A Study on AI-Enabled Basic Education Reform in China under the "Double Reduction": Key Tasks and Strategies

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Abstract. Within the framework of the "Double Reduction" in China, this study systematically examines the ways in which artificial intelligence (AI) empowers the reform of basic education. This study centers on three core issues - policy objectives, key tasks, and strategies. Their aim is to evaluate how effectively AI contribute to the key objectives of reducing students' homework burden and alleviating tutoring pressure. Drawing on national policy documents and other relevant materials, and employing the Latent Dirichlet Allocation (LDA) model, this study identifies six major themes: urban educational provision and regional disparities; holistic student development under policy guidance; advancement of teachers' instructional competence; diversification of educational provision and engagement of social forces; multidisciplinary teaching and learning research supported by AI; and educational infrastructure development and resource assurance. Collectively, they illustrate the multifaceted ways in which AI contributes to the formation of new pedagogical paradigms and the advancement of systemic transformation in education. The study finds that the deep integration of AI into basic education continues to face significant challenges. Achieving the objectives of AI-empowered education necessitates coordinated advancement in four critical dimensions: Top-level Design, Teacher Development, Technological application, Educational resource allocation.

Keywords: "Double Reduction", AI, Basic Education, LDA Topic Model.

1. Introduction

In recent years, the educational system of basic education in the country has experienced a structural transformation that has never taken place in the past few years with the help of the national strategy of China on educational modernization. Opinions on Further Reducing the Homework Burden and Off-Campus Training Burden of Students in Compulsory Education, was issued on 24 July 2021 by the General Office of the Chinese Communist Party and the State Council of the People's Republic of China (In Wikipedia). This is referred to as the "Double Reduction". The introduction of it is a milestone in China's education system reform. It is intended to establish a more well-developed system of basic education by reducing homework and after-school tutoring pressure on primary and secondary school students. And Its adoption marks a new period in the attention of the country on equity in education, quality of teaching, and physical and psychological well-being of youth.

With the progress of the regulations of the policy of the "Double Reduction", there is a challenge with the models of the teaching management and classroom organization. Important question as an implementation concern would be the attainment of quality improvement amid the minimization of the burdens as well as the in China long-standing structural imbalance in favor of urban areas, in regards to educational resource allocations (From Xinhua News Agency). In the meantime, AI is one of the actual technological solutions to education reform. The uses of AI, including automated scoring, learning recommendation, smart classroom communication and student data processing are well-distinguished as an efficient usage to teach more efficiently, reduce the workload of teachers as well as bring precision teaching.

However, there are a variety of reality practical concerns with the implementation of AI in basic education as well. Such as low AI literacy among teachers, low adaptability of educational platforms and imbalanced regional resource. Thus, it is necessary to thoroughly analyze how AI can successfully strengthen the classroom practice in the context of the so-called policy of the "Double Reduction" and how the barriers to its application and how to overcome them.

This study focuses on the application of AI in the context of the "Double Reduction", which holds substantial practical relevance. On one hand, it helps empirically assess the actual impact of AI in reducing students' academic burden, enhancing teaching quality, promoting educational equity, and improving overall satisfaction—thus responding to the core objectives of China's educational reform. On the other hand, by aligning policy goals with technological pathways, this research investigates effective ways for AI to empower teaching practices, providing both theoretical insights and practical guidance for the ongoing transformation toward "smart education." Furthermore, by accounting for regional disparities and teacher competencies in AI, the study proposes targeted recommendations for optimizing educational resource allocation, strengthening teacher training mechanisms, and improving policy implementation. Through the application of Latent Dirichlet Allocation (LDA) topic modeling, this study also aims to expand methodological approaches in educational policy research and enrich the tools for data-driven evaluation, thereby enhancing the practical value and scalability of its findings.

2. Literature Review and Conceptual Framework

2.1. Literature Review

The "Double Reduction" sets two primary objectives: reducing homework and easing after-school tutoring pressures for primary and secondary school students. Their objectives are to promote students' all-round development, safeguard educational equity, and finally making schools the primary platform for education (From Ministry of Education of the People's Republic of China). Burden reduction interpreteda paradigm shift that goes beyond pedagogical insignificance as the focus shifts toward overcoming the test-centered paradigm of teaching to the more balanced and developmentally sound educational paradigm [1]. Improving the quality of teaching in school is a prerequisite for "Double Reduction". Tougher measures such as curtailing off-campus tutoring and reducing homework are worthwhile practices, but they cannot work in the long-run unless they are complemented with real changes in the school system itself (From Ministry of Education of the People's Republic of China). And The initiatives signal a shift of the piecemeal approach toward interventions to structural adjustments in weighting: instead of focusing on individual competition, the system can be made more fair [2]. In summary, the "Double Reduction" revolves around two primary objectives, which collectively form the strategic framework for systemic educational reform. And it represents an attempt to profoundly reconstruct the basic education system in China.

AI technologies are penetrated at various levels of education such as homework planning, classroom instruction, feedback on learning, and teaching enhancement. AI-based systems like a Homework AI Engine called "Xue Er Si" employ big data and algorithmic processing to produce individual assignments by overlaying them with what the students really need to study. In addition to lessening the repetition and amount degree of homework, these systems enhance the precision of the instruction by real-timing the perplexity and structure of the content, and the feedback information. Classroom with AI have converted learning experiences traditionally characterized by the lecture method into dynamic and responsive learning classrooms. These technologies help magnify participation in the classroom and enhance remembering the information by offering a multimodal approach and instant feedback [3]. Moreover, Teachers can provide students with more accurate personalized education with the help of AI feedback on learning. This will help build a more inclusive and effective learning model [4]. The process highlights the student-centered teaching philosophy, while offering technological support for the realization of both educational equity and quality. AI is used as part of the teacher mentoring systems where a personalized pro plan is possible [5]. Nevertheless, researchers, such as Jin Yunbo and Gong Panpan warn against the excessive reliance on AI, and insist on the mixed approach, which harmonizes technological breakthroughs and humanistic ideals [6]. Educators do not simply need to be educated about the usage of the AI tools, but also the ability to evaluate those critically, so that they can remain central in designing the

curriculum, ethical decision-making and caring about the students. Concisely, AI is driving the radical change in the basic education system in China within the context of the "Double Reduction".

2.2. Conceptual Framework

Based on the 2025 report *AI Empowering Education: Opportunities, Practices, and Challenges* published by China Education News, achieving the national goal of implementing AI education in all primary and secondary schools by 2030 requires coordinated efforts across educational authorities, schools, enterprises, teachers, students, and even parents.

Jiaqi Sun(2025) points out there are still some problems in the Top-level Design, Teacher Development, Technological application, Educational resource allocation [7]. At first, there are Some deficiencies in the top-level design of the integration of AI and education. Secondly, limited AI literacy among teachers has become a major bottleneck. Next, On the technical, it is proposed that large language models should be incorporated into the infrastructure of campuses. it means the application of AI in education faces challenges in both software and hardware. Finally, Regional disparities in educational technology resources are prone to generating the "Matthew Effect", thereby exacerbating the imbalance of educational resources across regions [7].

Therefore, this study draws on the analytical dimensions of Jiaqi Sun (2025), from AI in educational, this study identifies systemic risks and, focusing on four topics—top-level design, teacher development, technological application, and resource allocation—proposes key tasks and strategies. (Figure 1)

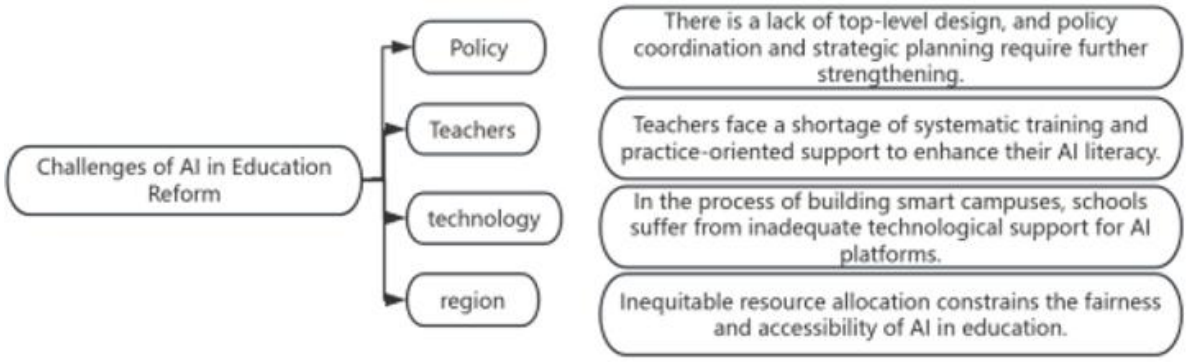


Fig 1. Four-dimensional analytical framework designed based on the analysis of Jiaqi Sun.

3. Research Methods and Data Preparation

3.1. Research Method: LDA Topic Modeling

This study adopts a mixed approach of literature review and LDA topic model to investigate the pathways through which AI empowers basic education and the practical challenges it faces in the context of the "Double Reduction".

The paper implements Latent Dirichlet Allocation (LDA) being one of the fundamental approaches to text mining to automatically discover the essential semantic topics regarding the AI-Enabled education reformation strategy based on the reduction policy, namely, the "Double Reduction". LDA, an unsupervised learning algorithm based on Bayesian inference, enables the extraction of latent thematic structures from large-scale texts without manual annotation [8]. To implement this, a corpus was constructed using four types of texts: national policies, media reports, academic papers, and school-level teaching reports. Most of the data were sourced from CNKI (China National Knowledge Infrastructure), using keywords such as "Double Reduction" and "artificial intelligence," yielding 221 articles. Additionally, 21 primary and secondary schools in major Chinese cities known for prioritizing education were selected as case sites, providing another 56 articles. After filtering for relevance to public schools and the target themes based on titles, abstracts, and keywords, 205 articles were finalized for analysis.

In the data preprocessing phase, Chinese word segmentation tools such as Jieba were used for tokenization and stop-word removal, followed by construction of a bag-of-words model. The LDA model was then trained and tuned using different topic numbers, with the optimal number determined based on perplexity and topic coherence scores (Wang et al., 2024). Key term distributions and high-frequency text excerpts were extracted for each topic, and thematic labels were assigned through manual interpretation.

The LDA modeling effectively identified several semantic themes closely associated with AI-Enabled education reform, including “intelligent homework,” “AI classroom interaction,” “learning feedback mechanisms,” “educational equity,” “technical adaptation,” “teacher training,” and “policy coordination.” The frequency and distribution of these themes across different text types provide empirical support for the study’s analytical framework and variable construction. Furthermore, by mapping LDA results to predefined variable dimensions, the study evaluates the extent to which AI technologies respond to the goals of the “Double Reduction” and identifies the implementation barriers and differentiated challenges that exist in practice. This methodological approach not only strengthens the data-driven nature of the study but also enhances the structural interpretation of policy discourse and educational practice, showcasing the value of topic modeling in educational policy research.

3.2. Data Collection

In this research, the journey and methods by which AI can transform education through basic education reforms in China are sought. It takes a mixed research methodology, with emphasis on policy document readings, teaching practice narratives, media opinion pieces and scholarly articles. The key analytical approach is the so-called LDA a topic model algorithm allowing to infer latent hierarchical topic structures within a large body of text. The flowchart below (Figure 2) demonstrates that four stages specifically data collection, preprocessing of texts, LDA model, topic interpretation, and strategic analysis compose the research process [8].

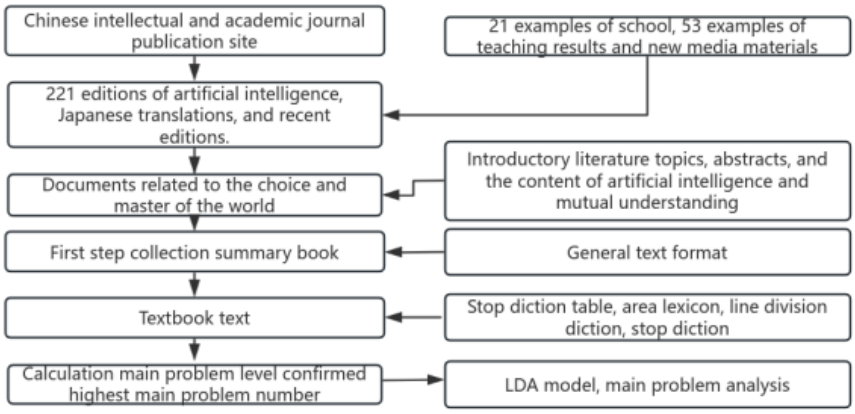


Fig 2. Research Flowchart.

In order to gain a typologically systematic idea of the main areas of focus of AI-Enabled reform in basic education from the background in“Double Reduction”, LDA has been used on a curated corpus of Chinese-language documents, to perform unsupervised topic modeling. LDA allows identifying the spread of latent topics among documents and therefore, allows identifying structural problems and multidimensional trends within educational and policy discourses. Initial text filtering was conducted manually by reading titles and abstracts to exclude irrelevant content. Selected documents were exported in .txt format for analysis.

3.3. Data Processing

To improve model performance, the text data first underwent stop-word removal, word segmentation, and domain-specific dictionary normalization. After these steps, the data was encoded

uniformly and then input into the LDA model for topic modeling analysis. Model training was conducted using the Gensim framework, with symmetric priors (α and η automatically set). The number of topics was set within the range of 2 to 11, and the model fitting performance was evaluated one by one.

After constructing the LDA model, in order to further analyze the semantic distribution and similarity between topics, this study used Multidimensional Scaling (MDS) to generate an "Intertopic Distance Map." [8]. This method is based on the word distribution distance between topics (usually calculated using Kullback-Leibler divergence or Hellinger distance), and projects the high-dimensional relationships among topics onto a two-dimensional plane through dimensionality reduction. In the map, each circle represents a topic. The area of the circle reflects the relative weight of that topic in the overall corpus, while the distance between the centers of the circles indicates the semantic similarity between topics — the closer the distance, the more similar the content. This map can intuitively show the clarity of boundaries and potential overlap between topics, and serves as an important method for evaluating the quality of the LDA topic model.

To identify the most distinctive core terms in topic identification across the entire corpus, this study further generated a bar chart of the "Top-30 Most Salient Terms." This chart evaluates the importance of terms based on the saliency function formula proposed by Sievert:

$$\text{saliency}(w)=\text{frequency}(w)\times\sum_t P(t/w)\times\log\left(\frac{P(t/w)}{P(t)}\right) \quad (1)$$

Here, frequency(w) denotes the frequency of the term in the entire corpus, and P(t|w) represents the probability that the term belongs to a particular topic. The high-frequency terms visualized in this chart help identify key research directions and regional features, which are further used to interpret topic content and assign topic labels. At the same time, this also provides empirical support for the results analysis section.

4. Text Analysis Based on Topic Model

4.1. Coherence and Perplexity

To determine the optimal number of topics, this study evaluates two key metrics: coherence and perplexity:

Figure 3 shows that when the number of topics is 6, the coherence score reaches its highest point (approximately 0.625), indicating the strongest semantic aggregation at this point. Figure 4 demonstrates that perplexity decreases as the number of topics increases, but the decline begins to level off between 6 and 7 topics, suggesting diminishing marginal improvements. Considering both topic interpretability and model stability, this study ultimately selects the 6-topic model as the basis for further analysis.

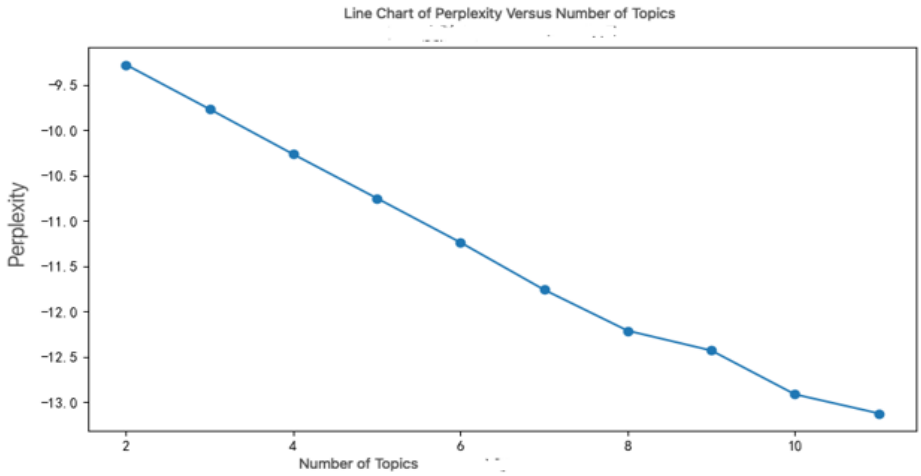


Fig 3. Line chart of perplexity versus number of topics

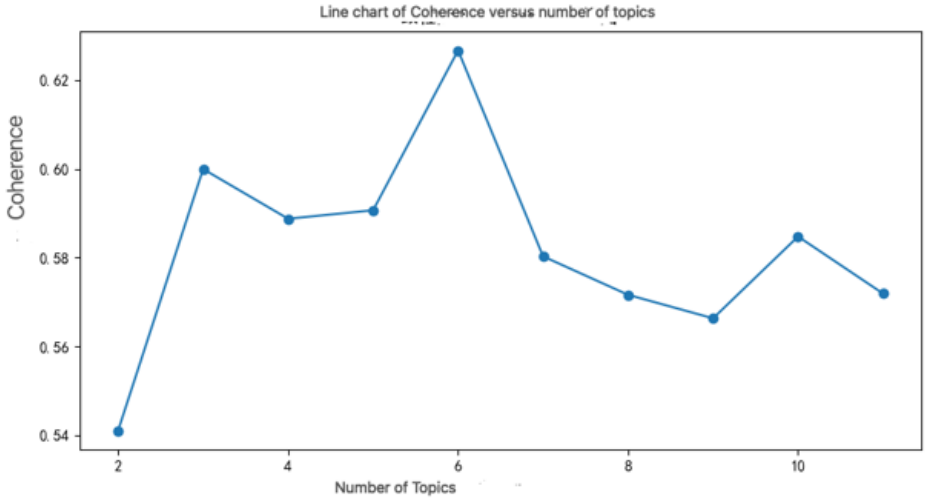


Fig 4. Line chart of Coherence versus number of topics

4.2. Intertopic Distance Map and Top-30 Most Salient Terms

Figure 5 presents a two-dimensional visualization of the six topics extracted by the LDA model using Multidimensional Scaling (MDS). Each circle in the left diagram represents a topic, and its size indicates the topic's relative weight across all documents. The distance between topics reflects their semantic similarity — the farther apart the circles, the more distinct the topics are with minimal overlap. The diagram shows that Topic 4 is the most dominant core topic, while the spacing among the other topics is reasonable, indicating good topic separability and interpretability of the model.

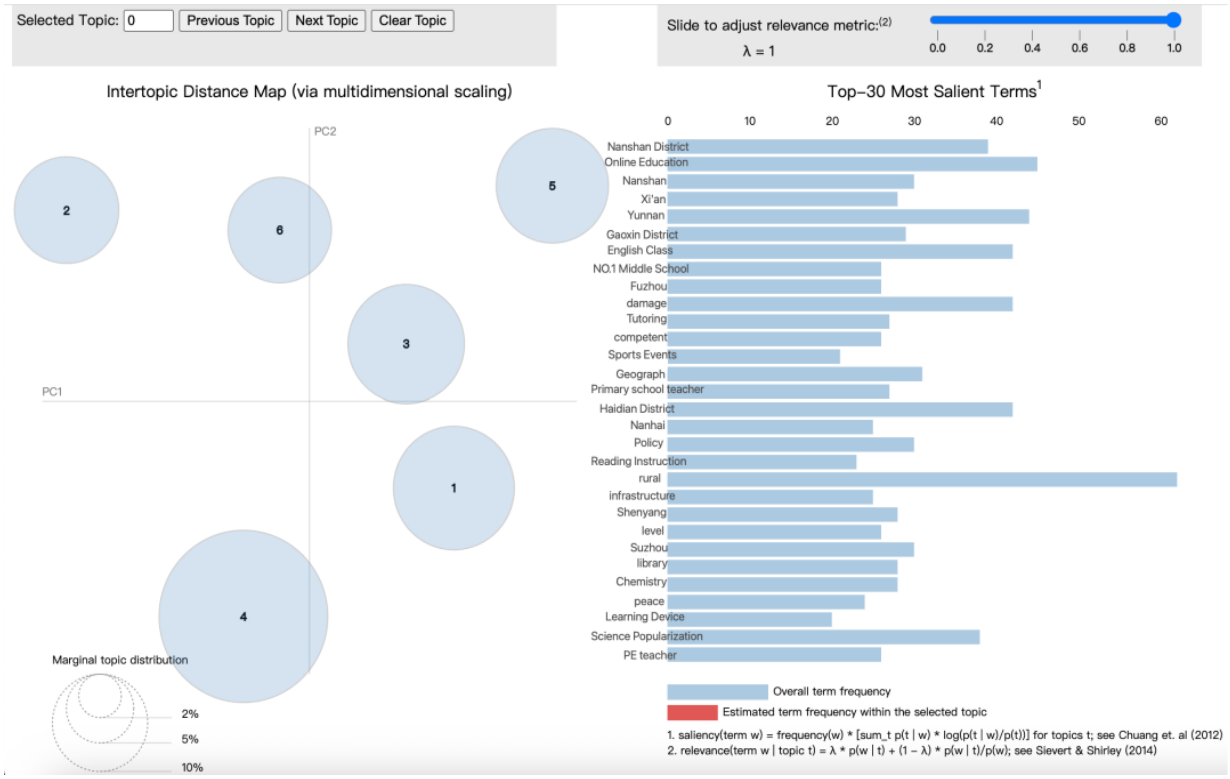


Fig 5. Intertopic Distance Map and Top-30 Most Salient Terms.

The right figure displays the top 30 most salient terms contributing to the LDA model. These terms are selected based on a combination of word frequency and their relevance to topics, serving as a key reference for determining topic distribution and thematic focus within the corpus. For instance, terms such as “Nanshan District,” “online education,” “Fuzhou,” and “burden” appear frequently, highlighting research hotspots related to local policy implementation, academic burden, and educational informatization. The red portion represents the term's weight within a specific topic,

while the blue bar indicates its overall frequency across the corpus, revealing the coupling relationship between keywords and topic distributions.

4.3. Topic Induction

Table 1. AI in Education Topic Clustering Term List.

Number	Topic Name	Topic feature words
Topic 1	urban educational provision and regional disparities	Rural / Tutoring / Science / Popularization / Foreign / Business / Shenyang / Nanjing / Exercises / Disguised
Topic 2	holistic student development under policy guidance	Politics / Competence / No. 1 Middle School / Sports Events / Fuzhou / Children / Civilization / Brain / Federation / Expression / Digital Intelligence / Citywide
Topic 3	advancement of teachers' instructional competence	Load / Xi'an / Gaoxin District / Teaching / Suzhou / Teaching System / Physical Teachers / Support / Dual-teacher / Evidence-Based / Scaled
Topic 4	diversification of educational provision and engagement of social forces	Rura / Demonstration/ Campus/ Training / Haidian District / Tutoring /Jinling Middle School / CSE / Micro-lesson / Family Education / Beijing
Topic 5	multidisciplinary teaching and learning research supported by AI	Online class / Nanshan District / Nanshan / English / Geography / Primary School / Teaching Assistant / Chemistry / Homework / Grades / Reading Instruction / Shenzhen
Topic 6	educational infrastructure development and resource assurance	Library / English Teaching / Haidian District / Infrastructure / Peace / Nanjing / Industry-Education / Learning Machine s/ Arts / Academy of Education / Chongqing

After determining six topics as the optimal classification, this study further conducted a summarized analysis of the keyword distribution under each theme (In Table 1). By clustering and associating the top ten keywords of each topic, six representative thematic focuses were identified and categorized into four analytical dimensions: region, policy, teachers, and technology. At the regional, urban educational provision and regional disparities reveal gaps in curriculum supply, teacher allocation, and educational quality between urban and rural areas, highlighting the demand for balanced development. As for policy, holistic student development under policy guidance emphasizes the guiding role of national policies in fostering students' all-round growth, while diversification of educational provision and engagement of social forces highlights the supplementary role of social forces, presenting a pluralistic model of collaboration among government, academic societies, and family education. In terms of teachers, advancement of teachers' instructional competence reflects the urgent need for digital and intelligent teaching skills amid workload and regional disparities, underscoring the importance of training, evidence-based evaluation, and technological application in supporting professional growth. From the technological perspective, multidisciplinary teaching and learning research supported by AI focuses on classroom reform and subject integration, while educational infrastructure development and resource assurance stress the role of hardware, laboratory equipment, and digital platforms in sustaining educational reform. In sum, these six themes collectively reveal the interactive relationships among regions, policy, teachers, and technology, pointing toward an integrated pathway for achieving students' holistic development under the support of AI and institutional safeguards.

5. An Analysis of Key Tasks and Strategies for AI-Enabled Basic Education

5.1. Urban Educational Provision and Regional Disparities

The application of AI can partially mitigate the challenges of urban educational provision and regional disparities. Research carried out by the Ministry of Education of the People's Republic of China also indicates that in eastern coastal provinces school are experiencing much greater rates of AI adoption, a more diverse array of digital platforms, greater access to funding, and more thorough

training schemes, as compared to those schools in central and western China (From Ministry of Education of the People's Republic of China). This is a digital-based form of socio-economic stratification and institutional capacity, which presents one of the primary barriers to educational equity as a policy goal.

In order to solve the problem, the analysis is organized around three dimensions.As for student, AI enables the precise sharing of high-quality curricular resources via intelligent platforms and leverages knowledge graphs and recommendation algorithms to deliver personalized learning content to students across different regions; In the teacher dimension, AI teaching assistants and virtual instructors can assume greater responsibilities in areas facing teacher shortages, while intelligent training systems support local teachers in enhancing their professional skills; At the resource, AI, through big data systems, can also monitor regional gaps in educational supply and demand in real time, assisting governments in the rational allocation of fiscal resources and teaching positions. By supporting student learning, strengthening teacher development, and improving resource allocation, AI establishes a new technological basis for narrowing regional educational disparities.

5.2. Holistic Student Development under Policy Guidance

Regarding policy, advancing digital-intelligent pathways for cultivating holistic competence calls for the establishment of a relatively well-developed top-level design under the national education digitalization strategy framework.

Education managers should incorporate art courses into subject reform and teaching evaluation systems to ensure that digital tools serve the well-rounded development of students. They should improve relevant laws, regulations, and financial support policies. They should also establish a scientific supervision, evaluation, and feedback mechanism, regularize sports competitions and other activities as vehicles for comprehensive quality development, and ensure that competition practices align with the goals of moral, intellectual, physical, aesthetic, and labor development, thus forming a sustainable and scalable model of sports-education integration.

5.3. Advancement of Teachers' Instructional Competence

According to a survey conducted by Southwest University, most primary and secondary school teachers have never received systematic training in AI teaching. As a result, they generally lack confidence in applying AI tools, experience strong anxiety, and tend to rely on traditional teaching methods. The current "digital divide" is no longer limited to imbalances in access to devices but is more prominently reflected in disparities in teachers' professional development and readiness in educational philosophy [9].

In terms of enhancing teachers' intelligent instructional capacity, educators are expected to progress along a systematic developmental ladder—from basic digital literacy training to the cultivation of higher-order skills such as AI tool utilization, data interpretation, algorithmic reasoning, and classroom adaptation. At the same time, local education authorities should support the establishment of AI teaching communities, encouraging teachers to co-develop intelligent curricular resources, share implementation experiences, and collaboratively address challenges in classroom practice, thereby embedding AI applications into a teacher-led culture of inquiry and collaboration. Moreover, teachers should be positioned as co-designers and critical interpreters of AI data, underscoring that technology ought to augment rather than replace professional expertise, thus reinforcing teachers' central role in the educational process [10].

5.4. Diversification of Educational Provision and Engagement of Social Forces

The central task of this theme is to broaden the provision of educational resources by engaging social forces, in order to address shortages in curricula, teaching staff, and services in under-resourced areas. Within the policy framework, a collaborative mechanism between government and social actors needs to be established to advance both equity and diversity in education.

In terms of strategies, four measures are proposed. First, lightweight and user-friendly AI education platforms should be promoted to lower the barriers to use in resource-constrained regions. Second, vendors should be required to provide long-term and localized technical support, avoiding the formalism of "one-off deployment." Third, policies should encourage the creation of new positions such as "AI education counselors" to help teachers and students effectively bridge technology and pedagogy. Fourth, social organizations, universities, and enterprises should be guided to participate jointly in curriculum development, experience sharing, and resource co-construction, thereby forming a diversified supply model led by government and coordinated with society.

5.5. Multidisciplinary Teaching and Learning Research Supported by AI

The theme main is to employ artificial intelligence to drive the deep integration of multidisciplinary teaching, dismantling traditional subject boundaries and fostering cross-disciplinary integration in curriculum content, pedagogy, and assessment. Meanwhile, technology should be harnessed to facilitate personalized learning, aiming to strengthen students' overall competence and innovative abilities.

To provide sufficient foundational support, several reforms are required. In curriculum reform, disciplinary boundaries should be broken, and an AI-based interdisciplinary curriculum framework should be established to promote project-based learning and inquiry in authentic contexts. In teaching reform, teachers can use AI for lesson design, virtual experiments, and personalized guidance, enabling a shift from "teaching-centered" to "learning-centered" classrooms. In assessment reform, AI-powered learning analytics should be employed to move from single-score evaluation toward process-oriented, diagnostic, and developmental assessment, strengthening the examination of students' interdisciplinary abilities and innovative thinking. In teacher training reform, a professional development system focused on AI literacy should be established, equipping teachers with skills in digital instructional design and intelligent classroom implementation. In resource and governance reform, governments and schools should collaborate with social actors to build open and shared AI education platforms, fostering cross-regional and interdisciplinary resource co-construction and collaborative mechanisms. Through these reforms, artificial intelligence can truly become the core engine driving multidisciplinary integration and educational innovation.

5.6. Educational Infrastructure Development and Resource Assurance

In terms of educational infrastructure and resource support, the reform should prioritize systemic and sustainable development. Hardware construction should first be approached from the perspective of equity, with efforts to channel smart campuses, network environments, and digital terminals toward underdeveloped regions, so as to avoid exacerbating the digital divide.

With respect to resource provision, a national–local collaborative education cloud platform and open resource repositories should be established to enable cross-regional sharing of high-quality textbooks, micro-lessons, and experimental resources. At the service support level, long-term operation and maintenance mechanisms and local technical support centers can be introduced to enhance schools' effectiveness in using intelligent devices and platforms, while also promoting the creation of new AI-related positions to provide continuous support for teachers and students. In terms of governance structure, targeted fiscal investment, guidance of social capital, and regional coordination mechanisms should be adopted to form a diversified participation model, thereby institutionalizing and normalizing educational infrastructure and resource support with greater efficiency.

6. Conclusion

From the perspective of China's "Double Reduction", this study systematically examines the pathways and challenges of AI-enabled basic education reform. The research focuses on three core issues: the implementation of policy objectives, the advancement of key tasks, and the formulation

of response strategies. It aims to evaluate the effectiveness of AI technologies in reducing students' academic burden, improving teaching quality, promoting educational equity, and enhancing overall satisfaction. Through text analysis of national policy documents combined with LDA topic modeling, six major themes were identified: urban educational provision and regional disparities; holistic student development under policy guidance; advancement of teachers' instructional competence; diversification of educational provision and engagement of social forces; multidisciplinary teaching and learning research supported by AI; and educational infrastructure development and resource assurance. These themes, reflected across four analytical dimensions—top-level design, teacher development, technological application, and educational resource allocation—demonstrate the multifaceted role of AI in shaping new teaching paradigms and driving systemic educational transformation. Achieving the goals of AI-enabled education requires coordinated progress along these four dimensions, thereby providing both theoretical insights and practical implications for the implementation of the "Double Reduction" and the pursuit of high-quality educational development.

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