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Research on the Status Quo and Improvement Path of Digital Literacy of County Primary and Secondary School Teachers

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Abstract: With the deepening of educational digital transformation, the digital literacy of county-level primary and secondary school teachers has become a critical factor influencing the balanced allocation of educational resources and the improvement of educational quality. This study conducts a systematic review and integration of existing literature and multi-regional empirical survey data to analyze the overall level, structural characteristics, and group differences in digital literacy among county-level teachers, revealing practical challenges in areas such as infrastructure, teacher cognition, and the training system. Building on this analysis, the study constructs a systematic improvement pathway from four dimensions: policy support, training models, evaluation mechanisms, and resource integration. These findings provide theoretical references and practical paradigms for advancing the digital transformation of county-level education.

Keywords: teachers' digital literacy; improvement path; county education; primary and secondary school teachers

1. Introduction

The digital transformation of education serves as a national strategy to advance educational modernization and build a learning society. In this context, teachers 'digital literacy has become a pivotal factor determining the success of educational reforms and the quality of talent cultivation in the digital era. As the cornerstone of China's education system, county-level education institutions 'teachers' digital literacy not only directly impacts regional educational quality but also profoundly influences the implementation of educational equity and rural revitalization strategies[1].

While international research on teachers 'digital literacy has established a

comprehensive framework, and national initiatives like the Teachers Digital Literac standard and Smart Education Platform have been vigorously promoted, China's county-level primary and secondary school teachers still face significant challenges in digital literacy development. These issues, constrained by regional economic disparities and the urban-rural digital divide, have become a critical bottleneck in the "last mile" of educational digital transformation. Current studies predominantly focus on macro-level analyses or developed regions, with insufficient exploration of the deep-seated structures, developmental challenges, and systematic improvement pathways for teachers' digital literacy within this specific context.

This study employs empirical data from surveys conducted in Yunnan, Hubei, Henan, and Shaanxi provinces, combined with policy analysis and multi-case examination, to systematically assess the current status, structural characteristics, and key challenges of digital literacy among county-level teachers. Based on this analysis, the research develops an integrated improvement strategy that incorporates policy, training, evaluation, and resource coordination, aiming to provide actionable insights for advancing digital transformation in county education.

The study is not only committed to responding to the urgent reality of improving the digital literacy of county teachers, but also hopes to provide theoretical reference and practical paradigm for solving the deep contradictions of educational digital transformation and promoting the high-quality and balanced development of county education.

2. Analysis of the current situation of digital literacy of primary and secondary school teachers in countie

2.1. Overall level and structural features

Multiple empirical studies indicate that the digital literacy of primary and secondary school teachers in China's county-level regions remains at a moderate-to-low level, with uneven development across various dimensions. A survey of 548 rural teachers in Yunnan Province yielded specific performance data across different competency areas, as detailed in Table 1.

Table 1. Digital Literacy Performance of 548 Rural Teachers in Yunnan Province

Dimension	Average Score (Out of 5)	Performance Level	Specific Characteristics
Digital Awareness	3.98	Medium-High	Recognize the value of digital technology, but awareness of innovative application is weak.
Digital Technology Knowledge & Skills	2.45	Low	Master basic operational skills, but severely lack integrated application capabilities.
Digital Application	2.20	Low	Struggle to integrate digital technology into the entire teaching process (design, management, assessment).
Digital Social Responsibility	3.82	Medium-High	Possess basic cybersecurity and ethical awareness.

Dimension	Average Score (Out of 5)	Performance Level	Specific Characteristics
Professional Development	2.35	Low	Clearly lack the ability to use digital technology for self-learning and professional growth.

This phenomenon suggests that although county-level teachers recognize the importance of digital technology, their ability to effectively integrate technology into teaching practices remains inadequate.

Similarly, a sampling survey of 595 junior high school English teachers across 10 counties and districts in Huanggang City, Hubei Province, provided granular data confirming this uneven development. When assessed on key data application skills, the average proficiency scores were notably low: Data Collection (2.6/5), Data Processing (2.2/5), and Data Analysis (1.9/5). This specific skill gap directly hinders their ability to implement data-driven precision teaching, as they struggle to gather, interpret, and act upon student learning data effectively[2].

The findings from eight primary and secondary schools in L Town, Henan Province, present an even more concerning picture, indicating an overall low level of local teachers' digital literacy. Performance scores across critical application scenarios were particularly low: Classroom Management (2.1/5), Student Assessment (2.3/5), Instructional Design (2.4/5), and Professional Development (2.0/5). These scores underscore that the application of digital technology in core teaching activities and personal professional growth remains a major challenge, requiring significant and targeted improvement.

Table 2. Comparison of digital literacy levels in various dimensions of primary and secondary school teachers in counties

dimension	Performance level	Specific features
Digital awareness	above-average	Have a basic understanding of the value of digital technology, but weak awareness of innovative application
Digital technology knowledge and ability	Lower middle	Master basic operational skills, lack of integrated application ability
Digital applications	lower	It is difficult to integrate digital technology into the whole teaching process
Digital social responsibility	above-average	Have basic network security and ethical awareness
Professional development	lower	Lack of ability to use digital technology for self-improvement

2.2. Group diffreence characteristics

There are notable disparities in digital literacy among county-level teachers. Research indicates that factors such as age, teaching experience, subject specialization, and school infrastructure significantly influence digital literacy levels. Younger teachers and science educators typically demonstrate higher technology adoption rates and practical application skills. Moreover, there's a strong positive correlation between teachers' digital literacy and

their participation in professional development programs—the more training they receive, the better their overall digital competence and performance across various dimensions[3]. This finding underscores the crucial role of systematic training in enhancing teachers' digital literacy capabilities.

While the advancement of digital rural education has created new development opportunities for rural schools, improved teaching facilities, enhanced educational quality, and profoundly influenced teachers 'instructional methods, the actual situation remains concerning. According to statistics, as of June 2022, internet penetration in rural areas increased by 1.2 percentage points compared to December 2021. In urban areas, China's internet penetration rate reached 82.9%with 758 million internet users accounting for 72.1% of the total. Rural areas, however, saw a penetration rate of 58.8% and 293 million users, representing 27.9% of the national total. Both in terms of proportion and quantity, rural areas still account for less than half of the urban population[4].

3. Realistic dilemma of digital literacy development of teachers in counties

3.1. Insufficient infrastructure and application scenarios

Schools in county-level regions, particularly rural areas, commonly face challenges such as outdated digital equipment and unstable network connectivity, which limit the application scenarios of digital technologies. Before 2022, Yanzibian Town Middle School in Ningqiang County, Shaanxi Province, had only 30-plus full-time and part-time teachers across its 12 classes. The physics laboratory's teaching aids had accumulated dust for years, lacking basic digital teaching facilities. When the school first attempted to participate in the "Special Delivery Classroom" initiative, teachers encountered numerous difficulties: "The AR vocabulary cards meticulously prepared by young English teacher Wang Yixuan ultimately became sluggish PPT slides in classrooms with insufficient bandwidth and unstable networks." These infrastructure shortcomings severely hindered the practical development of teachers' digital skills.

A deeper issue lies in the fact that even in schools where digital infrastructure is already in place, the integration of technology with subject teaching often remains superficial, failing to penetrate core classroom activities. Many teachers can only use basic tools like PowerPoint for presentations, while lacking proficiency in advanced applications such as data-driven instruction and precision assessment. This insufficient application depth prevents digital technology from becoming a genuine driving force for educational transformation.

3.2. Weak cognition and ability of teachers

Some county-level teachers lack sufficient understanding of digital technology's educational value, exhibiting cognitive biases and apprehension. Research indicates that rural educators generally demonstrate weak digital literacy, with insufficient recognition of emerging technologies' educational potential. Some teachers mistakenly equate digital teaching with merely using PowerPoint slides or downloading online resources, failing to grasp the underlying pedagogical concepts and innovative instructional models they represent.

In practical skills, county-level teachers demonstrate significant deficiencies in data literacy and innovative application capabilities. A survey conducted in Huanggang, Hubei Province reveals that junior high school English teachers generally lack proficiency in critical competencies such as "data collection, processing, and analysis", which hinders their ability to implement data-driven precision teaching. This limitation prevents educators from effectively adjusting instructional strategies based on student learning data to achieve personalized education. Furthermore, the absence of established habits and professional development capabilities among teachers in utilizing digital technologies for self-improvement constrains their potential for sustainable growth.

3.3. Imperfect training system and support mechanism

Current teacher digital literacy training programs suffer from issues such as content disconnects from classroom practices, monotonous methodologies, and insufficient sustainability. Many initiatives focus excessively on technical operations while lacking practical demonstrations and guidance for integrating technology with subject-specific instruction. The predominant "lecture-style" approach in training formats, coupled with inadequate hands-on components and follow-up support, results in teachers who "get excited during lectures but remain unmoved when back at the office".

In county-level regions, particularly rural schools, there remains a widespread lack of professional learning communities and sustained support mechanisms. When teachers at Shaanxi's Yanzibian Town Middle School first tried specialized online classrooms, they "failed to achieve desired outcomes due to operational inexperience." Although the school later established teacher collaboration systems through initiatives like "Tech Night Schools" and "cloud-based teaching workshops," such systematic school-based support remains uncommon across county schools. Most educators are left to experiment with digital technology applications in isolation, often succumbing to frustration and giving up prematurely.

4. Pathway construction for improving digital literacy of teachers in counties

4.1. Strengthening policy support and infrastructure development

To enhance digital literacy among county-level teachers, prioritizing strategic planning and infrastructure investment is essential. County education authorities should develop targeted digital literacy enhancement programs that integrate teacher development into regional educational informatization strategies. Infrastructure development must address not only availability but also quality and applicability. Yang Meigui, a training expert from Kangle County, emphasized that digital transformation isn't an optional choice but a mandatory requirement. He highlighted the guiding significance of the "Three Alls, Two Highs, One Big" objectives in the "Education Informatization 2.0 Action Plan" for county-level education.

Schools at different educational stages and with varying conditions should adopt differentiated resource allocation strategies. Primary schools should emphasize playful

integration, junior high schools focus on routine application, while senior high schools prioritize in-depth integration. Meanwhile, establishing county-level digital education resource repositories and platform sharing mechanisms can prevent redundant construction and resource waste. Ningqiang County in Shaanxi Province has achieved this through building a "Big Data Center" to consolidate resources among affiliated schools. This unique resource generation mechanism enables urban and rural teachers to exchange teaching experiences, ensuring sustainable accumulation and sharing of digital educational resources.

4.2. Innovation of training mode and research system

To address the structural gaps in digital literacy among county-level teachers, it is essential to establish a multi-tiered and targeted training system. The "Four-Dimensional Advancement Method" implemented in Xintian County under the National Training Program serves as a systematic model. Its core components—precise planning, resource aggregation, skill deepening, and application innovation—form a step-by-step development path from tool mastery to integrated practice and innovative application (Table 2).

A practice-oriented training model is particularly crucial. The "Teacher-led Navigation Course" pioneered by Shiquan County in Shaanxi Province establishes a complete closed-loop teaching research mechanism. This approach achieves exemplary guidance through three key components: lesson plan refinement, classroom observation and discussion, and interactive Q&A sessions. Following the training program, schools carry out simulated teaching activities and lesson refinement through methods such as "same lesson with different instructional approaches," "different lessons with the same structure," and "multiple iterations of a single lesson." This creates a comprehensive empowerment chain featuring online guidance, offline practice, continuous monitoring, and performance improvement.

Simultaneously, the "Tech Night School" spontaneously organized by grassroots schools emphasizes mutual learning and problem-solving, effectively supporting school-based teaching research and training. Furthermore, the "Data Workshop" launched in Leiyang City focuses on enhancing specialized data application skills for subject teachers. As shown in Table 2, these four representative training models each possess distinct core features, applicable scenarios, and practical cases, collectively forming a diversified support system for the development of digital literacy among county-level teachers.

Table 3. Comparison of Digital Literacy Training Models for County Teachers

Training modalities	Core features	applicable scene	typical case
Four dimensional progression	Progressive, systematic improvement	In-depth training for key teachers	Guotai County "National Training Plan"
Teacher-led lessons	Demonstration by teachers, closed-loop research	County-wide staff training	Shiquan County combines online navigation with offline practice
Night School of Technology	Mutual learning, problem orientation	school-based teaching research and training	Teachers of Yanziphan Town Middle School organized spontaneously
Data Workshop	Focus on data application skills	Specialized ability	Data literacy training for English

Training modalities	Core features	applicable scene	typical case
		improvement for subject teachers	teachers in Leiyang City

4.3. Build a data-driven evaluation and feedback mechanism

Establishing a data-driven teaching evaluation and feedback mechanism serves as a crucial safeguard for continuously enhancing teachers 'digital literacy. Xintian County's training program particularly emphasizes the concept of "data as the brush, sketching learning profiles," guiding educators to utilize tools like Questionnaire Star and UMU Interactive Platform. This enables pre-class collection of students' knowledge reserves and learning styles, achieving precise academic diagnostics.

In classroom settings, educators can utilize tools like Seewo Easy Classroom and student tablets to collect real-time data on teacher-student interactions and answer feedback, enabling dynamic adjustments to teaching pacing. Case studies presented during Xintian County's training demonstrate that when data indicates students' delayed understanding of the semi-conservative replication concept, teachers can promptly deliver micro-videos for reinforcement. For students who have grasped the concept, instructors can guide them in extended explorations such as replication errors and biological evolution, achieving personalized instruction tailored to individual needs.

In post-class evaluation, we should establish a new teaching assessment system through the integration of quantitative and qualitative data. Quantitative metrics provide clear indicators of knowledge mastery, while qualitative insights reveal students' cognitive development trajectories. This data-driven approach to teaching reflection enables educators to continuously improve instruction through dimensions like "problem chain design" and "interactive guidance methods," driving quality improvement in education in a virtuous cycle.

4.4. Promoting regional coordination and resource integration

Breaking down barriers between schools and building county-level teaching research communities serves as an effective strategy to comprehensively enhance teachers' digital literacy. The "Research on Strategies for Improving Digital Literacy of Primary and Secondary School English Teachers" project in Leiyang City has established a three-tier support system. Centered around a model school, it selects regional digital education experts to form elite teaching teams. Through demonstration classes, skills competitions, and cross-school collaborative research activities, the initiative fosters a vibrant digital teaching environment.

Shiquan County in Shaanxi Province has implemented a "half-day teaching and research system" to resolve the conflict between work and study for teachers. The county mandates that each subject be allocated a fixed half-day per week without regular teaching duties. During these designated periods, schools conduct "pilot classes" or organize school-based professional development activities and collaborative district research initiatives, ensuring synchronized academic and research activities across the county. This institutional innovation

provides essential time guarantees for teachers to continuously engage in professional development activities.

Another crucial direction for resource integration is to fully leverage public resources such as the National Smart Education Platform. Research by Yu Haisheng demonstrates that national platforms can empower county-level teacher training through strategies including: utilizing high-quality resources for comprehensive staff development, constructing digital knowledge graphs for training evaluation, and restructuring resources for pedagogical innovation. County education authorities may adapt and redevelop these national platform resources according to local conditions, creating a digital resource system that aligns with national standards while showcasing regional characteristics.

5. Conclusions and Prospects

The value of this study lies not only in mapping the current landscape and improvement pathways of digital literacy among county-level teachers, but also in systematically analyzing the complex nature of this issue and its critical significance within the broader educational digital transformation process. Here, we distill and summarize key findings while offering insights into future research directions and practical trends.

5.1. Research conclusions: from status description to system reconstruction

First, the current situation is analyzed: the structure of digital literacy presents "multi-dimensional imbalance", and its development is restricted by "micro teaching context"[5].

The empirical analysis in this study confirms that digital literacy among county-level teachers is not a simple matter of high or low on a single dimension, but rather a complex construct with inherent structural imbalances. Specifically, while digital awareness remains relatively advanced, the application and innovation of digital technologies lag significantly behind. Data literacy, which serves as the crucial bridge connecting cognition and action, has become the most pronounced skill gap. This disconnect between knowledge and practice originates from the "micro-teaching contexts" of educators 'daily work: outdated teaching equipment, rigid curriculum structures, and score-oriented evaluation pressures collectively create an environment that stifles innovation. Consequently, teachers' use of digital technologies often remains at the level of spot-based experimentation rather than systematic integration, failing to bridge the critical divide from occasional use to routine use and from basic application to innovative implementation.

Second, the findings identify a fundamental systemic mismatch—rather than mere skill deficiencies—as the core obstacle. The research demonstrates that attributing digital literacy challenges solely to teachers' individual capabilities or attitudes is reductive and ineffective. This systemic failure manifests in several critical dimensions: a training-practice mismatch, where training programs are often divorced from authentic subject contexts and real classroom needs, rendering them impractical for daily teaching application; and an evaluation-incentive mismatch, wherein the current teacher evaluation system fails to

recognize or motivate innovation in digital teaching, leading to diminished internal drive among educators. These structural disconnects collectively underscore a deeper contradiction: a fundamental rift between the top-down, standardized model of technology provision and the bottom-up, contextualized demands of classroom practice.

Third, the construction of effective pathways must transition toward an ecological development model. Building on this systematic understanding, the core essence of the improvement pathway proposed in this study lies in transitioning from "technology empowerment" to ecosystem restructuring. We advocate that policy design should shift from resource allocation to institutional innovation: Beyond continuous investment, greater efforts should focus on creating an institutional environment that stimulates intrinsic motivation. For instance, establishing a cross-institutional digital literacy credit bank for teachers and strongly linking learning outcomes with career development would be particularly effective.

The training system should transition from skill indoctrination" to building a practice community: True empowerment emerges through sustained, socialized interactions. Moving forward, we must vigorously cultivate online academic communities where teachers can collaboratively construct knowledge through peer reviews, case studies, and problem-solving.

The evaluation mechanism should be shifted from "result judgment" to "data empowerment": using technical means, the process and accompanying data collection of teachers' digital literacy development, and provide personalized digital literacy physical examination report and development suggestions for them, so that the evaluation itself becomes an enabling tool to promote reflection and growth.

5.2. Future outlook: the paradigm leap from digital literacy to intelligent education literacy

Facing the future, the research and practice of digital literacy of county teachers must be considered in a forward-looking way under the dual background of accelerated technological iteration and deep educational reform.

First, exploring the depth of research fields: from county-level to classroom, focusing on contextualized micro-practices. Future research needs to further sink down, entering the authentic classrooms of county-level schools and conducting Design-Based Research. Key questions include: Under specific teaching themes in subjects like Chinese and mathematics, how are digital tools skillfully woven into the teaching process by teachers, and how do they substantially transform teacher-student interaction patterns and students' cognitive processes? Such contextualized, subject-specific micro-research will provide a solid theoretical foundation and practical cases for refining digital teaching models with distinctive Chinese rural characteristics.

Second, the research content is cutting-edge: from digital literacy to intelligent education literacy to cope with the wave of AIGC.

The rise of generative artificial intelligence is fundamentally reshaping the roles of educators and redefining the concept of competence. Future research must shift focus from "how to use tools" to how to collaborate with intelligent agents. This demands exploring a new framework for teachers' intelligent educational competence, which may include:

AI teaching collaboration: the ability to work with AI to prepare and teach lessons, such as generating high-quality teaching resources through accurate prompt engineering, and using AI to play different roles in scenario-based teaching.

AI evaluation insight: Understand and use AI-generated student learning analysis reports to gain insights into learning patterns and problems that are difficult for human intuition to find from the data.

AI Ethics Leadership: Guide students to correctly understand the boundaries and risks of AI, and cultivate critical thinking and digital citizenship responsibility in the era of human-machine collaboration.

Third, research paradigm innovation: build a dynamic perception-precision intervention intelligent governance system.

With the help of big data and learning analytics, a smart platform for the development of digital literacy of county teachers can be built in the future. This platform can:

Dynamic perception: Through the analysis of teachers' teaching design, resource use, interaction data, etc., their digital literacy level can be evaluated in real time.

Precise portrait: automatically identify teachers' ability shortcomings and development needs, and generate personalized literacy map.

Intelligent intervention: to accurately push matching training courses, teaching cases and peer mentors to teachers, realize the transformation from "people looking for resources" to "resources looking for people", and finally form a new data-driven and self-evolving professional development ecosystem for teachers.

Enhancing the digital literacy of primary and secondary school teachers in county-level regions is a protracted battle concerning educational equity and quality, as well as a profound transformation of the education system's own digital reshaping. It requires us to transcend the limitations of instrumental rationality, adopt a broader humanistic vision and deeper systemic thinking, and build a fertile ground that supports every teacher's autonomous growth and innovation. This study is merely an attempt to spark further exploration, hoping that more researchers and practitioners will engage in this endeavor, jointly writing vivid chapters of China's educational digital transformation across the vast field of county-level education.

References

[1] Yu Hao, Zhang Wenlan. (2024). Current Status and Improvement Pathways of Digital Literacy Among Rural Primary and Secondary School Teachers: A Survey Analysis of 1,127 Rural Teachers in Henan Province. Primary and Secondary School Management, (05): 39.

[2] Fan Desheng, Wang Wenwei. (2015). Current Status and Improvement Strategies of Digital Literacy for County Teachers in the Context of Smart Education. Anhui Education Research, (12): 104-107.

[3] Liu Litao, Que Qianhang, Xin Cheng, et al. (2023). Strategies for Enhancing Digital Literacy of Primary and Secondary School Mathematics Teachers in County Areas. Digital Teaching in Primary and Secondary Schools, (10): 31-34.

[4] Ministry of Education. (2022). Teacher Digital Literacy: JY/T 0646-2022. Beijing: Ministry of Education, PRC, 1.

[5] China Internet Network Information Center. (2022). The 50th Statistical Report on the Development of China's Internet [EB/OL].

http://www.cnnic.net.cn/n4/2022/0914/c88-10226.html.