An empirical research on China's policy for ICT integration in Basic Education from 1988 to 2021

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Abstract

This paper presents a comprehensive review of China's policy for the integration of ICT in basic education from 1988 to 2021 through a mixed-methods research on 179 policy documents. I identified three phases of China's evolving policy system for the integration of ICT in basic education. The policy focuses on the innovation of teaching, the construction of infrastructure, and the cultivation of ICT competence to promote education reform and modernization, which finally contributes to education equity and quality. To achieve these targets, in recent 10 years, joint efforts and open communication have been stressed in the policy. This study provides a quantitative foundation for understanding policy change for the integration of ICT in basic education in China.

Keywords Empirical research · China · Policy · ICT integration · Basic education

Introduction

China has always given priority to the development of basic education to adapt to the international trend of educational reform. Information and Communication Technologies (ICT) integration in basic education is very important for China considering that it has one of the largest basic education systems. At the end of 2020, the population of students in primary schools was 107.5 million, and secondary schools 90.8 million (MOE (Ministry of Education), 2020). Since 1988, China has issued many projects such as the *Rural Elementary and Secondary School Distance Education Project*, which played a guiding role in promoting ICT integration in basic education. With their successful implementation, China has made great achievements regarding school infrastructure construction, learning resources provision, and equal education opportunities (Wang et al., 2018; Zhong et al., 2017). However, despite the large scale of China's policy and numerous descriptions of its contributions, little research has examined its pattern and intention, especially in an empirical way. Considering China's large basic education system and ICT integration projects, giving a policy scenario of it would add an essential part for global experience. What's more, China has a

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strong state responsibility for basic education and policy is the main driver for educational reforms, which is different from western countries. Hence, an empirical inquiry exploring China's policy for ICT integration in basic education is needed, which can not only illuminate the educational situations and prospects in China, but also illustrate international implications.

This study attempts to explore the characteristics as well as underlying intentions and logic of the policy for ICT integration in basic education in China. To this end, I conduct this inquiry leveraging the advantages of content and bibliometrics analysis, which not only investigates policy-issuing time and agencies, as well as the correlation among policy, but also compares policy themes, targets, and tools across different time intervals. This evolving perspective is important because it helps us get a deeper understanding of the principles behind the policy issuance. By doing so, this study can yield rich insights on how and why China integrates ICT in basic education, provide references and perspectives for future policy-making, and bring a more comprehensive view of global policy scenarios for ICT integration in basic education. I organize this paper as follows: First, I outline previous research on policy for ICT integration in basic education and describe the background of China's basic education system. Then, I report the data collecting process, selecting criteria as well as coding and analyzing methods of this study. In the next section, results of data analysis and conclusions are presented. Finally, implications for other countries which may face similar educational needs and possible suggestions for China's future policy planning are put forward.

Previous research on policy for ICT integration in basic education

Education administrators, scholars, and teachers all over the world are increasingly interested in integrating ICT into basic education (Keengwe & Onchwari, 2009). Global educational innovation is symbolized by ICT (Sahlberg, 2007) which are often presented as both the cause and consequence of educational innovation and change (Clegg et al., 2003). Since the 1970s, ICT integration in basic education has been made part of national strategy all around the world. For instance, Turkey implemented ICT integration projects in 1984 (Çetin & Solmaz, 2017) and the EU proposed the "eEurope" plan in 1999 to create a digitally literate Europe (Yildirim & Göktas, 2007). The application of ICT in basic education not only produces a variety of teaching models and methods, but also makes it possible for students to learn at any time at any place (Al-Azawei et al., 2016). As a result, governments have made high-leveled ICT investment in basic education and expect that such investment will improve the quality of teaching, provide equal learning opportunities and prepare young people for the knowledge-based global economy in the twenty-first century (Austin & Hunter, 2013; Jimoyiannis & Komis, 2007; Lu et al., 2015; Yelland & Masters, 2007). Integration of ICT has become increasingly important in educational systems, especially those of developing countries, and is a key component of educational reform agendas. Though many countries advance ICT with the same aim to create quality education (Prasojo et al., 2019) and a competitive nation in the twenty-first century, they met different obstacles in this integration process. For some, lack of teacher competency and human resources is an essential matter (Hermawan et al., 2018) while for others, financial issues and strategic investments, supporting policy and policy alignment could be challenging (Lim et al., 2020). In some regions, non-government organizations and private

sectors support the integration of ICT in basic education. Nevertheless, governments take the leading role in China and many other countries.

Although ICT programs bring changes to practices and policies, they are often uncoordinated and separate, which could hinder the implementation of ICT in basic education. Therefore, policy and legislation are used to promote ICT integration. Policy for ICT integration in basic education refers to measures and standards formulated by the political party or the government in a certain historical period to standardize and manage the process of ICT integration in basic education to achieve certain goals. ICT policy exists on different decision levels and in various domains. It describes the prospect and realization path for integrating ICT into education (Fishman & Zhang, 2003). With the rapid development of modern information technology and its wide application in education, policy for ICT integration can be correspondingly formulated, revised and adjusted. The introduction of policy into educational systems can lead to a systematic change, adding value to the process and result of education (UNESCO, 2011). School systems are now facing more and more challenges, requiring students to prepare for successful participation in the digital age (Henshon, 2017; Zhao & Frank, 2003). This has led to a variety of efforts and changes in national policy (Zhang et al., 2018).

The analysis of educational policy can usually be divided into three dimensions: policy agency, target, and pattern (Du et al., 2020). Policy agency refers to the decision-making body or planning organization of educational development. It's argued that more stakeholders should participate in policy development on ICT in education (Peeraer & Petegem, 2015). Policy target refers to the goal and expected results of the formulation and implementation of policy. In other words, it points out what problems policy agencies want to solve and what goals they want to achieve (Howlett & Ramesh, 2016), such as leading nations to face the coming digital era (Zagami et al., 2018). To achieve those policy targets, policy patterns should at least cover issues related to learning, teaching, evaluation, ICT competence and infrastructure (Zhang, 2020). Learning represents digital and informational learning resources that enable learning at any time and place. Teaching focuses on digital and information-based teaching modes to satisfy learners' needs. Evaluation refers to unified data exchange standard systems and multi-dimensional, full-visioned, and intelligent education evaluation systems. ICT competence means the ability to identify, transmit, and process information. Infrastructure means technical equipment support. The development trajectory of national policy for ICT integration in basic education may be complex and non-linear. However, it usually follows the sequence from simply using technology, modifying technology to better serve basic education to deeply integrating ICT with basic education (Melissa & Heather, 2013; Park & Tan, 2016; Selwyn, 1999). And research has shown that only when such integration of technology is led by basic education itself, rather than society and industry, can it be effective (Barto, 1996).

A few studies have carried out comprehensive policy inquiries. For instance, Valente and Almeida (2020) used the Four in Balance Model and adopted a methodology based on a study of documents to illustrate the history and lessons learned from Brazilian technology policies in basic education. Lopez de la Madrid et al. (2021) conducted qualitative research on national education policy and programs to figure out the guidelines marking the course of ICT in basic education in Mexico. However, considering the wide popularization of ICT and the urgent need for comparative studies of ICT policies in different geographical contexts, evidence from other countries and regions, especially the east, is necessary. Besides, previous research mainly used qualitative methods while policy science argues that the development of quantitative research in policy literature can offer a new paradigm for public policy analysis (Yang et al., 2020). To fill in the research gap above, this empirical takes

the policy framework proposed by Du et al. (2020) to do an empirical inquiry on China's policy for the integration of ICT in basic education. It should not only provide insights into the basic patterns and changes of China's educational policy for ICT integration, but also possible pathways towards future policymaking for both China and other regions.

Contexts of ICT integration in basic education in China

In this section, I will introduce the state quo of Chinese basic education and its main features. Then the threshold and background of ICT integration in basic education were illustrated, followed by its achievements. Based on context information, we can have a deeper comprehension of China's policy intentions and logic which may differ from those of western developed countries.

As a developing country with a large population, China's education scale is enormous. Until 2020, in primary and secondary schools, the number of students has reached 198 million and the number of full-time teachers exceeded 13 million. There are more than 240 thousand primary and secondary schools. In PISA 2018, China achieved 555 in reading, 591 in mathematics, and 590 in science, ranking first in the list composed of 79 countries and regions. However, due to uneven social and economic development and the localized basic education financing system, huge gaps of education quality exist between different districts, especially between rural and urban areas. Studies have shown that students from developed regions have more power and advantages than those from poor areas in admission to prestigious colleges (Li & Yang, 2013; Liu, 2015).

The integration of ICT into basic education resonates with Chinese national progress of technology development. National policy makes macro planning and guidance for the development of basic education. At the same time, the development of global technology advance constantly contributes to the iteration and innovation of educational ICT (Hu, 2019). China first initiated the integration of ICT in education near the 1990s, during which the construction of an information superhighway was put forward nationally (Jiao et al., 2014). After 10 years, the Ministry of Education put forward an important education reform called *Chinese New Basic Education Curriculum Reform*. Since then, all-around education has been a focus in Chinese basic education which goes against exam-oriented education. For a long time, the exam-oriented basic education system has been criticized by scholars and the public because of too much stress on memorization, disconnection with daily life, students' homework load, teacher-dominated class, and dull teaching modes (Guo et al., 2019). All-around education refers to comprehensive human development and it focuses on cultivating students' creativity, self-learning, morality, and so on. ICT in education are conceived to facilitate this reform by promoting the access and inclusion of learning opportunities (Li et al., 2019). ICT courses are specially designed to cultivate students' innovative and practical competence. Meanwhile, ICT-based pedagogy such as *Integration Theory of Information Technology and Curriculum*, *Teacher-guided and Student-centered Teaching Structure* is advanced.

China vigorously facilitated ICT integration in education and infrastructure is usually put in the basic place. In China, projects have been launched aiming at strengthening national and regional network coverage. More than \$32 billion has been invested in ICT integration from the 1990s to 2010. Since 2000, projects like *School Network Popularization* (*xiao xiao tong* in Chinese), *Class Network Popularization* (*ban ban tong* in Chinese), and *Distance Education in Rural Areas* (DERA) have been implemented, through which

significant progress has been made in infrastructure, resources and competence (Zhang et al., 2010; Zhu et al., 2014). Taking *DERA* which started in 2003 for instance, the central government aimed to enhance the quality and efficacy of basic education in rural areas via broadcast stations, instructional CDs, satellite reception stations for instruction, and computerized classrooms. Besides, China has completed large-scale educational administrators, principals, and teachers training in their use of ICT. In 2019, nearly 6000 principals and teachers in primary and secondary schools took national training courses related to ICT application in education. The Ministry of Education carried out ICT-related training projects for 900 directors from the educational departments of different provincial governments. After initial infrastructure construction and personnel training, China began to put more emphasis on designing platforms for public schools and services (Jiao et al., 2014). In terms of software resources, the focus has shifted from software construction to media materials, online courses, and other digital resources such as MOOCs (Massive Open Online Courses). During the COVID-19 epidemic, online courses and digital resources contributed a lot to school teaching and students' self-learning. Due to these efforts, until 2020, all primary and secondary schools in China have been connected to the network and half of them are equipped with the wireless network. 95.2% of schools have multi-media classrooms and more than 70% of schools have digital teaching resources. As to teaching, 48.8% of teachers in China are capable to carry out online teaching research and 96% of them can use ICT to facilitate their class teaching (Dong et al., 2021).

Methodology

Data collection

Policy documents were collected from 4 sources: PKULAW Database (a policy document database developed by the Legal Artificial Intelligence Laboratory of Peking University and Beijing Beida Yinghua Technology Co., Ltd), the official website of the Ministry of Education of the People's Republic of China (www.moe.gov.cn), the official website of Chinese National Center for Educational Technology (www.ncet.edu.cn) and the Chinese Education Information Website (www.ict.edu.cn). For searching, I respectively used "ICT integration in education", "e-learning", "educational technology", "distance education", and "online education" as keywords in the title and "ICT integration in basic education" as the keyword in content. ICT integration has been mentioned in many educational policy documents, but only those which contain at least one section especially focusing on ICT integration are selected into the database. Finally, 179 policy documents from 1988 to 2021 were selected, including policy directly related to ICT integration, general educational policy, and annual working plans of the Ministry of Education.

Research framework

This study proposes a mixed-methods research that combines bibliometrics-based analysis and content analysis for exploring policy patterns and evolution. Metadata of those documents contain policy issuing agency, time, and their citation relationships. Based on the extraction of metadata and using the bibliometrics-based method, I identified policy-issuing time intervals marked by key events, and built a joint policy-issuing agency network based on the relationships between issuing agencies that co-occurred in the same policy

documents. I also built a policy-citation network to identify the most significant policy documents all over time. Next, I identified policy keywords, targets, tools, and focused educational elements by content analysis. Networks reflecting co-occurrence relationships were built to identify key issues and targets (Huang et al., 2015; Ying et al., 2001) as well as their evolutions in different time intervals through bibliometrics-based analysis. A summary of the research framework is presented in Fig. 1.

Analyzing

Policy-issuing agency networks refer to the phenomenon that multiple decision-makers jointly issue the same policy document and the networks depict the relationships between them. It is easy to extract this metadata considering that such collaborative behaviors are clearly presented in the policy issuer part of Chinese policy documents (Yang et al., 2020). In each network, the agency is represented by a node and the size of the node depends on the number of policy documents issued by that specific agency. Agencies that have collaborative relationships are connected by lines whose width depends on the frequency that two agencies appear in the same policy documents. Eigenvector centrality is used to determine the most influential agencies.

Policy citation network reflects the diffusion and inheritance between policy documents. The citation relationships are reflected by the textual description of the policy content, such as "To implement" and "Refer to". In this network, each node represents a policy document, and the edges indicate the connections between them. One thing to note is that the same kind of policy documents issued annually are merged as one policy document in this network.

Fig. 1 Research framework of policy for ICT integration in basic education in China

Policy key issues are reflected in document keywords and focused educational elements. Keywords are identified based on the thesaurus of official documents of the State Council and the Ministry of Education and their frequency should be above 1% or at least 20 times in one document. Focused educational elements should be either related to the construction of ICT integration in basic education or the application of ICT in teaching, learning, and management. Through word frequency and networks analysis, policy priorities can be discovered. In networks, each node represents a focused educational element and they are connected by lines if there are co-word relationships. Bigger nodes represent higher eigenvector centrality.

Chinese policy documents are usually written in a standard format, in which the expression of policy targets often appears in the first paragraph or the beginning sentence of each paragraph marked by "In order to achieve...". I cleaned all such expressions into noun terms and calculated their frequency in each phase. Finally, the targets that appear in the same policy document were considered to have co-occurrence relationships and their co-occurrence networks were built to identify the core targets. Through the change of targets with the higher eigenvector centrality, I figured out the evolution of China's policy targets.

Policy tools are methods used by the government to achieve specific targets (Huang et al., 2018). Different kinds of policy tools will emerge in different decision processes with different functions. Rothwell and Zegveld (1985) classified them into three categories and this study employed their framework. Three categories are presented as supply-side policy tools, environmental policy tools, and demand-side policy tools. Their classification has been widely adopted by many policy-related researchers (Huang et al., 2018; Ye et al., 2017; Zhang, 2020), especially on technological innovation. More details about them are presented in Table 1. I followed the coding principle of "detailed mutual exclusion", which means that in the same policy document, the case of using the same policy tool to act on the same policy object is only coded once and when different policy tools are used to act on the same policy object, the case is calculated according to the type of tools. I identified the frequency of policy tools used in each phase and its evolution across time.

Coding results were compared between two independent coders invited to help in this study to verify the reliability of the coding rules for educational elements, policy tools, and targets. The intercoder agreement tool in software Nvivo was set up to compare and contrast a single document coded by two independent coders, highlighting the areas where the two researchers' coded segments aligned and did not align. The reliability of the coding rules is reflected by the kappa coefficient, a statistical measure of reliability between independent coders. Our kappa coefficient reaches 0.534 (above 0.4) which shows good reliability.

Results

Basic patterns of policy for ICT integration in basic education

Time intervals of issuance

Figure 2 shows the number of policy documents spanning from 1988 to May 2021 from which we can see a growing trend. From 1988 to 1999, only 1 document was promulgated every five years and by 1999, there were just 5 in total. From 2000, when *The Outline of the National Plan for Medium-and-Long-Term Educational Reform and Development*

Table 1 Classification and definition of policy tools

Classification	Definition	Sub-classification
Supply-side tool	Government agency directly supports the development of ICT in education through the means of expenditure, personnel, information and technology by itself	Professional cultivation Research investment Infrastructure construction Personnel training Financial investment Public report Marketing
Demand-side tool	By reducing the resistance and transaction cost of technological innovation products entering the educational market and arising social awareness, the government promotes interaction between technological research and application in education	Cooperation with companies and institutions Domestic and international communication Purchasing service Demonstration Social appealing
Environmental tool	The government influences environmental factors of the development of both ICT and education through finance, system, and regulatory control to encourage the integration of ICT in education	Investment from non-governmental organizations Moderating mechanism Supervision and evaluation Legislation and regulation Goal planning Strategy

Fig. 2 Number of policy documents for ICT integration in basic education in China

(2010–2020) (*The Outline*) was promulgated, policy documents were issued more frequently. 4 were promulgated in 2000 and 6 in 2010. Starting from 2011 marked by the issuance of the *Ten-Year Development Plan for ICT Integration in Education (2011–2020) (TYDP)*, there has been rapid growth and the number peaked in 2016 as 16 issuances. This trajectory of policy issuance is consistent with the findings of previous research (Gao et al., 2019; Zhong et al., 2017). Based on these results, the development of China's policy in ICT integration in education can be divided into three phases: phase 1 from 1988 to 1999, phase 2 from 2000 to 2010, phase 3 from 2011 to 2021.

Policy-issuing agency network

The policy-issuing agency network is presented in Fig. 3, and according to their eigenvector centrality, core departments are listed in Table 2 from which we can see the Ministry of Education (which was called State Education Commission from 1985 to 1998) is the core agency.

Fig. 3 Policy-issuing agency network

Table 2 Departments with the higher eigenvector centrality in the joint policy-issuing network

Government department	Label	Number of policies	Eigenvector centrality
Ministry of Education (State Education Commission)	2	149	1.00
National Development and Reform Commission (State Development Planning Commission)	1	18	0.67
Ministry of Finance	3	17	0.27
Ministry of Public Security	6	2	0.17
Ministry of Industry and Information Technology	5	5	0.12
The People's Bank of China	7	1	0.11
National Radio and Television Administration	4	3	0.07
Office of the Spiritual Civilization Development Steering Commission	12	1	0.07
State Administration for Market Regulation	8	1	0.06
Ministry of Civil Affairs	13	2	0.04
China Banking and Insurance Regulatory Commission	9	1	0.03
Ministry of Human Resources and Social Security	14	2	0.03
China Securities Regulatory Commission	10	1	0.01
Ministry of Agriculture	16	1	0.01

It not only issued the most policy documents, but also collaborated with other ministries most frequently. These two facts suggest that it plays a leading role in China's educational ICT integration. Interestingly, although the State Council issued a comparatively large number of policy documents (19 in total), the number of its jointly issued policy documents is lower than most ministries (so it doesn't appear in Table 2). Besides, National Development and Reform Commission (used to be called State Development Planning Commission) ranks second and the Ministry of Finance ranks third.

Policy-citation network

In Chinese educational policy, the higher-leveled and more significant policy document is often cited by other documents as guidance. In the policy network, these policies can be referred to as "meta policies". The result of network analysis is presented in Fig. 4 and Table 3. It is obvious that *TYDP* and *The Outline* can be called "meta policies". Interestingly, these two policy documents were both issued at the beginning of phase 3 which witnessed the rapid development of ICT integration in basic education. *TYDP* is issued by the Ministry of Education and *The Outline* by the State Council and Central Committee of the Communist Party of China. *The Thirteenth Five-Year Plan of ICT Integration in Education* issued by the Ministry of Education in 2016 ranks third and from Fig. 4 we can see that numerous other policies are around it, which means that it plays a guiding role among them. *National Five-year Plans for Education*, a series of policy documents issued by the State Council, rank fourth in the list.

Fig. 4 Policy-citation network

Evolution of policy

Policy keywords

Through keywords, we can explore the evolution of policy focus. The frequency of keywords in each time interval is presented in Table 4 and the evolutionary trend is shown in Fig. 5. The words in the same color represent the same keywords (except black), and are connected with lines of corresponding colors to present their continuity. Policy keywords with higher frequency are placed at the higher level on the vertical axis. From the analysis results, we can see that teaching is one of the priorities for China's basic education development and its frequency has become higher in phase 2 and 3. School is another, which shows that the integration of ICT has always been school-based. Although training constantly appears, its importance has decreased.

Focused educational elements and their co-occurrence networks

Educational elements reflect the specific problems that policy focuses on. From Fig. 6 and Table 5 we can see that infrastructure, ICT competence, learning resource, and teaching mode have been constantly in focus. Many researchers regard infrastructure as the main

Table 3 Policy documents with the higher eigenvector centrality in the policy-citation network

Policy document	Label	Frequency	Eigenvector centrality
Ten-Year Development Plan for ICT Integration in Education (2011–2020)	36	10	1.00
The Outline of the National Plan for Medium-and-Long-Term Educational Reform and Development (2010–2020)	18	9	0.98
The Thirteenth Five-Year Plan of ICT Integration in Education	2	16	0.44
National Five-year Plans for Education	16	4	0.32
ICT Integration in Education 2.0 Action Plan	3	9	0.13
National Five-year Plan(s) for Economic and Social Development	49	6	0.07
Outline of National Informatization Development Strategy	17	2	0.05
Guiding Opinions on the Construction and Application of Public Service System of Digital Educational Resources	32	2	0.05
Decision of the State Council on Further Strengthening Rural Education	21	4	0.04
Opinions on Comprehensively Deepening the Reform of the Construction of Teachers' Team in the New Era	46	4	0.04
2003–2007 Education Revitalization Action Plan	13	4	0.04
Guide to the Construction and Application of Online Learning Space	38	1	0.04
Opinions on Accelerating the Promotion of the National Network Alliance for Teacher Education and Organizing and Implementing a New Round of Training for Teachers in Primary and Secondary Schools	30	2	0.03
Annual Key Points of ICT Integration in Education	7	3	0.03
Implementation Plan of Building an Effective Mechanism to Expand the Coverage of High-Quality Education Resources by Means of Information Technology	14	2	0.02
Action Plan for the Revitalization of Teacher Education (2018–2022)	25	2	0.02
Annual Key Points of ICT Integration in Education and Internet Security	9	2	0.02
Implementation Plan of National Vocational Education Reform	60	2	0.02
Opinions on Comprehensively Improving the Quality of Higher Education	31	2	0.02
The Thirteenth Five-year Plan for Poverty Alleviation Through Education	35	1	0.01

Table 4 Keywords with the higher frequency in each time interval

No	Phase 1		Phase 2		Phase 3	
	Keyword	Frequency	Keyword	Frequency	Keyword	Frequency
1	Audio-Visual Education	3	Resource	14	Resource	22
2	Textbook	2	Teaching	12	Teaching	21
3	Teaching	2	Distance education	11	School	19
4	School	2	Primary and secondary school	10	Teacher	17
5	District	1	Curriculum	7	Network	15
6	Ethnic minorities	2	School	7	Learning	11
7	Training	1	Teacher	6	Management	9
8			Rural area	5	Platform	8
9			Training	5	Digital	8
10			Network	5	Safety	7
11					National	7
12					Capability	7
13					Training	7
14					Innovation	6

Fig. 5 The evolutionary trend of policy keywords

challenge of ICT integration in education (Khan et al., 2012; Kisanga & Ireson, 2015) and China has paid a lot of attention to the construction of infrastructure, especially those in rural areas. ICT competence is also important and has been put in the center. Besides, teaching mode and learning resources are paid much attention to. Learning resources affect

Fig. 6 The evolution of focused educational elements co-occurrence networks

Table 5 Educational elements with the higher eigenvector centrality in each time interval

Time interval	Educational element	Frequency	Eigenvector centrality
Phase 1	Teaching mode	2	1.00
	Infrastructure	1	0.07
Phase 2	Independent learning	2	1.00
	ICT competence	19	0.81
	Infrastructure	29	0.37
	Learning resource	30	0.14
	Standard and regulation	6	0.04
	Teaching mode	11	0.01
	Teacher's professional development	23	0.01
Phase 3	Infrastructure	60	1.00
	Learning resource	83	0.57
	ICT competence	37	0.30
	Management	61	0.14
	Standard and regulation	20	0.06
	Teaching mode	57	0.03
	Teacher's professional development	23	0.01

Policy targets and their co-occurrence network

In phase 1 (1988–1999), teaching efficiency is the core target, connected with education reform and modernization, which shows that ICT were mainly used to improve teaching efficiency while further realizing education reform and modernization. This result corresponds with China's national strategy in 1978 which focused on the modern construction of the economy and society. At that time, the State Council disseminated a series of strategies aiming at modern educational tools such as television and radio to improve the development of education with more outcomes, higher speed, better quality and less cost (*duo kuai hao sheng in Chinese*).

Figure 1 consists of three network diagrams illustrating the evolution of educational governance systems across three phases.

Phase 1 (Top Left): This diagram shows a simple network with a central green node labeled "teaching efficiency". It is connected to two other nodes: "educational reform" (orange) and "education quality" (purple).

Phase 2 (Top Right): This diagram shows a more complex network with a central green node labeled "education modernization". It is connected to several other nodes: "information-based society" (pink), "professional development of teacher" (orange), "education quality" (purple), "education equity" (black), "education reform" (black), and "educational innovation" (blue).

Phase 3 (Bottom): This diagram shows a highly complex network with a central grey node labeled "educational reform". It is connected to many other nodes, including "education modernization" (black), "education quality" (purple), "education equity" (black), "education reform" (black), "educational innovation" (blue), "e-learning space" (blue), "poverty alleviation and intellectual aid through education" (black), "modernization of educational governance system and capacity" (black), and "digital school" (black).

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Fig. 8 The evolution of policy targets

more, all-around education (*su zhi jiao yu in Chinese*) appears in the network to advocate students' cooperation and self-investigation. Whilst, some macro-targets corresponding to national strategies are also mentioned such as national revival, building education power, and constructing rural areas.

In phase 3 (2011–2020), e-learning space ranks first, followed by the modernization of the educational governance system and capacity. The development of the e-learning space in China dates back to 2000, when online teaching and learning platforms such as *Moodle*, *Blackboard*, *4A*, and *Tsinghua Online Education* flourished. In 2012, the *Santong Project* (project aims at constructing networks in every school, providing learning resources for every class and e-learning space for every teacher and student) was carried out, further accelerating the development of e-learning space. Since 2017, China has given priority to the development of education. In 2019, *China's Educational Modernization 2035* was issued to accelerate the progress of educational modernization. As an important part of educational modernization, optimizing the governance system and capacity not only follows China's national administrative reform but also changes the relationships between educational departments and public schools. In phase 3, the importance of education equity rises to a new historical height in China. Digital school, moral education (*li de shu ren in Chinese*), education quality and equity, poverty alleviation come into the spotlight. With the integration of ICT in basic education, students and teachers in rural areas can get access to high-quality courses and e-literature. The variety of policy targets reflects the government's multiple expectations on ICT.

Table 6 Policy targets with the higher eigenvector centrality in each time interval

Time interval	Policy target	Frequency	Eigenvector centrality
Phase 1	Teaching efficiency	1	1.00
	Educational reform	2	0.07
	Education modernization	1	0.07
Phase 2	Information-based society	1	1.00
	Education modernization	5	0.90
	All-round education	4	0.25
	Professional development of teacher	3	0.14
	Educational reform	4	0.10
	Deep integration between ICT and education	2	0.10
	Talents	2	0.04
	Decision-making	1	0.04
	The Chinese nation's bright prospect on the road to revival	1	0.01
	Social and economic development of rural areas	1	0.01
	Education power	1	0.01
Phase 3	e-learning space	2	1.00
	Modernization of educational governance system and capacity	5	0.80
	Educational reform	10	0.77
	Digital school	2	0.68
	Poverty alleviation and intellectual aid through education	2	0.48
	Education modernization	10	0.35
	power(nation)	6	0.25
	Innovation	9	0.10
	Education quality	6	0.08
	A networked, digital, personalized and life-long education system	3	0.05
	Education equity	5	0.04
	Professional development of teacher	8	0.02
	Learning society	4	0.02
	Moral education (<i>li de shu ren in Chinese</i>)	3	0.01
	Decision-making	1	0.01

Policy tools

Tables 7, 8, 9 shows the frequency and proportion of each tool and its sub-tools. The supply-side tool is used most frequently in phase 2 to construct infrastructure and improve ICT competence. In terms of sub-tools, financial and research investment have always been put in the center, although more attention has been put specifically on infrastructure construction in phase 2 and 3. Personnel training is always on the spot, and in recent years, more emphasis has been put on cultivating talents and professionals. Compared to the supply-side tool, the demand-side tool is used much later, corresponding with governmental reform. In 2013, China launched a new round of administrative system reform in which relationships between government, market, and social institutions are greatly changed. Everything that can be done by the market will no longer be managed by the government who only takes the responsibility of macro-control and supervision. Besides, social institutions

Table 7 The frequency and proportion of policy tools in phase 1

Tool	Sub-tool	Frequency	Proportion
Supply-side tool (6, 35.29%) *	Financial investment	2	11.76%
	Personnel training	2	11.76%
	Research investment	2	11.76%
Demand-side tool (3, 17.65%)	Domestic and international communication	1	5.88%
	Demonstration	1	5.88%
	Public report	1	5.88%
	Goal planning	1	5.88%
Environmental tool (8, 47.06%)	Legislation and regulation	1	5.88%
	Moderating mechanism	6	35.29%

*The number in the bracket is the frequency of each tool with its proportion followed (the same in Tables 8 and 9)

Table 8 The frequency and proportion of policy tools in phase 2

Tool	Sub-tool	Frequency	Proportion
Supply-side tool (44, 44.90%)	Professional cultivation	4	4.08%
	Research investment	11	11.22%
	Financial investment	7	7.14%
	Infrastructure construction	9	9.18%
	Personnel training	13	13.27%
Demand-side tool (16, 16.33%)	Cooperation with companies and institutions	2	2.04%
	Social appealing	1	1.02%
	Demonstration	3	3.06%
	Marketing	3	3.06%
	Public report	2	2.04%
	Purchasing service	2	2.04%
	Domestic and international communication	1	1.02%
	Investment from non-governmental organizations	2	2.04%
	Legislation and regulation	11	11.22%
Environmental tool (38, 38.78%)	Moderating mechanism	14	14.29%
	Goal planning	10	10.20%
	Supervision and evaluation	3	3.06%

are allowed to operate more independently and government no longer dominates the activities of private enterprises, leaving more autonomous space. Consequently, phase 3 witnessed more enterprises and social institutions joining in. The government cooperates with companies and institutions and purchases services from non-governmental organizations, aiming at drawing various investments. Besides, sub-tools include domestic and international communication, demonstration, public report, and social appealing. In 2015, International Conference on Educational Informatization was jointly launched by UNESCO and the Chinese government. Since then, a series of conferences have been held annually in

Table 9 The frequency and proportion of policy tools in phase 3

Tool	Sub-tool	Frequency	Proportion
Supply-side tool (77, 31.17%)	Financial investment	7	2.83%
	Research investment	7	2.83%
	Professional cultivation	10	4.05%
	Infrastructure construction	28	11.34%
	Personnel training	24	9.72%
Demand-side tool (72, 29.15%)	Investment from non-governmental organizations	7	2.83%
	Cooperation with companies and institutions	9	3.64%
	Public report	17	6.88%
	Domestic and international communication	10	4.05%
	Purchasing service	4	1.62%
	Demonstration	5	2.02%
	Marketing	19	7.69%
	Social appealing	2	0.81%
Environmental tool (98, 39.68%)	Moderating mechanism	47	19.03%
	Strategy	2	0.81%
	Legislation and regulation	28	11.34%
	Supervision and evaluation	10	4.05%
	Goal planning	11	4.45%

China. The environmental tool has been constantly used by the government in all three phases, with proportions ranging from 38.78% to 47.06%. Through planning goals, promulgating regulations and standards, the Chinese government aims at making a well-ordered environment for the deep integration of ICT in basic education.

Discussion

Based on the findings above, this section explores and analyzes the characteristics, underlying logic, and intentions of China's evolving policy.

A growing number of policy documents for ICT integration in basic education

The Ministry of Education promulgates key points in the work related to ICT integration annually, from which we could see China has put much emphasis on this issue. Moreover, policy promulgation has been more rigorous in the recent 10 years (phase 3 in this study). Thus, it's not surprising that "meta policies" in the policy-citation network both appear in phase 3. *The Outline* depicts the development goals, ideas, programs, and measures of China's basic education from 2010 to 2020, and gives ICT an important role during this period. Whilst, *TYDP* depicts more details about how ICT and basic education should be like and the goal that China should achieve under the guidance of *The Outline*. These two documents both play a guiding role in the policy network.

Regarding ICT integration as a state-level strategy

From the analysis of policy agencies, we can conclude that ICT integration in basic education has been regarded as a state-level strategy from the very beginning. China's State Council deploys general working plans for basic education while the Ministry of Education implements them in practice. China's National Development and Reform Commission which makes policy related to national technology development and innovation also acts as the core policy-issuing agency. This shows that the integration of ICT in basic education has been considered as part of the foundation of national innovation and development. With the rapid popularization of ICT in different domains, the policy-issuing agency has become diversified since 2010. Joint issuance by different ministries and commissions has gradually become normal. More and more ministries including the Ministry of Science and Technology, the Ministry of Human Resources and Social Security, the Ministry of Industry and Information Technology have begun to participate in issuing policy for the integration of ICT in basic education.

Emphasis on teaching and teachers' ICT competence

Teaching and teachers' competence have always been the focus in China's policy throughout these years while other regions or countries may stress students' competence. For instance, Singapore focused on integrating ICT to help students engage in higher-order thinking (Lim, 2007). This may be explained by the cultural difference in education. Some countries pay more attention to teaching than learning, and therefore focus on teaching innovation. Although it's widely acknowledged that infrastructure is the foundation of ICT integration, China also stresses teachers' and principals' ICT competence. China paid a lot of attention to training personnel in preparation for their application of ICT in teaching and managing. Information literacy of teachers and administrators was stressed from the early stage even though ICT infrastructure wasn't fully developed at that time. In conclusion, infrastructure and ICT competence both play an engine role in the integration of ICT in basic education in China.

Aiming at quality education and educational equity

Similar to western peers, China has realized that ICT can bring educational revolutions. But different from the West's concern on students' competency and performance (Salam et al., 2017), China aims at promoting education equity and quality. This characteristic serves as the core of policy for ICT integration in basic education in China.

It can be seen that the integration of ICT serves China's educational goal to cultivate all-around-developed students, which is in line with the international trend of providing quality education (Prasojo et al., 2019). Morality (*De in Chinese*) is considered as the priority of student's competence in China and moral education (*li de shu ren in Chinese*) is given the first place in China's basic education system which should be carried out at all stages and through various methods. The integration of ICT may bring convenience and scientific tools to implement moral education and student evaluation.

China is also making efforts to bridge the education gap through the integration of ICT because basic education equity is considered as the foundation and method of achieving social equity. *The Outline* takes education equity as one of the policy targets

in national basic education, which not only reflects the attention that China has put on it, but also shows China's long-term and arduous task of realizing it. The gap in educational opportunities between urban and rural areas is the main reason for China's educational inequality (Qian & Smyth, 2008) and "reforming education with technology" has become an important goal in China.

Joint efforts and open communication as policy tools

In the early developing stage, the government played the dominant role in constructing infrastructure and improving teachers' ICT competence to promote the integration of ICT in basic education. Finance and research support served as the government's main tools. However, with China's administrative system reform, there is a sharp increase of the demand-side tool, especially in the recent 10 years, which witnessed more enterprises and social institutions joining in. What's more, there are more and more international conferences held by China. These conferences provide China with chances to learn from other regions as well as demonstrate its own experiences on the international stage. In summary, joint efforts and open communication are preferred in policy tools.

Conclusion

This paper presents a mixed-methods research that combines bibliometrics-based analysis and content analysis on policy documents. It enriches current qualitative research by analyzing many policy documents at the same time while demonstrating policy changes in depth. In the future, correlation analyses between policy targets and agencies could be done to specify the role of different departments in the development of basic education. This study takes basic education as the research scope. However, in the near 10 years, ICT will be integrated into both formal and informal education, all stages from preschool education to higher education (Wang et al., 2018). There is a need for further inquiry to use the methodology of this paper in analyzing policy for other scopes of education.

Drawing on the findings of this study, the characteristics of China's policy patterns are identified. Policy evolution based on policy keywords, focused educational elements, policy tools, and policy targets further shows us the underlying intentions and logic of policy for ICT integration in basic education. New technologies and their hype cycles constantly appear and impact educational development (Walker, 2017). Considering the rapid speed of scientific and technological innovation, educational policy planning is more and more important. By analyzing China's policy patterns and evolution, this study supplies policymakers in other regions and countries with suggestions for possible approaches to integrating ICT in basic education. First, the integration of ICT should be leveraged to a nation-level considering that lack of policy alignment has been a major challenge for the integration process (Lim et al., 2020). A major decision agency like the State Council could guarantee the continuity of policy. Second, the integration of ICT requires joint efforts from multiple departments as well as non-governmental organizations. Researchers find that various factors such as accessibility of resources, capacity to use the technology, availability of time, and provision of technical support could influence the use of ICT in schools (Nyakwara, 2014). However, these requirements can't be fully achieved by educational departments alone so cooperation with other agencies is necessary. Further, in underdeveloped regions where governments can't afford the construction of infrastructure

and learning resources alone, public–private partnerships can be a better choice. Third, the ICT competence of both teachers and students should be paid much attention to. Return on infrastructure investment depends on policy related to access and use. Students', teachers', leaders', and educational administrators' knowledge, understanding, and skills related to ICT are crucial to helping them participate in digital technology. Last, by providing high-quality educational resources across time and space, ICT could help create more educational opportunities. If implemented appropriately, ICT can bring new hope to educational equity.

This study could also supply policymakers with references for possible policy adjustments in China's policy for the integration of ICT in basic education. For one thing, China put a lot of emphasis on supporting teachers' management and teaching but ignoring students' learning. Studies have shown that students' ICT competence is one of the prominent factors influencing ICT integration into the learning environment (Turgut & Aslan, 2021). Besides, students' reaction to the complex system offered by technologies will influence their learning process. In the future, policymakers should attach attention to the ICT competence of both teachers and students. For another, due to the effect of the market economy on the allocation of educational resources, proficient teachers and high-quality teaching resources may inevitably gather in economically-developed areas, resulting in the imbalance of supply and allocation of public resources between urban and rural areas. As a result, it should be noticed that ICT development in education may bring new inequality.

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