

Theoretical Article

From Technical Operations to Deep Integration: A Conceptual Study on Enhancing the Digital Pedagogical Competencies of Rural Teachers

Shengjie Shui¹, Chang Li^{2,*}

¹School of Fashion, Henan University of Engineering, Zhengzhou 451191, China

²School of Intelligent Perception and Instrumentation, Zhongyuan University of Technology, Zhengzhou 450007, China

*Correspondence: Chang Li, changl_work@163.com

© The Author(s) 2026.

This article is published by Wisdom Academic Press Ltd. under a Creative Commons Attribution 4.0 International License. The license permits use, sharing, adaptation, distribution, and reproduction in any medium or format, provided that appropriate credit is given to the original author(s) and the source, a link to the license is supplied, and any modifications are indicated. Unless otherwise stated, all images and third-party materials included in this article are also covered by the same license. For any material not covered by this license, if the intended use is neither permitted by applicable law nor allowed under the license terms, direct permission must be obtained from the copyright holder. To view a copy of this license, please visit <http://creativecommons.org/licenses/by/4.0/>.

Abstract

Purpose: Against the backdrop of the educational digital transformation, the urban-rural digital divide has shifted from disparities in hardware infrastructure to an imbalance in teachers' digital competencies. Existing teacher training programs predominantly focus on singular technical operations, resulting in a practical dilemma for rural teachers characterized by the fragmentation of their Technological Pedagogical Content Knowledge (TPACK) composite knowledge structure and prolonged stagnation within basic application tiers of the Substitution, Augmentation, Modification, and Redefinition (SAMR) model. Consequently, technological integration struggles to penetrate core pedagogical workflows. As a conceptual paper, this study proposes a “three-stage progressive” competency enhancement pathway—defined here as a sequential development framework spanning scene-driven technology acquisition, lesson plan reconstruction, and community co-creation—to systematically remediate the disjointed pedagogical knowledge architecture of rural teachers. This mechanism aims to drive a structural transformation between digital technologies and disciplinary teaching models, thereby fostering transformative digital agency among rural educators. Ultimately, this theoretical framework provides a usable design tool and theoretical support for the high-quality development of educational digitalization in rural contexts.

Keywords

rural teachers, digital competencies, TPACK framework, SAMR model, deep integration

1. Introduction

The digital transformation of education constitutes a critical pathway for realizing

high-quality development and educational equity. Leveraging its capacity to transcend spatial and temporal boundaries, digital technology effectively mitigates unequal resource allocation stemming from geographical constraints, thereby offering strategic avenues to address the developmental dilemmas of rural education (Hu et al., 2023). Accompanying the deepening of national strategic initiatives for educational digitalization, the digital hardware infrastructure of rural schools has undergone substantial improvement. However, the proliferation of hardware devices has not spontaneously culminated in a synchronous enhancement of pedagogical quality. The manifestation of the digital divide is undergoing a profound evolution, shifting from disparities in physical access to an imbalance in teachers' digital competencies and the depth of technological application (Lin et al., 2023). This divide is deeply anchored in concrete rural policy contexts, where educators must continuously navigate systemic constraints including poor internet connectivity, a severe gap in context-specific instructional content, and intense daily teacher workload realities (Pant, 2025). Within this digitalized educational landscape, the level of technology integration achieved by teachers directly dictates whether technological investments can be translated into tangible educational outputs. Rural teachers lag behind their urban counterparts concerning their attitudes toward information technology application, foundational operational skills, and data literacy (Lin et al., 2023). This competency gap renders advanced digital equipment largely ineffectual in fulfilling its anticipated efficacy within rural classrooms. Consequently, cultivating a professionalized cohort of rural teachers equipped with high-level digital pedagogical competencies represents the strategic core for advancing educational equity.

Current teacher training paradigms aimed at enhancing the digital capabilities of rural educators predominantly exhibit a bias toward techno-centrism and skill-centrism. Training content focuses heavily on the operational procedures of foundational software, becoming decontextualized from authentic educational and pedagogical settings. Such short-term, centralized training, devoid of a practical foundation and sustained follow-up support, struggles to catalyze substantive transformations in teachers' pedagogical behaviors (Ennis et al., 2020). During the application phase, rural teachers frequently relegate digital tools to a singular medium for content presentation. Multimedia courseware merely assumes the substitution function of traditional blackboards, failing to touch upon the restructuring of pedagogical workflows (Huang, 2025). Technology integration predominantly stagnates at the resource acquisition level during the lesson preparation phase, while remaining severely absent in core instructional processes such as classroom interaction, dynamic diagnosis of learning conditions, and precision evaluation. When navigating complex technological



environments, the barriers teachers face regarding pedagogical integration significantly surpass those related to technical operations (Pant, 2025). This persistent disconnect between training and practical application traps technological investments in a cycle of inefficiency, ultimately failing to facilitate a substantive renewal of pedagogical models.

Effective educational technology application must realize a qualitative leap from the mere accumulation of tool operations to the cultivation of a deep learning ecosystem (Huang, 2025). Technology should not manifest as an additive pedagogical burden, but rather serve as a scaffolding mechanism to enhance students' cognitive processes. To address these issues, this theoretical position paper aims to transcend the limitations of singular technical training and systematically reconstruct the developmental logic of rural teachers' digital pedagogical competencies. By conducting an in-depth diagnosis of the disconnect between the cognitive and practical dimensions of rural teachers' digital competencies, this research proposes a progressive reform pathway oriented toward deep integration. This pathway discards decontextualized, purely instrumental training, emphasizing instead the resolution of authentic pedagogical pain points as its primary driving force. The study articulates a structured progression mechanism encompassing scene-driven acquisition, instructional design restructuring, and collaborative evaluation. This mechanism is dedicated to propelling a vital pedagogical evolution for rural educators. The conceptual propositions of this paper provide both a theoretical foundation and an operational framework for optimizing the digital training systems of rural education, ensuring that the digital transformation authentically serves the substantive enhancement of instructional quality in rural classrooms.

2. Methodology

As a conceptual paper and integrative theoretical review, this study utilizes a qualitative narrative synthesis methodology to construct its evidence base. Literature was systematically retrieved from international and national databases, including Web of Science, Scopus, and CNKI, focusing on peer-reviewed articles published between 2018 and 2026. The search architecture employed combinations of keywords including "rural teachers," "digital competence," "TPACK," and "SAMR model". Inclusion criteria mandated that selected sources explicitly address educational technology integration frameworks, professional development constraints, or digitalization policies within rural education contexts. The three-stage progressive enhancement pathway proposed in this study was theoretically derived through a comparative framework analysis, which mapped documented empirical instructional dilemmas in rural classrooms directly onto the conceptual intersection of internal TPACK structural growth and external SAMR hierarchical stages.

3. The Dual Theoretical Models of TPACK and SAMR and Rural Teachers' Digital Competencies

The framework of Technological Pedagogical Content Knowledge (TPACK) and the Substitution, Augmentation, Modification, and Redefinition (SAMR) model establish a robust theoretical foundation for assessing and systematically enhancing teachers' digital pedagogical competencies. The TPACK model explains the composite knowledge structure prerequisite for technology integration, asserting that effective application of educational technology depends on the dynamic equilibrium and profound integration of content knowledge (CK), pedagogical knowledge (PK), and technological knowledge (TK) (Drugova et al., 2021). Singular technical operational skills cannot spontaneously translate into classroom pedagogical efficacy; educators must possess the comprehensive capabilities characterized by the interplay of “technology and pedagogy” alongside “technology and content.” Within the context of integrating digital intelligence technologies into education, the function of technological tools has shifted from mere instructional auxiliaries into pivotal elements facilitating knowledge transformation. The driving mechanism of pedagogical knowledge has transitioned from being experience-led to data- and intelligence-led, while disciplinary knowledge has been restructured from static modules into dynamic cognitive topographies (Li & Mo, 2025). Consequently, TPACK constitutes the nucleus of teachers' digital pedagogical competencies, directly determining the scientific rigor and adaptability of their instructional designs.

Functioning as a hierarchical rubric for the depth of technological application, the SAMR model categorizes the integration process of pedagogy and technology into four progressive tiers: Substitution, Augmentation, Modification, and Redefinition (Nadav et al., 2026). The “Substitution” tier signifies instances where technology acts merely as a direct replacement for traditional tools, with no substantive functional alteration occurring within the learning activity (Liu, 2018). The “Augmentation” tier introduces functional improvements afforded by technology, yet remains confined within the inherent framework of pre-existing pedagogical paradigms. These two foundational tiers fail to penetrate the core of instructional strategies, as the locus of technological impact predominantly stagnates at the presentation and acquisition of learning resources (Liu, 2018). Conversely, the “Modification” tier embodies the central influence of technology in restructuring pedagogical activities, necessitating the utilization of technology for the effective antecedent design and transformation of learning tasks and processes. The “Redefinition” tier represents the highest level of technology integration, demanding the genesis of novel learning tasks and

pedagogical paradigms that would be fundamentally inconceivable absent technological support (Liu, 2018; Zhang, J., 2026).

Concerning the developmental trajectory of rural teachers' digital competencies, the TPACK framework elucidates the constraining mechanism that the teacher's knowledge structure imposes on the depth of technology integration. The proficiency level of a teacher's integrated knowledge framework constitutes the decisive threshold for transcending the tiers of the SAMR model (Huang, 2025). Currently, the cohort of rural educators pervasively suffers from a tenuous foundation of technological application knowledge (Zhang, L., 2025). Constrained by the paucity of local hardware configurations, training resources, and professional support systems, the technology integration efforts of the vast majority of rural teachers have languished chronically within the "Substitution" and "Augmentation" tiers (Zulfiani et al., 2025). Digital technologies are predominantly deployed to sustain traditional, unidirectional didactic classrooms; this low-level technological application is incapable of serving the objectives of cultivating students' higher-order cognitive capabilities and realizing deep learning. To achieve the qualitative leap toward the "Modification" and "Redefinition" tiers, it is imperative to shatter the entrenched cognitive limitations of rural teachers and systematically reconstruct their TPACK knowledge architecture.

As nascent digital technologies, such as Generative Artificial Intelligence (GenAI), profoundly intervene in educational systems, the synthesis of these models provides a lucid guiding logic for the digital pedagogical reform of rural teachers. The TPACK model offers a critical lens through which to scrutinize the role of AI at the intersection of technology, pedagogy, and content. Concurrently, the SAMR model is employed to assess the transformative potential and application proficiency of emerging digital tools, guiding the trajectory of tool application from superficial assistance toward the restructuring of pedagogical tasks (Zhang, J., 2026; Kohnke & Zou, 2025). The comprehensive application of this framework demands that educators not only master foundational system operational skills but, more crucially, acquire a profound comprehension of the intrinsic mechanisms by which intelligent technologies intervene in pedagogical content (Drugova et al., 2021). While existing linear frameworks such as the UNESCO ICT Competency Framework for Teachers (ICT-CFT) present macro-level progressions from Knowledge Acquisition to Knowledge Deepening and Knowledge Creation, the distinct originality of this study lies in explicitly coupling the internal structural growth of TPACK with the external hierarchical movement of the SAMR model at each stage of professional development. This structural synthesis provides an operational mechanism tailored for rural settings, distinguishing it from generic professional development or traditional lesson-study models.

4. Diagnosing the Dilemmas of Rural Teachers' Digital Competencies Based on the TPACK-SAMR Framework

This study introduces the TPACK and SAMR framework to provide a structured analytical perspective for analyzing the structural impediments in rural teachers' adoption of digital technologies. Rural educators face multiple barriers alongside the urban-rural digital divide in advancing digital pedagogical practices (Wang & Zhang, 2024). These barriers exhibit a complex, interactive relationship characterized by a deficiency in structural knowledge and a stagnation in the hierarchical levels of technological application.

The first dilemma concerning rural teachers' digital competencies manifests as the fragmentation of the TPACK knowledge structure. Content Knowledge (CK), Pedagogical Knowledge (PK), and Technological Knowledge (TK) have long remained in a compartmentalized state (Li & Mo, 2025). Constrained by traditional educational paradigms and insular environments, rural teachers' technological knowledge fails to effectively integrate with their pedagogical knowledge. In actual classroom instruction, digital devices are frequently relegated to mere content display media. Multimedia courseware assumes the singular function of an electronic blackboard (Huang, 2025). This deficiency in the structural knowledge dimension prevents technology from transitioning into a cognitive tool that facilitates students' deep learning. The dearth of Technological Pedagogical Content Knowledge directly impedes the comprehensive realization of digital technology's pedagogical efficacy (Li, M., 2025).

The second dilemma is reflected in the prolonged stagnation and mechanical application within the SAMR hierarchy. Constrained by a tenuous knowledge architecture, the depth of technological integration among rural teachers has long been locked at the Substitution and Augmentation tiers (Zulfiani et al., 2025). The rapid iteration of digital technologies provokes a pervasive state of technostress within the teaching cohort (Pant, 2025). Lacking the capacity for pedagogical restructuring, teachers are highly susceptible to falling into the operational pitfall of functional singularization when attempting to apply frontier tools such as generative artificial intelligence (GenAI). Mechanical application bereft of deep cognitive processing inevitably leads to the superficialization of classroom knowledge and lower-order cognitive engagement, resulting in a prolonged failure of conventional pedagogical practices to cross the threshold into the Modification and Redefinition stages (Nadav et al., 2026). The misalignment between the complexity of technology and the teachers' inherent task design capabilities constitutes a direct barrier to deep technological adoption.

The third dilemma stems from a severe disconnect between teacher training paradigms



and the developmental trajectories prescribed by the theoretical frameworks. Existing in-service professional development for rural teachers relies heavily on decontextualized, foundational technical operational guidance (Mahara, 2024). The design of training content remains confined to the transmission of singular technological knowledge, failing to provide the pedagogical scaffolding required to ascend to the higher-order tiers of the SAMR model. Purely theoretical lectures or basic skill demonstrations are incapable of catalyzing enduring transformations in teachers’ pedagogical behaviors (Ennis et al., 2020). Upon returning to conventional classrooms, trained teachers continue to struggle with deeply integrating acquired digital tools into their respective teaching disciplines (Pant, 2025). This supply-demand mismatch in training directly undermines rural teachers’ enthusiasm for advancing pedagogical reform. The absence of continuous pedagogical mentoring solidifies the practical dilemma of stagnation at lower application tiers (Mahara, 2024).

To lucidly delineate the aforementioned analytical logic, a summary of the dilemma diagnosis based on the core dimensions of the TPACK and SAMR theories is presented in Table 1.

Table 1

Diagnostic Matrix of Rural Teachers’ Digital Competency Dilemmas Based on the TPACK-SAMR Framework

Dimension of Dilemma	TPACK Mapping	SAMR Mapping	Core Manifestations in Rural Pedagogical Practice	Theoretical Roots of Practical Impediments
Fragmentation of Knowledge Structure	Low TPACK Integration	Stagnant at low tiers	Digital tools are rigidly relegated to singular content presentation media.	Prolonged compartmentalization of Technological Knowledge (TK) from Pedagogical Content Knowledge (PCK).
Stagnation in Application Hierarchy	Deficient TK/PK synthesis	Locked Substitution and Augmentation	Tool operations insuccumb functional singularization and mechanical application.	Deficiency in the pedagogical restructuring capacity required to transcend to the Modification and Redefinition tiers.

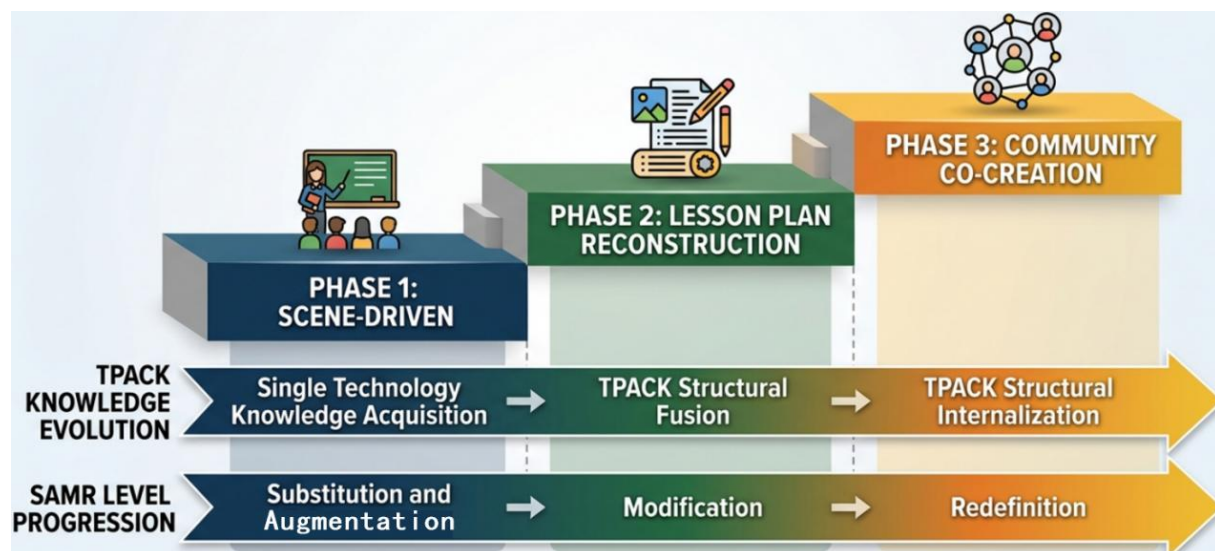
Disconnect in Training Mechanisms in Isolated TK delivery Lack of high-order scaffolding Difficulty in translating training outcomes into normalized, routine classroom instruction. Training paradigms focus on singular technical operations, lacking high-order application scaffolding.

5. Construction of a “Three-Stage Progressive” Enhancement Pathway Based on the TPACK-SAMR Framework

In response to the practical dilemmas of fragmented knowledge structures and stagnant application hierarchies among rural teachers, this study constructs a “three-stage progressive” pathway for enhancing digital pedagogical competencies. This pathway aims to remediate disjointed training mechanisms and propel rural teachers to accomplish a structural leap from singular technical operations to deep TPACK integration. The specific pathway evolution and its theoretical mapping are illustrated in Figure 1.

Figure 1

Mechanism for Enhancing Rural Teachers’ Digital Competencies from the Perspective of TPACK-SAMR Theory



5.1. Scene-Driven Technological Solutions

The primary phase of pedagogical reform is to dismantle the purely technical-operation training model and establish a context-driven mechanism for technology acquisition. Rural teachers must discard software-menu-style learning divorced from pedagogical realities; instead, a precise training paradigm should be directly driven by the resolution of specific

classroom pedagogical pain points. In implementation, training organizers must preliminarily compile a checklist of high-frequency instructional pain points in rural classrooms, ensuring the technology acquisition process directly serves high-efficiency learning condition analysis and resource acquisition tasks. For instance, guiding teachers to utilize Generative Artificial Intelligence (GenAI) or digital tools for learner analysis thereby achieves efficacy augmentation of their pre-existing pedagogical capabilities (Nadav et al., 2026). To operationalize this phase, the entry indicator requires a basic willingness to adopt digital tools despite a low baseline of TPACK proficiency (Lin et al., 2023). The measurable competency outcome involves successfully applying technology to optimize specific administrative or preparatory task efficiency. The suggested assessment instrument is a basic task-completion checklist. The transition criterion mandates that teachers demonstrate the ability to independently execute augmented tasks without experiencing elevated technostress. The technological application in this phase precisely corresponds to the Substitution and Augmentation tiers of the SAMR model; digital tools serve as highly efficient substitute media for pre-existing pedagogical workflows without imposing additional pedagogical cognitive load (Liu, 2018). This practical paradigm of rapid feedback assists teachers in establishing initial technological self-efficacy, effectively overcoming the technostress prevalent in the early stages of technology adoption, and enabling foundational Technological Knowledge (TK) to be preliminarily constructed within authentic instructional contexts.

5.2. Integration Practice via Instructional Design Restructuring

The second phase focuses on remediating teachers' fragmented knowledge structures and propelling the penetration of technology into core instructional workflows. This phase introduces a collaborative workshop model, deeply integrating pedagogical discourse with digital technology experimentation, thereby providing teachers with the practical scaffolding required to transcend technological application hierarchies (Dilek et al., 2025). Rural teachers are required to select their own routinely taught traditional lessons and conduct digital restructuring under the guidance of professional mentors. The instructional design establishes the core philosophy of "technology as a cognitive scaffold," compelling teachers to substantively construct their TPACK composite architecture by systematically integrating Content Knowledge (CK), Pedagogical Knowledge (PK), and cutting-edge Technological Knowledge (TK). During the restructuring process, teachers utilize GenAI to assist in mapping differentiated learning pathways for students (Kohnke & Zou, 2025) and mandatorily embed collaborative documents and real-time interactive feedback systems into the instructional workflow. This phase is operationalized through the following metrics: the

entry indicator necessitates the verified mastery of foundational digital tools acquired in the prior phase. The measurable competency outcome is the production of a restructured lesson plan that actively utilizes technology as a cognitive scaffold. The suggested assessment instrument is a standardized TPACK learning assessment rubric structuralized within the SAMR hierarchy. The transition criterion requires the successful classroom implementation and trial of the modified instructional design. The practice in this phase necessitates the complete dismantling of the inherent framework of unidirectional knowledge transmission, propelling technology integration into the Modification tier of the SAMR model. Technology not only alters the physical presentation of instruction but, more importantly, realizes a structural transformation of the pedagogical model through the redesign of core learning tasks (Li & Mo, 2025).

5.3. Reflective Evaluation and Community Co-creation

The ultimate phase of the enhancement pathway focuses on the internalization of the TPACK knowledge structure and the highest-order leap in the technological application hierarchy. The training assessment mechanism pivots entirely from singular courseware outcome evaluation to pedagogical process and technological reflection evaluation; teachers are required to submit complete micro-lesson recordings accompanied by in-depth analyses of their technological application. Evaluation rubrics strictly divest themselves of excessive attention to multimedia visual effects, comprehensively focusing instead on the intrinsic alignment between technological tools and pedagogical objectives, as well as the degree to which students' higher-order thinking is stimulated. Leveraging cloud-based teaching and research platforms, a digital collaborative community of rural teachers that transcends geographical boundaries is constructed, enabling teachers to engage in continuous peer review and pedagogical experience sharing within this virtual community. This normalized, informal learning network provides sustained professional mentoring, effectively preventing the regression of technological application to the inefficient substitution stage (Mouta et al., 2025). The operationalization of this final phase relies on clear criteria: the entry indicator involves the sustained classroom application of modified lessons. The measurable competency outcome is the collaborative design of entirely novel, technology-dependent learning tasks and active participation in peer evaluations. The suggested assessment instruments rely on longitudinal peer-review protocols within the digital platform. The transition criterion focuses on the sustained, independent contribution of pedagogical innovations to the collaborative community. Technological application in this phase comprehensively enters the Redefinition tier of the SAMR model; through pedagogical

co-creation in virtual spaces, the teaching cohort engenders novel models of peer collaborative teaching and research that would be unattainable without technological support (Liu, 2018; Korhonen et al., 2024). Consequently, rural teachers realize a profound role transition toward adaptive instructional leadership (Korhonen et al., 2024).

6. Discussion of Challenges, Coping Strategies, and Expected Outcomes

6.1. Expected Outcomes

The proposed three-stage progressive pedagogical reform pathway is theorized to systematically improve rural teachers' digital technology acceptance. By addressing authentic pedagogical pain points, this pathway effectively enhances the perceived usefulness and perceived ease of use of digital tools. Techno-anxiety and cognitive dissonance are fundamentally alleviated during progressive pedagogical practice. The professional identity of teachers undergoes a substantive transformation in this process. Rural teachers are anticipated to gradually evolve from passive observers and mechanical executors of digital technology into proactive pedagogical innovators within intelligent environments. This transformation not only bolsters teachers' comprehensive digital pedagogical competencies but also reshapes pedagogical autonomy in daily classrooms. Novel pedagogical models based on human-machine collaboration prompt teachers to translate pure technical literacy into creative instructional design behaviors. The modalities of knowledge presentation and acquisition shift from unidirectional indoctrination to multidimensional interactive exploration. Ultimately, digital technology achieves deep integration with disciplinary teaching. Technology is no longer an additive burden independent of the classroom; rather, it is internalized as a core element scaffolding students' cognitive development and higher-order thinking cultivation.

6.2. Implementation Challenges

Implementing deep-integration pedagogical reforms within rural educational contexts faces severe structural and agentic challenges. Structural barriers encompass the objective reality of scarce professional training resources, limited local bandwidth connectivity, and chronic shortages in training funding that directly impede the effective execution of pedagogical reform initiatives. Conversely, agentic barriers manifest through the intense time-allocation pressures and heavy daily teaching and campus management workloads borne by rural educators. Given limited preparation time and relatively large class sizes, it is difficult for teachers to consistently and frequently apply the digital knowledge acquired from short-term training into their routine classrooms. The lack of sustained professional mentoring and localized pedagogical support renders technology application susceptible to regressing to



the inefficient substitution stage. Once encountering complex technical malfunctions or interdisciplinary integration bottlenecks in pedagogical practice, teachers often retreat to traditional, familiar didactic models driven by risk-aversion psychology. This long-term inequality in resource acquisition further exacerbates the urban-rural digital divide. Mere upgrades in technical hardware, if devoid of accompanying support from higher-order software literacy and institutional mechanisms, will perpetually fail to penetrate the core zone of educational quality enhancement.

6.3. Coping Strategies

Overcoming the aforementioned implementation challenges necessitates the construction of normalized University-Rural School Partnerships (URSPs). Higher education institutions should leverage their academic accumulation and professional resource advantages to provide long-term, localized guidance for rural schools. This cross-phasal collaborative model can effectively elevate the structural disciplinary knowledge and pedagogical practice proficiency of rural teachers. To mitigate the identified structural barriers, URSPs must facilitate institutional resource reallocation and provide direct expert-led scaffolding to offset funding and resource scarcity. To resolve agentic barriers, the collaborative frameworks within URSPs must design adaptive, time-efficient digital workflows that reduce lesson preparation burdens and explicitly counter technostress. Partnerships must fully respect the geographical uniqueness and specific cultural ecology of rural education. Clear communication mechanisms and consistent formative evaluation criteria must be established during the planning and implementation phases. By constructing a multi-tiered pedagogical support system encompassing technical tutoring, lesson plan refinement, and learning-condition data analysis, rural schools can receive sustained external feedback. This sustained systemic support is the critical safeguard for maintaining the achievements of digital pedagogical reforms. The continuous infusion of external intellectual resources helps to dismantle the relatively closed traditional teaching and research environments of rural schools. The cross-regional flow and restructuring of educational resources will ultimately propel the sustainable development of rural education and the comprehensive deepening of the digital transformation.

7. Conclusion

The core objective of the educational digital transformation is not merely to achieve the popularization of technical hardware, but rather to facilitate the deep integration of digital technologies with disciplinary teaching models. Enhancing the digital pedagogical



competencies of rural teachers is a long-term, systemic endeavor. Singular software operational skills training cannot fundamentally resolve the informatization application dilemmas in rural education. Technical operations merely constitute the initial starting point of digital pedagogy; deep integration is the ultimate destination of educational technology evolution. This conceptual paper, employing the dual TPACK and SAMR theoretical frameworks, dissects the issues of cognitive stagnation and practical disconnect faced by rural teachers during the technology adoption process. The three-stage progressive enhancement pathway constructed to address these practical dilemmas provides a lucid theoretical logic and operational framework for propelling the translation of novel digital technologies into authentic rural classrooms. The development of rural teachers' digital competencies is not an overnight accumulation of skills, but a continuous, bidirectional constructive process of educational philosophy renewal and technological tool application. Leveraging collaborative networks between universities and rural schools (URSPs) and establishing long-term professional pedagogical support mechanisms are indispensable safeguards for ensuring the effective execution of digital pedagogical reforms and realizing the high-quality development of rural education.

Acknowledgments

Not applicable.

Author contributions

Not applicable.

Funding

The authors disclosed receipt of the following support for the research, authorship, and publication of this article: Henan Provincial Soft Science Research Project (262400410100); Henan Provincial Philosophy and Social Sciences Planning Project (2025CJY090).

Data Availability

No datasets were generated or analysed during the current study.

Declarations

Conflict of interest

The authors declare that there is no Conflict of interest.

Ethics approval

Not applicable.

**Consent to participate**

Not applicable.

Consent for publication

All authors have given their consent.

Additional information

Received: 1 May 2026

Accepted: 26 May 2026

Published online: 15 June 2026

Publisher's Note

Wisdom Academic Press Ltd. remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

References

- [1] Dilek, M., Baran, E., & Aleman, E. (2025). AI literacy in teacher education: Empowering educators through critical co-discovery. *Journal of Teacher Education*, 76(3), 294–311. <https://doi.org/10.1177/00224871251325083>
- [2] Drugova, E., Zhuravleva, I., & Aiusheeva, M. (2021). Toward a model of learning innovation integration: TPACK-SAMR based analysis of the introduction of a digital learning environment in three Russian universities. *Education and Information Technologies*, 26(4), 1–18. <https://doi.org/10.1007/s10639-021-10514-2>
- [3] Ennis, R., Royer, D., Lane, K., & Dunlap, K. (2020). The impact of coaching on teacher-delivered behavior-specific praise in Pre-K–12 settings: A systematic review. *Behavioral Disorders*, 45(3), 148–166. <https://doi.org/10.1177/0198742919839221>
- [4] Hu, S., Dai, J., Wen, H., Lai, Z., Li, X., Lin, L., & Chen, L. (2023). Digital transformation promotes the high-quality development of rural education: Value, dilemma and strategy. *Journal of Social Science Humanities and Literature*, 6(6), 211–218. [https://doi.org/10.53469/jsshl.2023.06\(06\).32](https://doi.org/10.53469/jsshl.2023.06(06).32)
- [5] Huang, L. (2025). Review on the evolution of technology adaptation in college English smart classrooms based on the SAMR-TPACK model. *Journal of Hubei University of Economics (Humanities and Social Sciences)*, 22(12), 152–156. <https://doi.org/10.3969/j.issn.1671-0975.2025.12.028>
- [6] Kohnke, L., & Zou, D. (2025). Artificial intelligence integration in TESOL teacher education: Promoting a critical lens guided by TPACK and SAMR. *TESOL Quarterly*, 59(S3), S267–S278. <https://doi.org/10.1002/tesq.3396>
- [7] Korhonen, T., Karne, S., Airaksinen, J., Laakso, N., & Salo, L. (2024). Finnish teachers' experiences with transformative digital agency. *Cogent Education*, 11(1). <https://doi.org/10.1080/2331186X.2024.2402683>
- [8] Li, M. (2025). Exploring the digital divide in primary education: A comparative study of urban and rural mathematics teachers' TPACK and attitudes towards technology integration in post-pandemic China. *Education and Information Technologies*, 30(2), 1913–1945. <https://doi.org/10.1007/s10639-024-12890-x>
- [9] Li, Z., & Mo, D. (2025). Implementation path of practical training systems for economics and management majors in applied undergraduate universities under TPACK-SAMR framework. *Advances in Vocational and Technical Education*, 7(3), 56–66. <https://doi.org/10.23977/avte.2025.070308>



- [10] Lin, R., Chu, J., Yang, L., Lou, L., Yu, H., & Yang, J. (2023). What are the determinants of rural-urban divide in teachers' digital teaching competence? Empirical evidence from a large sample. *Humanities and Social Sciences Communications*, 10, 1–12. <https://doi.org/10.1057/s41599-023-01933-2>
- [11] Liu, S. (2018). Research hotspots and progress of the SAMR model. *Journal of Jilin Engineering Normal University*, 34(11), 91–96. <https://doi.org/10.3969/j.issn.1009-9042.2018.11.030>
- [12] Mahara, K. K. (2024). Receiving and implementing in-service teacher training programmes: Identifying challenges from teachers' perspectives. *KMC Journal*, 6(1), 153–175. <https://doi.org/10.3126/kmcj.v6i1.62338>
- [13] Mouta, A., Torrecilla-Sánchez, E. M., & Pinto-Llorente, A. M. (2025). Comprehensive professional learning for teacher agency in addressing ethical challenges of AIED: Insights from educational design research. *Education and Information Technologies*, 30, 3343–3387. <https://doi.org/10.1007/s10639-024-12946-y>
- [14] Nadav, L. L., Inbal, S. T., & Blau, I. (2026). What are teachers' perspectives and practices regarding the integration of GenAI tools in pedagogical design and classroom instruction? *Education and Information Technologies*, 1–26. <https://doi.org/10.1007/s10639-026-13925-1>
- [15] Pant, C. (2025). Challenges faced by secondary English language teachers in integrating ICT in the classroom. *Journal of Research in Education*, 2(1), 45–62. <https://doi.org/10.3126/jore.v2i1.92058>
- [16] Wang, H., & Zhang, H. (2024). Rural teachers' digital competence: Impediments and developmental responses. *Journal of Education and Educational Research*, 9(3), 414–419. <https://doi.org/10.54097/sbh3a880>
- [17] Zhang, J. (2026). Research on the pedagogical application of generative artificial intelligence based on SAMR model. *Continuing Education Research*, (2), 83–88. <https://doi.org/10.3969/j.issn.1009-4156.2026.02.013>
- [18] Zhang, L. (2025). Research on strategies for enhancing digital literacy of rural middle school teachers [Master's thesis, Ningxia University].
- [19] Zulfiani, Z., Suwarna, I., Islami, R., & Sari, I. (2025). Trends in SAMR research in teaching and learning from 2019 to 2024: A systematic review. *International Journal of Advanced and Applied Sciences*, 12(4), 99–106. <https://doi.org/10.21833/ijaas.2025.04.012>