking down geographical barriers to educational resources. Once hardware became more widely available, new problems emerged: schools operated their resources independently, while high-quality educational resources were disproportionately concentrated in urban areas. Policy priorities consequently shifted toward resource integration, leading to the establishment of a five-level resource platform system spanning the national, provincial, municipal, county, and school levels. Schools in remote areas such as Tibet and Qinghai were able to access live-streamed classes from leading schools in Beijing and Shanghai. By 2017, the application of high-quality digital educational resources in rural areas had increased substantially compared with 2012, effectively alleviating shortages of high-quality teachers. As artificial intelligence and big data technologies matured, education digitalization needed to move beyond localized optimization toward systemic restructuring. Guided by the *Overall Layout Plan for the Construction of Digital China* (2023) and the *Opinions on Accelerating the Advancement of Education Digitalization* (2023), policies sought to develop an intelligent and open digital ecosystem. Through initiatives such as "AI + targeted poverty alleviation through education", intelligent homework-marking systems were provided to under-resourced rural schools. By 2024, the accuracy rate of homework marking for rural students had reached 98%, while teachers' marking time had been reduced by 60%. This stage was built entirely upon the hardware foundation established during earlier periods, thereby avoiding a disconnect between equipment availability and resource provision and demonstrating the incrementalist principle of gradual and orderly reform.

Technological forms have evolved from standalone devices toward intelligent ecosystems. Technological development has been closely intertwined with policy priorities, progressing from foundational technologies such as computers and networks, to big data and cloud computing, and subsequently to artificial intelligence and digital twins [18]. Each technological iteration has continuously expanded the scope of policy intervention. During the initial stage, the core technologies were computer hardware and basic networking, and their level of maturity limited policy intervention primarily to infrastructure development. The widespread adoption of computers transformed multimedia teaching from a pilot practice into a standard feature of schools, while network connectivity made the cross-school transmission of educational resources possible. Policies consequently incorporated digital education into basic education development planning for the first time, extending educational practice beyond the traditional classroom environment without digital tools. As cloud computing matured and the cost of big-data storage declined, policy attention shifted from hardware toward resources. Technology transformed cross-regional resource sharing from a theoretical possibility into a practical reality, while the scope of policy intervention expanded from hardware management within individual schools to nationwide coordination of educational resources, enabling large-scale and more targeted

provision of educational resources for the first time. Breakthroughs in AI and digital twin technologies subsequently drove a shift from resource integration toward intelligent governance and ecosystem openness. Technology extended education digitalization beyond instructional support into the full range of educational management, assessment, and international cooperation. AI transformed the goal of tailoring education to individual learners from a policy aspiration into an implementable practice, while digital twins enabled campus governance to shift from manual management toward intelligent early-warning systems. Policies incorporated education digitalization into the broader national framework of Digital China for the first time, making it an important component of the national strategy. Each policy adjustment was premised on a corresponding level of technological maturity, embodying the incrementalist principles of contextual adaptation and steady expansion.

The scope of governance has expanded from individual schools to international cooperation. The expansion of the governance dimensions of education digitalization has resulted both from the domestic need to promote balanced educational development and from the inevitable outcome of China's increasing participation in global education governance. Each expansion of the governance scope has been accompanied by innovations in policy instruments and growing international influence. Initially, governance was confined largely to individual schools, with the primary objective of ensuring the proper operation of hardware and addressing problems such as irregular equipment procurement and inadequate maintenance. With the establishment of resource platforms, the scope of governance expanded to cross-regional coordination, with the central task of facilitating the flow of high-quality educational resources toward disadvantaged areas. As the volume of educational data increased dramatically, governance priorities shifted toward data standardization and application, with the aim of preventing data silos and data misuse. As China's experience with education digitalization matured, the scope of governance extended further toward global cooperation, focusing on sharing China's experience and participating in the development of international rules. The scope of governance thus evolved from individual schools to cross-regional and nationwide coordination and ultimately toward internationalization. By 2024, 20 countries had drawn on China's experience in developing smart education platforms, significantly enhancing China's voice in global governance of digital education. Throughout this process, every expansion in the scope of governance and every increase in international influence resulted from the cumulative effects of earlier policy initiatives. This progression vividly illustrates the core incrementalist principle of "turning small steps into major advances and expanding from the local to the systemic".

4.3. Policy actors: expansion from a single actor to a multiplicity of stakeholders

China's education digitalization policies have developed a multi-actor governance structure characterized by "government leadership–institutional coordination–enterprise participation–social collaboration". The roles of policy actors have shifted from unilateral provision toward collaborative empowerment, participation mechanisms have expanded from administrative-driven implementation to a combination of "market coordination + social participation", and the division of responsibilities has become increasingly clear, evolving from unilateral government oversight toward joint development and shared benefits among multiple stakeholders. Throughout this process, policy development has remained focused on the core objectives of improving policy implementation effectiveness and ensuring the inclusive benefits of education digitalization.

The evolution of policy actors particularly highlights the logic of incrementalism. The transition from leadership by a single government department to coordinated involvement under high-level national planning was not achieved overnight; rather, the scope of collaboration expanded progressively as the complexity of policy tasks increased. The first stage focused on hardware deployment, particularly the establishment of

multimedia classrooms and the provision of computers. This required only the leadership of the Ministry of Education and did not necessitate cross-sectoral coordination. For example, the *Implementation Plan for the School-to-School Connectivity Project* was issued solely by the Ministry of Education, with funding primarily drawn from local education budgets. When the policy focus shifted toward resource integration, new challenges involving funding guarantees and supporting infrastructure emerged, leading to the gradual involvement of the Ministry of Finance and the National Development and Reform Commission. For instance, the *Pilot Program for the National Public Service Platform for Educational Resources* was jointly issued by the Ministry of Education and the Ministry of Finance and explicitly specified central government subsidies. As the focus subsequently shifted toward improving effectiveness, the development of new educational infrastructure and data governance required technical support and cybersecurity oversight, resulting in the participation of additional bodies such as the Ministry of Industry and Information Technology and the Cyberspace Administration of China. For example, the *Guiding Opinions on New Educational Infrastructure* were jointly issued by six ministries and commissions. It was not until the stage of ecosystem-oriented development that coordination was further elevated to the strategic level of the Central Commission for Deep Reform, with the Standardization Administration of China participating in the formulation of international rules in order to align education digitalization with national strategies and international standards. For example, the *National Education Digitalization Strategy Action* was reviewed by the Central Commission for Deep Reform and subsequently promoted the incorporation of Chinese standards into the global system. Each expansion of the policy-actor base was thus closely aligned with the needs of the new stage rather than being predetermined in advance.

Participation mechanisms have expanded from administrative-driven implementation toward "market coordination + social participation". During the initial stage of policy implementation, the government relied primarily on administrative directives to advance education digitalization. Through the formulation of special plans, assignment of construction targets, and allocation of fiscal funds, policy requirements were transmitted down through successive levels to educational institutions. This administrative-driven model offered the advantage of efficient coordination, enabling concentrated efforts to address critical hardware shortages within a relatively short period. However, it also suffered from limited flexibility and inadequate incentive mechanisms, making it difficult to accommodate the differentiated needs of different regions and educational institutions. As policy priorities shifted toward resource integration and the development of intelligent ecosystems, a purely administrative-driven model could no longer satisfy the demand for diversified resource provision and technological innovation, prompting the gradual establishment of market coordination mechanisms. The government used policy instruments such as service procurement, project bidding, and tax incentives to encourage enterprises to participate in the development of digital educational resources and the construction of intelligent education platforms. At the same time, mechanisms for social participation continued to improve. The government actively encouraged industry associations, public-interest organizations, research institutions, and other social organizations to participate in education digitalization by providing digital education teacher training, organizing public-interest donations, and facilitating academic exchanges, thereby supplementing service gaps left by government and market actors. The China Education Development Foundation, for example, launched a public-interest digital education initiative and worked with enterprises to donate smart teaching equipment to rural schools in western China. Industry associations, meanwhile, formulated standards for digital education services to regulate the conduct of market participants. Together, these efforts contributed to the formation of a diversified participation mechanism characterized by "administrative guidance, market leadership, and social supplementation".

The division of responsibilities has evolved from unilateral government oversight toward clearly defined responsibilities for joint development and shared benefits. During the period of single-government leadership, the division of responsibilities among policy actors was characterized by "the government undertaking everything while educational institutions passively implemented policies". The government assumed virtually all responsibilities, including policy formulation, resource provision, and implementation oversight, while educational institutions were primarily responsible for installing equipment and carrying out basic applications as required. This blurred allocation of responsibilities resulted in inefficient oversight and delayed feedback on implementation problems. With the diversification of policy actors, however, the boundaries of responsibility have gradually become clearer. The government's core responsibilities have shifted from comprehensive direct involvement toward overall planning, policy guidance, and regulatory assurance. These responsibilities include formulating strategies for education digitalization, improving relevant laws and regulations, regulating market activities, and safeguarding educational equity. As the principal carriers of policy implementation, educational institutions assume primary responsibility for digital teaching applications, the development of institution-specific resources, and faculty development. They are expected to promote the deep integration of digital technologies with teaching and learning in accordance with their own institutional circumstances. Enterprises focus primarily on technological innovation and service provision and are required to provide high-quality and secure digital education products and services in accordance with relevant policies and industry standards, while also assuming obligations for data security and protection. Social organizations undertake complementary responsibilities in areas such as public-interest empowerment, industry self-regulation, and academic support, helping narrow the digital education divide and promote the orderly development of the sector. The clarification of responsibility boundaries not only safeguards the government's coordinating and leadership role but also fully mobilizes the initiative of educational institutions, enterprises, and social actors. It thereby enhances the effectiveness of education digitalization policy implementation while reflecting the incrementalist reform logic of "gradual adjustment and dynamic adaptation". Each optimization of responsibility boundaries has corresponded to the expansion of the policy-actor base, ensuring that reform proceeds in a stable and orderly manner.

5. Future directions of China's education digitalization policies

From an incrementalist perspective, China's education digitalization policies are the product of "continuous limited comparison": building on existing decision-making foundations, policymakers gradually approach long-term objectives through small-scale adjustments, iterative trial and error, and the accumulation of experience. Since the 1990s, China's educational informatization has undergone four major transitions, represented by the "School-to-School Connectivity" initiative, "Three Connectivities and Two Platforms", the "Education Informatization 2.0", and the National Smart Education Platform. Throughout this process, policy evolution has consistently demonstrated the incrementalist characteristics of "rapid yet gradual progress, continuity across stages, and rolling revisions". Against the new backdrop of the 2035 education development strategy and the development of Digital China, the core objectives of future education digitalization can be clearly defined as follows: by 2035, China will establish a digital ecosystem that supports comprehensive high-quality educational development and achieve the "Three Comprehensives"—fully establishing a smart education service system, fully developing a data-driven model of educational governance, and fully developing new forms of human–machine collaborative teaching and learning—thereby making digitalization a core engine of building a leading country in education and a key pillar of talent development.

5.1. Proceeding step by step: goal-oriented development and continuity across policy stages

From an incrementalist perspective, policy is not a blueprint completed through one-time design but a dynamic process that is continuously revised and reconstructed over time. In the future development of education digitalization, the anchoring and decomposition of overarching strategic objectives must fundamentally follow national top-level planning. This requires not only carrying forward the long-term vision articulated in *China Education Modernization 2035* of "building a learning society in which everyone can learn, learning is possible everywhere, and learning is available at all times", but also remaining closely aligned with the central task of "improving the modernization of the educational governance system and governance capacity" in building a leading country in education. At the same time, it must respond to the key requirement of "empowering high-quality educational development through digitalization" under the integrated national strategy for education, science and technology, and talent development.

The core objective of the "Three Comprehensives" is inherently compatible with the incrementalist principle of continuity across stages. The two stand in a relationship between an overarching framework and its implementation pathway: the core objective provides a strategic anchor that subsequent stages must not deviate from, while continuity across stages provides a prudent and feasible pathway toward its realization. Looking ahead, this core objective will be broken down into a series of interconnected and progressively advancing tasks. Each stage will both inherit the achievements of the preceding stage and lay the groundwork for the next. By 2025, the foundation-connectivity period will focus on establishing comprehensive connectivity among the national, provincial, municipal/county, and school-level data foundations, achieving seamless integration between six major public databases and individual lifelong learning accounts, and addressing fundamental problems such as fragmented data and dispersed resources, thereby laying a solid foundation for the development of the digital ecosystem. By 2030, the deep-application period will focus on comprehensively aligning the dual engines of "subject knowledge graphs + skills graphs" with teaching, assessment, and employment systems, developing personalized learning solutions at scale and establishing data-driven models of educational governance, thereby shifting digitalization from being merely "usable" to being genuinely "effective and user-friendly". By 2035, the ecosystem-maturation period will seek to achieve full maturity in smart education services, data governance, and human–machine collaborative teaching and learning, thereby realizing the core objectives and making digitalization an endogenous driver of high-quality educational development.

Such continuity across stages is reflected not only in the vertical extension of the timeline but also in the horizontal coherence of policy logic. Incrementalism emphasizes the rationality of "limited comparison": at each decision-making juncture, policymakers do not seek a globally optimal solution but instead select an option that is better than previous arrangements on the basis of accumulated experience and limited information. In the staged advancement of education digitalization, this form of rationality is manifested as follows: guided by the core objective, each stage concentrates on the most pressing and feasible breakthrough points of the moment. During the foundation-connectivity period, for example, policymakers do not attempt to comprehensively transform governance models; during the deep-application period, they do not rush to fundamentally transform the forms of teaching and learning. Instead, through perceptible marginal improvements, the minimum standards of the digital ecosystem are progressively raised, creating a dynamic mechanism in which "stage objectives serve the core objective, while the core objective guides stage objectives". This approach not only avoids implementation difficulties arising from excessively ambitious objectives but also enables policies to remain continuously responsive over the long term, consistently centered on the fundamental goal of supporting high-quality educational development.

Proceeding step by step does not mean conservative adherence to established practices. Rather, it represents a highly strategic approach to controlling the pace of development through "anchoring core objectives + decomposing stage-specific tasks". By dividing development into stages, cognitive burdens can be reduced; by using core objectives to guide development, education digitalization can maintain an orderly trajectory even under conditions of uncertainty. This evolution is not a mechanical process of linear accumulation but an organic process of spiral development. Each cycle brings the system closer, at a higher level, to the core objective of supporting high-quality educational development, while new variables are introduced at the micro level in response to changes in technology and educational needs. For example, successive iterations of artificial intelligence technologies may generate new forms of teaching and learning and consequently lead to corresponding policy adjustments. In this way, policy can continue to innovate while maintaining its strategic anchor, ultimately achieving comprehensive alignment between education digitalization and the development of a leading country in education by 2035.

5.2. Seeking change while maintaining stability: policy adjustment in response to environmental change and lessons learned

Incrementalism differs from the discontinuous innovation advocated by radical paradigms in its understanding of change. Rather than treating change as a fundamental rupture, incrementalism tends to view it as a form of disturbance that can be absorbed by existing institutions. In the future development of education digitalization, seeking change while maintaining stability will become the core logic of policy adjustment, ultimately serving the future objective of achieving the "Three Comprehensives".

Future education digitalization policies will adopt a proactive and anticipatory approach by establishing multidimensional mechanisms for environmental sensing. On the one hand, policymakers will continuously monitor three core categories of data in real time: data on technological iteration, educational needs, and industry linkages. These data will be systematically compared with the three major performance indicators set out in *China Education Modernization 2035*—ensuring high-quality and balanced compulsory education, enhancing the capacity of vocational education to serve economic and social development, and strengthening the competitiveness of higher education—in order to identify deviations between changes in the external environment and strategic objectives with greater precision. On the other hand, mechanisms such as county-level pilot programs and discipline-specific trials will be used to contain the risks of technological applications and the effects of policy adjustments within localized micro-scenarios. For example, when promoting AI-based educational tools, pilot programs could first be conducted in selected counties to monitor their actual effects on teaching quality and students' cognitive development, after which minor policy adjustments could be made on the basis of pilot experience. This would help avoid the systemic risks that might arise from large-scale implementation. Such a closed loop of "sensing–comparison–piloting–adjustment" can ensure the stability of policy adjustment while continuously moving education digitalization toward a more proactive and anticipatory mode of governance, thereby achieving a dynamic balance between "change" and "stability".

The learning capacity of the policy system constitutes the key link between environmental change and the advancement of strategic objectives. In the future, education digitalization policies will establish a mechanism for transforming "experience–concepts–models". Local experiences generated through each pilot program will be distilled into replicable policy concepts and subsequently incorporated into a dynamic adaptive model for education digitalization, thereby continuously updating the policy system's cognitive map. For example, when monitoring reveals that declining birth rates have led to a sharp reduction in student enrollment and shrinking class sizes in some rural schools, the policy system could draw on previous pilot programs involving digitally enabled synchronous classrooms connecting county-level secondary schools with rural teaching sites and

rapidly introduce a minor adjustment in the form of "flexible class grouping + cloud-based combined classes". Students of the same grade from several teaching sites could participate in the same real-time "cloud classroom", where instruction would be delivered by a leading county-level teacher, while teachers at the original schools would transition into learning facilitators. This approach could avoid the public concern and disruption that might accompany large-scale school consolidation while maintaining continuity and quality in rural educational provision at minimal administrative cost, thereby advancing the goal of high-quality and balanced education. Such a learning mechanism ensures that "stability" is no longer rigid conservatism but a rational commitment grounded in accumulated experience, while "change" is no longer blind trial and error but a precise movement toward clearly defined objectives.

The goal of establishing an education digitalization ecosystem provides a clear direction for policy adjustment based on seeking change while maintaining stability, while the policy logic of "high-frequency sensing and low-amplitude adjustment" provides a practical pathway toward achieving that goal. This relationship—"objectives guide adjustment, and adjustment serves objectives"—enables education digitalization to maintain a stable trajectory amid complex conditions such as technological iteration and demographic change, while continuously approaching the strategic objectives set for 2035 through incremental adjustments. Ultimately, education digitalization can become a core force for ensuring the resilient advancement of educational modernization and supporting the development of a leading country in education.

5.3. Achieving major changes through cumulative small improvements: incremental reform toward policy objectives

Incrementalism differs from the "big bang" approach to comprehensive restructuring in its understanding of scale. Rather than pursuing large-scale transformation all at once, it tends to view "the large" as the cumulative effect of "the small". Achieving major changes through cumulative small improvements will become the basic unit of reform, with the "Three Comprehensives" serving as the ultimate objective of this reform pathway.

This objective is deeply aligned with the incremental reform logic of achieving major changes through cumulative small improvements. The ambitious goal of reshaping the digital ecosystem cannot be achieved overnight; rather, it must be realized progressively through the precise intervention of countless "micro-scenarios" and the replication and diffusion of "micro-paradigms". Guided by this core objective, future education digitalization policies can break reform into highly contextualized "micro-interventions". For example, customized micro-courses and teaching toolkits can be developed to address the insufficient digital teaching capabilities of rural teachers; modular interfaces for sharing curriculum resources can be established to facilitate cross-regional access to high-quality courses; and digital training scenarios integrating industry and education can be developed to address the mismatch between talent development and industrial demand. Each micro-intervention will remain closely aligned with the overarching objective of "ecosystem transformation". At the same time, each intervention will have clearly defined boundary conditions and measurable performance indicators, while lowering implementation barriers and improving the efficiency of feedback. This will enable policymakers to test assumptions rapidly, correct deviations, and establish a virtuous cycle of rapid iteration.

Achieving this objective also requires patience over time and robust institutional safeguards. The advancement of digitalization policies should therefore incorporate institutional arrangements that prioritize long-term returns. A tiered incentive structure could be established to encourage primary-level schools and technology enterprises to sustain long-term investment in digital infrastructure and the research and development of innovative applications. Delayed evaluation mechanisms could also be introduced to assess, over five- and ten-year periods, the long-term effects of digitalization on educational quality, talent

development, and technology transfer, thereby preventing short-term performance incentives from producing an excessive emphasis on form at the expense of substantive outcomes. In addition, a system for recognizing historical contributions could be strengthened, providing retrospective rewards and formal recognition to schools, teachers, and enterprises that make "micro-contributions" during the early stages of digital reform. Such arrangements would foster a positive expectation that "what is planted today will be harvested in the future". This temporal strategy not only provides sufficient evolutionary space for achieving major changes through cumulative small improvements but also ensures that every "small step" continues to move steadily toward the core objective set for 2035.

The goal of reshaping the education digital ecosystem provides a clear direction for incremental reform based on cumulative small improvements, while small-scale "micro-interventions" and "micro-diffusion" provide a feasible pathway toward realizing the overarching objective. The relationship between "objectives guiding pathways and pathways supporting objectives" reflects precisely the logic of emergence in complex systems. Each "micro-improvement" may appear insignificant, much like a single cell undergoing division, yet through countless cycles of replication and variation, these incremental changes can gradually construct the digital ecosystem needed to support the development of a leading country in education. Ultimately, the strategic vision of integrated development across education, science and technology, and talent, together with the grand narrative of China's education modernization by 2035, will be realized quietly and steadily through these seemingly modest advances made day after day.

6. Conclusion

In the era of the digital economy, education digitalization has become a core engine for advancing educational modernization and supporting the development of a leading country in education, and its policy evolution has demonstrated distinct incrementalist characteristics. Based on the incrementalist decision-making model, this study identifies four interconnected and progressively advancing stages in the evolution of China's education digitalization policies and reveals the underlying logic of changes in policy objectives, content, and actors. It also demonstrates the validity of the principles of "proceeding step by step", "seeking change while maintaining stability", and "achieving major changes through cumulative small improvements" in policy practice. This incremental approach has not only mitigated the systemic risks associated with radical reform but also enabled education digitalization to evolve from instrumental applications toward systemic transformation. In doing so, it has contributed to the development of a digital education system with Chinese characteristics, while also providing Chinese experience for global education digitalization governance and demonstrating China's distinctive governance wisdom in educational reform.

Looking ahead, China's education digitalization policies will continue to follow the logic of incrementalism, with the "Three Comprehensives" as the core objectives. Policy continuity will be maintained, while reforms will advance through precise adaptation to environmental changes and small-scale, incremental interventions, thereby promoting the formation of a mature digital education ecosystem. At the same time, policymakers will need to recognize the key challenges arising throughout the transformation process and continuously optimize relevant policies. This study provides theoretical and practical references for future policy planning. Further research could focus on specific application scenarios to examine implementation barriers and pathways for policy optimization in greater depth, thereby providing more targeted support for the high-quality development of education digitalization and the development of a leading country in education.

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