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Strategic Path for Introducing Generative Artificial Intelligence into Education: An Analysis Based on Digital Leadership and TOE Model

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Abstract

With the development of generative artificial intelligence (GenAI) technology, the field of education is facing unprecedented opportunities and challenges for change. This paper takes Guangzhou as a case study to explore how the education system can promote the adoption and integration of GenAI through digital leadership in the context of digital transformation of education. This paper constructs an analytical framework based on digital leadership theory and Technology-Organization-Environment (TOE) model, combines national policy orientation with local practice paths, designs semi-structured interviews, and collects the views of multi-level respondents such as municipal education bureaus, district education bureaus, demonstration schools, and AI enterprise representatives. The study found that educational leaders play a key role in vision formulation, organizational mobilization, teacher support, platform collaboration, and ethical governance; at the same time, it also reveals realistic bottlenecks such as uneven resources, insufficient teacher capabilities, and lack of systems. On this basis, this paper proposes five systematic strategic paths, aiming to provide theoretical support and practical guidance for the deep integration of China's education system in the era of generative artificial intelligence.

Keywords: Generative Artificial Intelligence, Digital Leadership, Toe Model, Digitalization Of Education

Introduction

In the digital wave of the 21st century, the rapid development of AI technology, especially GenAI, is profoundly changing the global education ecosystem. Generative AI tools represented by ChatGPT, Claude, Copilot, etc. have powerful natural language processing and knowledge generation capabilities. They are widely used in the education field for automatic

feedback, text creation, course assistance, teaching management and learning personalization, showing revolutionary potential (Fernández Cerero et al., 2025; Kurtz et al., 2024). However, despite the broad prospects for the application of technology, its integration process in the education system is not smooth sailing, facing multiple obstacles such as teacher resistance, ethical anxiety, organizational lag, and unclear supervision (Kalmus & Nikiforova, 2024; Jo & Bang, 2023).

In order to promote the digital transformation of education, promote high-quality development of education, and fully support the construction of a strong education country, the Ministry of Education of China clearly proposed in the Outline of the Plan for Building a Strong Education Country (2024-2035) that it is necessary to take the digitalization of education as a breakthrough point, accelerate the opening of a new track for education development, and use emerging technologies such as artificial intelligence to promote educational reform. The plan emphasizes that it is necessary to lead educational development with in-depth applications, promote the overall transformation of educational concepts, teaching models and educational governance, and especially emphasizes the establishment of a more ubiquitous and accessible lifelong education system through the application of artificial intelligence technology to support a learning society where all people learn (Ministry of Education of the People's Republic of China, 2025). Among them, building an intelligent education environment, promoting the equalization of educational resources, and improving the ability to educate people online are the core contents of the plan.

Current research on the adoption of GenAI in education presents three characteristics: first, it focuses more on the perspective of students, but not enough on the roles of teachers and education administrators; second, it is dominated by the technical perspective, but lacks analysis of systemic factors such as organization, policy, and culture; third, although there are scattered case analyses, there is still a lack of a systematic theoretical framework for integration (Cao, 2025; Prasad Agrawal, 2024). In the field of higher education, teachers and administrators are the key intermediaries in promoting technology adoption, and their cognition, attitudes, and behaviors profoundly affect the application effect of GenAI technology. Technological innovation in education is not just a "supply" problem of technology itself, but also a complex process of "demand adaptation" and "organizational change."

Therefore, this study introduces the "Digital Leadership" and "Technology-Organization-Environment" (TOE) models as theoretical fulcrums, attempting to systematically analyze the strategic path of educational institutions to introduce GenAI from the two levels of strategic leadership and system adoption mechanism. Digital leadership emphasizes the vision shaping, cultural guidance, resource coordination and organizational empowerment capabilities of educational leaders in the face of emerging technological changes (Karakose et al., 2024; Zhu et al., 2025). The TOE model, as a systematic analysis framework, can identify the key influencing factors of technology adoption from the three dimensions of "technical characteristics", "organizational capabilities" and "external environment", and is widely used in the research of big data, blockchain, social media and intelligent systems (Nguyen et al., 2022; Chittipaka et al., 2023).

In the context of digital transformation of education, the combination of digital leadership and TOE model has important practical significance. The Ministry of Education clearly proposed in the Outline of the Plan for Building a Powerful Education Country (2024-2035) that it is necessary to promote the overall transformation of educational concepts, teaching models and educational governance through application orientation and digital empowerment (Ministry of Education of the People's Republic of China, 2025). This strategic goal provides a clear direction and value guidance for this study, especially in exploring how educational managers can integrate emerging technologies and overcome challenges in educational reform through digital leadership.

In summary, this paper aims to construct an analytical framework that combines theory and practice to explore the strategic path of educational institutions in the process of introducing GenAI. The research objectives include: (1) defining the key mechanism of digital leadership in promoting GenAI integration; (2) identifying the multidimensional influencing factors of universities in the process of technology adoption based on the TOE model; (3) proposing strategic recommendations for future-oriented education intelligence to help universities improve their organizational resilience and leadership in the wave of technological transformation. This study not only responds to the urgent need for the integration of technology and education, but also attempts to provide systematic theoretical support and practical guidance for education administrators, policymakers, and teachers.

Literature Review

Generative Artificial Intelligence

Generative Artificial Intelligence (GenAI) is a frontier field in current artificial intelligence research and application. Its core capability lies in generating multimodal content such as natural language, images, and speech through deep learning models. Especially in the field of education, the widespread application of large-scale language models such as ChatGPT has triggered a profound change in the education model. Studies have shown that teachers can use GenAI to optimize teaching resources, realize automatic homework grading, content creation and classroom feedback, and greatly reduce their workload (Fernández Cerero et al., 2025). As a virtual teaching assistant, ChatGPT not only improves teaching efficiency, but also provides students with a more personalized learning experience, significantly improving learning satisfaction and interaction frequency (Jo & Bang, 2023).

However, despite the wide range of advantages of GenAI, its application in educational scenarios still faces significant challenges. The first is the coexistence of "technical dependence" and "ethical anxiety": if AI-generated content lacks supervision, it may lead to students' lazy dependence or encourage academic misconduct (Fernández Cerero et al., 2025). Secondly, teachers' own technical literacy, cognitive attitudes, and professional security also affect their enthusiasm for technology adoption. Kurtz et al. (2024) pointed out that when many university teachers face AI tools, they feel the "attraction" of improved efficiency, but also worry about the "repulsion" of marginalizing professional values, forming a typical "technical paradox."

In the study of teachers' willingness to adopt GenAI, Kalmus and Nikiforova (2024) combined the Innovation Resistance Theory (IRT) with the TOE model to construct a model to predict the willingness of college teachers to adopt. They found that the barriers to teacher

adoption are not limited to technical complexity, but also include systemic factors such as insufficient organizational support and lack of environmental atmosphere. In addition, Cao (2025) pointed out through a survey of Chinese college teachers that technical readiness, training opportunities, school strategies, etc. all significantly affect whether teachers are willing to use GenAI in teaching . Furthermore, the TOEK model proposed by Jo and Bang (2023) adds the "knowledge dimension" to the original TOE framework, emphasizing that the level of cognitive understanding of AI systems by teachers or students has an important impact on their adoption attitude. This reminds us: In addition to resource construction and policy promotion, improving educators' AI knowledge literacy and ethical cognition is also an important prerequisite for promoting the smooth integration of GenAI technology into the educational ecosystem.

In short, generative artificial intelligence provides a powerful technical tool for educational innovation. Its value lies not only in improving teaching efficiency, but also in promoting a fundamental transformation of the teaching paradigm. However, its successful application must address teachers' technical resistance, ethical anxiety, and systemic obstacles. Subsequent research needs to explore its integration path in depth from multiple dimensions such as educational management, organizational strategy, and teacher development.

Digital Leadership

Digital leadership is a systematic leadership capability demonstrated by educational leaders to promote educational change, manage digital transformation, and promote technology integration in a rapidly developing information technology environment. This concept was first applied in the business field, but with the acceleration of digitalization of education, its importance in higher education management has become increasingly prominent. Karakose et al. (2024) pointed out that digital leadership is no longer limited to "understanding technology", but emphasizes how leaders can promote the transformation and upgrading of the education system by formulating vision, guiding culture, coordinating resources and building a digital ecosystem.

Zhu et al. (2025) systematically reviewed and emphasized the core functions of digital leadership in three dimensions: first, at the organizational strategy level, leaders should formulate a clear technology development blueprint to promote the digital transformation of the institution's teaching and research processes; second, at the teacher support level, training, resources and policy guarantees should be provided to lower the psychological threshold for teachers to use AI; third, at the ethical and governance level, a fair, safe and transparent technology use environment should be built to respond to the concerns of teachers and students. Anwar and Saraih (2024) further added that leaders with deep learning capabilities and emotional intelligence can better stimulate organizational vitality and teacher participation in digital transformation. In the actual scenario of colleges and universities, the role of digital leaders such as presidents, heads of the academic affairs office, and department leaders is crucial. Kovacevic et al. (2025) pointed out through a study of the teaching reform of university leaders driven by AI that although strategic guarantees at the institutional level are important, the ultimate decision on the success of the transformation is often whether teachers are willing to participate. Therefore, in addition to providing hardware support and institutional policies, leaders need to lead by example, demonstrate their willingness to be

open to and apply new technologies, and create a synergy of "digital vision" and "action model".

In addition, digital leadership also needs to focus on the professional development of teachers and the improvement of their technical literacy. Karakose et al. (2023) found in their research on ChatGPT that AI can assist teachers in designing courses, generating content, and providing feedback on teaching results, but the premise is that the teachers themselves have certain judgment and ethical awareness. Therefore, digital leaders need to assume multiple roles such as technology selectors, cultural guides, and ethical gatekeepers, and activate the "AI empowerment effect" within the organization from a system level. Current digital leadership research has also exposed some shortcomings. For example, most studies focus on the role of primary and secondary school principals, while ignoring the complex organizational structure of colleges and universities and the interactive coordination of different leadership roles in the multi-level governance system (Karakose et al., 2024). At the same time, how to cultivate digital leaders with strategic vision and cross-border thinking in a non-technology-oriented context still requires more experience summary and mechanism construction. Therefore, this study attempts to combine digital leadership with the TOE model to explore the leadership mechanism and organizational mobilization path of colleges and universities in the process of introducing GenAI, filling the research gap between theory and practice.

TOE Model

The TOE model (technology-organization-environment framework) was proposed by Tornatzky and Depietro (1990). It was originally used to analyze the adoption behavior of new technologies at the enterprise level and has now become an important theoretical pillar of educational technology research. The model points out that when an organization adopts new technologies, its decision-making process is affected by three dimensions: technology characteristics (Technology), organizational resources and capabilities (Organization), and external environmental pressure (Environment). Compared with other behavioral models, the TOE model emphasizes the dynamic influence of the external environment, making it more explanatory and applicable in the face of complex change situations (Nguyen et al., 2022; Chittipaka et al., 2023).

In the field of education, the TOE model has been widely used to study the adoption of technologies such as big data analysis, the Internet of Things, blockchain, and online learning platforms. For example, when AlKhawaldah et al. (2025) studied the adoption of e-learning in Jordanian universities, they found that loose organizational structure, lack of leadership support, and training mechanisms were key factors in the failure of educational technology adoption. Similarly, Wael Al-Khatib (2023) applied the TOE model to GenAI research, emphasizing that GenAI has dual innovation (exploratory and developmental), and its adoption is limited by organizational culture, cognitive bias, and technology acceptance maturity.

Especially when GenAI is introduced into university teaching as a cutting-edge technology that has not yet been institutionalized, the comprehensive perspective of the TOE model provides a clear path identification tool. Prasad Agrawal (2024) pointed out through an empirical study of 108 universities in India that technical characteristics such as usability, scalability, and interoperability are the first threshold for teachers to adopt GenAI; secondly,

whether there is a training system, management support, and sharing culture at the organizational level also directly affects the success or failure of adoption; and external factors such as policies and regulations, industry trends, and social and cultural atmosphere constitute a lasting impact. These findings show that the educational integration of GenAI should be promoted simultaneously from the three dimensions of "technical system-organizational change-institutional governance."

In addition, the TOEK model proposed by Jo and Bang (2023) supplements TOE with a "knowledge dimension", emphasizing the importance of "AI cognitive literacy" for technology adoption, indicating that the differences in the abilities of teachers and managers in understanding and evaluating AI technology will affect their actual usage behavior. This extension lays the theoretical foundation for this study to incorporate digital leadership into the TOE model, that is, to indirectly influence teachers' technological cognition and environmental adaptability through the strengthening of "organizational leadership", thereby improving the overall adoption level. In summary, the TOE model provides a theoretical tool for systematically analyzing the introduction of GenAI technology by educational organizations, and its three-dimensional structure is highly consistent with the complex ecology of the education system. In future education governance, the TOE framework not only helps to explain why some organizations can successfully adopt new technologies, but also provides structural support for formulating feasible strategic paths.

Research Design

In this study, in order to fully understand the leadership role of Guangzhou in promoting the digital transformation of education, especially in the integration of artificial intelligence and education, multiple levels of respondents were selected. According to the report of the Guangzhou Municipal Education Bureau in "AI education moves from pilot to full domain! Guangzhou accelerates the digital transformation of education", Guangzhou is accelerating the digital transformation of education, especially in the deep integration of artificial intelligence education. The municipal government has proposed a strategy of advancing from "pilot" to "full domain" and clearly emphasized the important role of educational leadership in this process (Guangzhou Municipal Education Bureau, 2025).

Therefore, the interviewees of the study include the following groups: First, **leaders of the Guangzhou Municipal Education Bureau** , such as the Party Secretary and Director of the Municipal Education Bureau, can provide insights on how policy making, education digitalization strategy, and AI education are implemented into specific teaching practices through leadership. They play a key decision-making role in education reform and promote policy implementation and innovation (Guangzhou Municipal Education Bureau, 2025). Second, **leaders from the education bureaus of various districts in Guangzhou** , such as the Tianhe District Education Bureau and other local education leaders, can share how local governments coordinate the implementation of education digital transformation under the guidance of leadership, especially how to share and collaborate educational resources between regions to promote the balanced development of urban and rural education. Third, **teachers and teaching staff of Guangzhou Middle School (Phoenix Campus)** , as a model school, Guangzhou Middle School is at the forefront of the practice of integrating AI and education. Teachers play a leading role in actual teaching and can share their challenges and achievements in the process of technology integration, as well as how they promote

innovation in teaching models with the support of leadership. Finally, **representatives of AI technology companies** , such as iFlytek and CVTE, will discuss how to provide technical support for education from the perspective of technology and product development, and promote schools and teachers to smoothly adopt and integrate these technologies under the guidance of leadership. Through these interviewees, this study will explore in depth how educational leadership can play a driving role in the integration of AI and education from different levels and perspectives.

In order to gain a deeper understanding of the roles and influences of leaders at different levels in the education system in promoting strategy, organizing coordination, and adopting technology during the digital transformation of education and the application of generative artificial intelligence, this study designed a semi-structured interview outline based on digital leadership theory and the TOE (Technology-Organization-Environment) model. The interviewees included relevant leaders of the Guangzhou Education Bureau, heads of education bureaus in various districts, managers of demonstration schools, and front-line teachers, covering different levels such as policy formulation, organizational execution, and teaching implementation.

The interview questions are divided into five thematic modules: (1) overall cognition and strategic positioning; (2) the actual process and challenges of technology adoption (the "technical dimension" in the TOE model); (3) organizational leadership and management mechanisms (the "organizational dimension"); (4) external environmental support and policy linkage (the "environmental dimension"); (5) future prospects and institutional suggestions. The question design includes both common questions and targeted questions based on the role of the object, so as to obtain more in-depth and extensive empirical materials (see table1).

Table 1
Interview Framework for GenAI Integration in Education

Modules	Interview Questions	Theoretical Relevance
I. Overall cognition and strategic positioning	How do you view the role of artificial intelligence in the digital transformation of education?	Digital leadership concept, strategic vision
	What strategic plans does your organization have in promoting the integration of artificial intelligence and education?	Digital Leadership - Vision Setting
	What do you think are the core strengths and weaknesses of current schools/education bureaus in terms of digitalization?	TOE Model Overview
2. Technical Dimension: Adoption and Use of GenAI	What technical challenges do schools/education systems face in adopting generative AI technologies such as ChatGPT?	TOE - "Technology"

	What do you think about the actual application effect of AI tools in teaching or research?	TOE-Technology Application Satisfaction
	Are there concerns about technical dependence, misuse or ethical risks of AI technology?	Digital Leadership - Ethical Guidance
3. Organizational Dimension: Leadership and Management Mechanism	What key roles do you think leaders should play in the introduction of AI technology?	The core role of digital leadership
	In promoting the application of AI, how do schools/education systems organize resources and train teachers?	TOE - "Organization"
	Are teachers positive about using generative AI? Do they need more guidance and support?	Digital leadership-culture shaping, teacher empowerment
IV. Environmental Dimension: Policy Support and External Coordination	How do policies at the national or local level affect your organization's progress in advancing AI education?	TOE - "Environment"
	Has the school established a cooperation mechanism with external entities such as enterprises and universities to jointly promote AI integration?	Collaboration between government, industry, academia and research (news source)
	In terms of resource sharing, regional linkage, etc., which measures do you think are most effective?	TOE-Environment + Organizational Linkage
V. Future Prospects and Improvement Suggestions	What do you think are the key factors that will drive the sustainable development of generative AI in education in the future?	Comprehensive analysis
	If you could develop a policy or system to support the integration of AI into education, what aspects would you prioritize?	Digital Leadership-Institutional Construction Orientation

The Embedding Dilemma of Generative Artificial Intelligence in Guangzhou's Education System: Institutional, Organizational, and Cultural Perspectives

Based on the semi-structured interview outline designed in Chapter 3, this chapter summarizes the topics and conducts theoretical mapping of the interview content from the Guangzhou Municipal Education Bureau, District Education Bureau, demonstration school teachers and AI enterprise representatives. Combining the "technology-organization-environment" dimension of the TOE model with the digital leadership theory, this chapter extracts the key experiences and outstanding issues in the current integration of artificial intelligence and education.

Differences in the Levels of Strategic Cognition and Leadership Vision

Leaders of the Guangzhou Municipal Education Bureau generally emphasized that artificial intelligence has strategic significance in improving the effectiveness of education governance, promoting educational equity and personalized teaching, and has incorporated AI education into the overall layout of "moving from pilot to full domain". The municipal level has issued relevant guiding policies to promote the implementation of the "AI+Education" project in demonstration schools. However, when the strategic vision was transmitted to the district level and school-based level, there was an obvious gap between understanding and practice.

Some district education bureau leaders mentioned that although regional promotion plans have been formulated, due to the lack of continuous training and consensus building, grassroots schools rely too much on administrative mobilization in the process of promotion and lack internal motivation. Some principals said that although the vision is clear, the teacher group has not really understood the educational value of AI. Frontline teachers generally regard AI as a "task rather than a tool", and the strategic co-creation mechanism has not yet been truly established. At the same time, in terms of strategic communication mechanisms, there is a lack of effective vertical communication channels between different levels. The planning documents issued by the municipal level have not been effectively transformed into executable action plans at the grassroots level, resulting in the phenomenon of "failure" of the strategic vision in the process of downward transmission.

Adaptability and Concerns in the Technology Adoption Process

On the technical level, most schools have tried to introduce generative AI tools to assist in lesson preparation, student evaluation, and teaching content generation. Some teachers have reported that AI tools have significant advantages in improving work efficiency and achieving differentiated teaching, especially in personalized tutoring and generating student writing comments. However, this process has also exposed a series of practical challenges. On the one hand, the convenience and stability of technology access vary, and some schools lack a unified technical support team, so teachers can only rely on personal experience to explore how to use them. Corporate representatives pointed out that many schools have not formed an effective feedback mechanism during the adoption process, making it difficult for the technology development end to accurately meet the actual needs of teaching.

On the other hand, there are still major concerns about the accuracy and ethical risks of AI-generated content. Teachers generally mentioned the lack of clear usage specifications and were unclear about "how to use it in compliance", especially when using foreign platforms such as ChatGPT, they have doubts about data security and academic integrity. Some schools have not yet established an internal AI usage guidance system, resulting in a lack of boundaries and security in the adoption of technology. In addition, there are significant differences in teachers' technical literacy, especially older teachers generally express technical anxiety of "difficult to understand and fear of making mistakes". Some teachers believe that the existing training is relatively shallow, focusing more on tool operation demonstrations, and lacks practical guidance combined with specific subject scenarios.

Structural Bottlenecks in Organizational Support Systems

From the perspective of organizational governance, the education system has initially established a technology promotion structure with the principal as the core and the teaching and research group as the starting point, but in actual operation, it presents the characteristics of "strong administrative leadership and weak collaborative support". The district education bureau has set up a special office for overall promotion, and some districts have set up an "artificial intelligence education promotion group" responsible for resource allocation and work supervision, but the cross-departmental and cross-school collaboration mechanism has not yet been sounded.

At the school level, although some demonstration schools have set up "AI teaching experimental classes" and "seed teacher teams", there are generally problems with lagging institutional design and unclear division of responsibilities. Teachers reflected that there was a lack of systematic support in the process of AI teaching attempts, such as the lack of synchronous optimization of course arrangements, teaching equipment configuration and evaluation feedback mechanisms, resulting in a "gap" between attempts and implementation. In addition, the teacher training mechanism is mostly one-time, offline and centralized, lacking continuity and effectiveness. Some teachers mentioned: "There is a lack of follow-up support after the training, and I don’t know who to turn to for help when I encounter problems in actual application." The school has not yet established a teaching and research incentive mechanism based on tasks and results, nor has it formed an organizational culture that encourages exploration and tolerates failure.

The Interactive Model between the External Policy Environment and Multi-Party Collaboration

At the external environment level, policy support is one of the main driving forces for schools to try AI teaching. In its policy documents, Guangzhou proposed to build a "smart education ecosystem" to encourage enterprises and schools to carry out in-depth cooperation and promote the co-construction and sharing of educational resources by multiple entities. However, from the actual operation, the collaboration between the government, schools and enterprises has not yet formed an efficient closed loop.

There is a willingness to cooperate between the Education Bureau and technology companies, but the cooperation model is still mainly project procurement, lacking a long-term, embedded joint R&D mechanism. Enterprise representatives pointed out: "Many collaborations are just 'supply', lacking joint design and scenario testing." Some schools reported that the products provided by companies have many functions but are out of touch with actual teaching needs, resulting in the problem of "excessive functions and insufficient scenario matching." In terms of regional linkage, the resource sharing and experience transfer mechanism between different districts is not mature enough. Although the municipal education department has organized cross-district observation and exchange activities, the frequency is low and the content is superficial, making it difficult to truly form a mechanism network for cross-school joint teaching and research and resource sharing.

Future Outlook and Leadership Strategy Conception

Most of the respondents are cautiously optimistic about the future development of GenAI in education, believing that it will have a profound impact on the role of teachers, the organization of teaching, and the way of learning evaluation. In terms of specific strategies,

the education system has begun to explore the construction of more systematic mechanisms. Some district-level education bureaus plan to set up "AI Teacher Development Centers" to establish a comprehensive support platform covering technical training, teaching experiments, and teacher evaluation. At the principal level, many respondents expressed their hope to promote the "institutionalization of AI use", including the establishment of teaching experimental areas, the revision of school teaching process specifications, and the formulation of ethical guidelines for the use of AI. Some schools are trying to incorporate AI capabilities into the teacher performance appraisal system to stimulate teachers' enthusiasm for active participation. The teacher group generally calls for the establishment of a "continuous learning mechanism" and hopes to have more "learning while using" practice platforms, such as online learning communities and application results sharing mechanisms. Some teachers also suggest setting up AI teaching assistant positions or "technical consultant teachers" to provide timely guidance for front-line teachers.

In addition, many interviewees emphasized the importance of technological ethics education for students, and believed that an "AI literacy" module should be added to the curriculum system to guide students to rationally view the relationship between technology and humans and enhance their ability to identify algorithmic bias and information security.

Generative Artificial Intelligence Integration Path Strategy Driven by Educational Digital Leadership

Against the backdrop of the rapid development of generative artificial intelligence (GenAI), the digital transformation of education urgently needs systematic leadership and strategic guidance. Combining empirical data with the TOE model, this paper proposes five integration paths driven by digital leadership, including strategic vision setting, organizational support system optimization, teacher empowerment mechanism strengthening, platform ecological collaborative promotion, and institutional guarantee system construction, in order to provide reference and reference for the effective adoption and integration of GenAI technology in the education system.

Build a Clear Strategic Vision for AI Education

Building a forward-looking strategic vision is the starting point for the education system to promote the integration of artificial intelligence. Education administrative departments should formulate a forward-looking, operational and regionally distinctive blueprint for the development of artificial intelligence education, clarify the value positioning of GenAI in improving education quality, promoting educational equity and promoting teaching innovation, and integrate it into the regional education informatization and talent strategy. The strategy should not only respond to the direction requirements put forward by the National Outline of the Plan for Building a Powerful Education Country (2024-2035), but also reflect the regional artificial intelligence industry foundation and school development reality, and promote the effective connection between top-level design and grassroots implementation. At the school level, leaders should take the initiative to organize teachers to participate in AI teaching vision co-creation workshops, thematic teaching and research activities and teacher deliberation meetings, so that strategic goals can be gradually sunk and internalized into the consensus and actions of the teacher group. In addition, by establishing AI education specialty schools and promoting the inclusion of AI indicators in the "school-

based development plan", the internal driving force of school autonomous reform can be enhanced, and the transition from policy mobilization to practice can be truly realized.

Strengthening Organizational Mobilization and Resource Coordination Mechanisms

Optimizing the organizational support system is a structural guarantee for promoting the implementation of GenAI. In the process of promoting the transformation of artificial intelligence education, education leaders should establish a clear and efficient organizational governance system, coordinate the coordination and linkage of multiple functional departments such as teaching, teaching and research, information technology and administration, and form a work pattern with vertical and horizontal links and departmental collaboration. Regional education bureaus can set up special coordination offices or "AI integration promotion groups" to coordinate key links such as platform resource allocation, teacher training organization and data usage specifications, and improve execution through mechanisms such as monthly progress evaluation and cross-district collaboration meetings. At the school level, principals should play a dual role of leadership guidance and system design, promote the establishment of "AI teaching reform experimental classes" or "seed teacher teams", and reserve space and resources for AI teaching applications in terms of curriculum setting, class schedule, teaching and research management, and build an organizational operation system with goals, support and feedback. At the same time, organizational culture construction should be strengthened to create a digital campus atmosphere of "technology for good" and "collaborative symbiosis", so that AI teaching becomes an active choice for school development rather than an administrative task.

Establish a Teacher-Centered Empowerment System

Strengthening the construction of the teacher empowerment system is the key support for the integration of generative artificial intelligence. Teachers are not only the executors of AI technology implementation, but also the promoters of classroom reconstruction and teaching ecological reform. Digital leadership should play a dual role of guidance and guarantee in the growth path of teachers, and improve teachers' AI cognitive ability, teaching integration ability and critical thinking ability by building a "layered and classified training system" covering different development stages. It is recommended to set up an "AI Teacher Professional Development Center" at the regional level to promote diversified activities such as regional backbone teacher workshops, cross-school open classes, and "AI teaching assistant case challenge"; at the same time, develop modular online training resources to enable teachers to learn, practice and reflect on demand. At the school-based level, schools should establish a school-based training mechanism based on application scenarios, encourage teachers to try to use AI tools for lesson preparation, tutoring and evaluation in real teaching, and form a virtuous circle through peer mutual assistance mechanisms. Leaders need to pay attention to the psychological burden and professional anxiety of teachers in the process of using AI, provide emotional support and organizational recognition, and transform AI tools from "external pressure" to "internal motivation."

Promote the Collaborative Innovation Mechanism among Government, Industry, Academia and Research Institutes

Promoting platform ecological collaboration is a key link to ensure the effective integration of technology. Currently, there are many types of AI teaching platforms with different standards, which can easily cause resource redundancy and teaching problems.

Digital leaders need to start from the two dimensions of overall architecture and micro-application to promote the transformation of platform construction from "tool integration" to "ecological collaboration". At the macro level, local audio-visual education museums, information centers, and corporate technology parties should be united to promote the formation of unified interface standards for regional education platforms to achieve data interconnection and resource sharing. At the school level, the three-in-one use feedback mechanism of "teachers-platforms-technical support" should be used to promote the deep integration of platform functions and teaching scenarios. Taking Guangzhou as an example, the Education Bureau encourages the demonstration area to establish a "dual platform integration application" mechanism, integrating the national smart education platform and corporate AI tools in the teaching process, and forming a practical path for curriculum resources and intelligent recommendation systems to collaboratively support teachers. Principals and teaching and research group leaders should become core users and design participants in platform construction, guide teachers to transform from tool users to platform co-builders, and improve system adaptability and application efficiency.

Improve the Institutional Framework and Ethical Governance System

Improving the institutional guarantee system is the fundamental support for promoting the sustainable development of AI education integration. Against the background of the rapid development of AI technology, the education system faces unprecedented challenges in data security, ethical norms and quality assessment. Education leaders should strengthen the top-level design of the system and promote the establishment of a comprehensive system including platform supervision, data security, content generation norms, and the definition of teacher and student rights and responsibilities. At the policy level, we can promote the release of the "Guidance on the Application of AI Teaching in Primary and Secondary Schools", establish an AI education pilot area supervision mechanism at the national or regional level, and clarify the scope, norms and boundaries of the use of generative AI tools in teaching by schools. At the school level, we should promote the standardization of AI use processes, including teacher use approval, student use authorization, content review process, etc., so that the use of technology has rules to follow. At the same time, it is also necessary to establish an AI ethics education course module to guide students to form a correct view of technology, innovation and responsibility. By building a trinity guarantee mechanism of "technology-system-culture", we can ensure that artificial intelligence truly realizes "technology for good" in education.

Research Contributions and Future Prospects

This study focuses on the theme of "Strategic Paths for Introducing Generative Artificial Intelligence into Education: Analysis Based on Digital Leadership and TOE Model". Combining the policy background, literature foundation and actual cases in Guangzhou, this study has made the following research contributions by constructing a theoretical framework, designing semi-structured interviews and analyzing multi-level data:

First, this study organically integrates "digital leadership" and "TOE model" to construct a dual analysis framework suitable for educational organization research, enriching the theoretical dimension of educational technology adoption. Secondly, breaking through the traditional "student-centered" research inertia, starting from the perspective of "education leaders", emphasizing the strategic driving force and organizational empowerment of

leadership in GenAI adoption, filling the theoretical gap in the current literature in this field. Finally, combining the collaborative practice of "government, industry, academia and research" with local policy texts, the adoption of technology is linked to governance capabilities, expanding the research perspective of educational governance.

At the practical level, the study proposed five strategic paths (strategic vision, organizational support, teacher empowerment, platform collaboration, and institutional governance) based on typical cases in Guangzhou, providing specific and feasible path suggestions for education departments and schools in other regions of my country to carry out artificial intelligence integration. At the same time, the concepts of "teacher empowerment system", "dual platform integration mechanism", and "AI teaching experimental zone" proposed in the study can provide an operational framework for front-line teaching reform.

Although this study tried its best to cover multiple levels of respondents, it was unable to cover all school types and stages due to time and sample limitations. Future research can adopt a mixed method (quantitative + qualitative) and expand the sample range to the Midwest and rural areas to more comprehensively understand the regional differences in the adoption of educational technology. In addition, with the iteration of AI technology, it is recommended to build a longitudinal tracking mechanism to study the long-term impact of GenAI technology on teachers' professional identity, teaching evaluation mechanisms, and student learning outcomes.

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