Research Article

Digital Teaching Resources Integration and Teaching Quality in Rural Primary Schools in China: A Cultural System Perspective

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ABSTRACT

This study employs a qualitative research design to investigate how digital teaching resource inputs are integrated into teaching quality within the context of rural primary schools, grounded in the social system model. Participants were selected through purposive sampling, including six educational administrators and nine teachers from three rural primary schools in Yunnan, China. Data were collected via semi-structured interviews and analyzed using thematic analysis. The findings of the study are threefold. First, although investments in digital teaching resources have increased under top-down policy initiatives, a persistent systemic disconnect between resource adaptability, technical support, and pedagogical practice constrains the effective transformation of these resources into educational utility. Second, the school cultural system is crucial in translating digital resources into teaching quality through shared values, teachers' sense of belonging, ethnic minority cultural integration, and home–school collaboration. Third, digital teaching resources boost student engagement and classroom interactivity but have limited effects on learning outcomes due to gaps in family support, weak localization, and uneven teacher competence. The enhancement of teaching quality in rural primary schools needs to be advanced synergistically across three dimensions: resource construction, teacher professional development, and cultural ecology, thereby building a holistic educational ecosystem that supports sustainable digital transformation.

Keywords: Rural primary school; Digitalization of Education; Digital teaching resources; Teaching quality

1. Introduction

Teaching quality is a key way to show how factors in school management affect educational goals [1]. Research into school management can significantly enhance teaching quality [2]. The Sustainable Development Goals (SDGs) of the United Nations identify quality education as a priority (SDG4), pointing out that teaching quality is the basis for raising educational standards [3]. Teaching quality provides schools with a scientific framework, helping them check and focus on their actual work in the educational process [4]. With such a framework, schools can make specific improvement strategies to achieve continuous development [5].

Teaching quality is a key issue in basic education stage [6]. However, in China, most research on teaching

quality focuses on higher education, and there is a lack of attention to basic education stage [7]. Also, existing studies mainly discuss basic concepts and methods of teaching quality, and empirical research remains limited on teaching quality in rural schools [8]. Rural schools have received limited attention compared with those in cities or developed regions [9].

Previous studies have often pointed out the problem of limited resources in rural primary schools [10]. However, how to improve teaching quality under rural conditions still needs more study [11]. Digital teaching resources have become a key factor that can improve teaching quality in rural areas. Exploring how digital resources are used in rural schools to improve teaching quality is still rarely studied[12].

There is a close relationship between educational digitalization and teaching quality[13]. Educational digitalization refers to the process of integrating digital technologies into human activities, with digital resources as the core [14]. The digitalization of rural primary school education is seen as an important way for achieving educational equity and improving educational quality; however, it currently faces many complex problems [13]. Existing research focuses more on the application of digital teaching resources in different subjects, and rarely discusses the role of digital resources in enhancing teaching quality in rural basic education [15]. Rural schools continue to face pressure from universal reforms based on urban standards [16]. For example, the use of digital communication technologies is one such pressure [17]. The accessibility and actual application of technology bring both opportunities and challenges to rural education; however, these aspects have not been fully studied [18][19].

China is currently promoting a large educational digitalization campaign in rural areas, including Yunnan Province. Therefore, based on the educational digitalization actions in Yunnan, this study aims to explore the interaction between digital resources and teaching quality. By interviewing leaders and teachers from three rural primary schools in Yunnan, this study aims to address the following research questions:

1. What is the current status of educational digitalization and teaching quality implementation in rural primary schools in Yunnan, China?

2. What is the process by which digital teaching resource inputs shape teaching quality in rural primary schools in Yunnan, China?

2. Literature Review

2.1. Theoretical Framework: The School Social System Model

This study uses the school social system model proposed by Hoy and Miskel [20] as its theoretical basis. This model focuses on analyzing teaching quality from the perspectives of Inputs, Transformation, and Outputs.

At the Input level, the model looks at the resources that school operations rely on and their limitations. This includes external conditions, human and capital resources [21]; policy frameworks, which mean the school's goals and management guidelines [22]; materials and methods, such as teaching materials and teaching methods [23]; and equipment, specifically the hardware needed for teaching and learning. These inputs build the material and regulatory foundation for the school to achieve its goals [24].

The school's transformation process is about changing input resources into efficient teaching and learning processes. This transformation depends on the cooperation of four subsystems. Among them, the cultural system contains shared values and cultural orientations [25]. Its core includes shared values like goal orientation and a collaborative atmosphere, which affect the school's educational goals and implementation [26]. A sense of belonging is also an important part of this system, affecting the feelings of teachers and students

[27]. These systems work together to turn inputs into productive teaching and learning activities [28]. Using this social system model, this study focuses on the cultural system to investigate the current status of digital teaching resource inputs in rural primary schools and explore how digital teaching resources influence teaching quality. In this study, teaching quality is defined as a dynamic concept that includes teaching preparation, the teaching process, and teaching results [29].

2.2. Current Status of Rural Education Digitalization in China

China began promoting the "Education Informatization 2.0 Action Plan" in 2018. Subsequently, in 2022, the Smart Education of China platform for primary and secondary schools was officially launched. This initiative flooded digital platforms with massive amounts of high-quality educational resources covering all subjects and stages, providing richer resource support for educational digitalization. In 2023, the Yunnan Provincial Government released the "Three-Year Action Plan for High-Quality Development of Education in Yunnan Province [30]." This plan exerts efforts across multiple dimensions, including the optimized allocation of educational resources, the improvement of educational quality, and the innovation of talent cultivation models, aiming to promote comprehensive development in the education sector to meet the diverse and innovative demands for talent cultivation in the new era [31].

Educational digitalization mainly involves increasing investment in network facilities for rural schools to get full network coverage and make the signal stable; and giving schools necessary digital teaching equipment to improve teaching conditions [32]. It also encourages teachers to use digital resources and tools to improve teaching methods, such as using situational teaching [33].

Promoting rural education digitalization aims to break the time and space limits of urban-rural educational resources, allowing rural students to share high-quality urban resources [34]. It provides rural teachers with more opportunities for learning and exchange, improving their teaching ability and digital literacy through online training, thus helping teacher professional development [32].

2.3. Digital Teaching Resources

From a resource perspective, digital teaching resources use online platforms to facilitate access, enabling teachers and students to use them more effectively. In terms of teaching methods, they support diverse teaching models [32]. This supports students to learn at their own pace and choose learning content and time by themselves. It also helps teachers use diverse teaching methods and means flexibly [35].

Khafizova et al [36] classify the concept of educational digitalization into theories of technological application, comprehensive integration, and paradigm shift. Educational digitalization utilizes information technology to empower classroom teaching, innovating characteristic teaching models, methods, and strategies, aiming to improve the process and results of education and teaching using informational tools and platforms [37]. Digital technology is essentially the transformation of digital technology into educational benefits [27].

Digital educational resources are mainly divided into two types: hardware resources and software resources [23]. Software resources include digital textbooks, educational resource platforms, and educational apps [38]. Hardware resources mainly include interactive all-in-one machines, electronic whiteboards, computers, recording and broadcasting classrooms, virtual reality laboratories, etc. [31]. The construction of digital infrastructure in rural primary schools is the prerequisite for carrying out educational digitalization [19], and the extent of network coverage and the provision of hardware equipment such as computers significantly affect teaching quality [24].

2.4. Teaching Quality

Teaching Quality refers to the process where rural primary school teachers, using digital tools, help students develop comprehensively [23]. This includes instructional design, classroom teaching, and feedback [39]. In the preparation phase, teachers use digital resources to improve curriculum content and lesson planning [23]. During the implementation phase, teachers use technology to encourage interaction and increase students' interest [10]. Finally, in the result phase, quality is seen in knowledge mastery, homework, and feedback [40].

Factors affecting teaching quality include teachers and school management. Hanushek [41] shows that high-quality teachers greatly help student achievement. Effective teaching methods and school management are key approaches to improving teaching quality [42]. Moreover, effective school management can ensure that teaching activities run smoothly and resources are utilized efficiently[43]. Effective school administrators can maintain high teacher morale and teaching quality [4344].

2.5 Cultural System Factors Influencing Teaching Quality

The cultural system of the school social system theory constructs a collective schema of how the school should operate through elements of values and cultural atmosphere [26]. It provides implicit but powerful support for daily teaching and management practices and is one of the important factors determining school teaching quality [26].

Shared Values are reflected at the goal orientation level, focusing heavily on whether student development is central and the degree of attention paid to teacher professional growth [45]. The collaborative atmosphere dimension is mainly manifested in the strength of the teamwork spirit among teachers and the initiative to share teaching experiences. The innovation culture (spirit) dimension is reflected in the intensity of the school's encouragement of new teaching methods and technology applications [46]. The responsibility consciousness dimension is embodied in the degree of importance attached to teacher professional ethics and student learning responsibility [47]. The academic orientation dimension concerns the degree to which the school values academic achievement and the cultivation of research capabilities [48].

The dimension of equity and diversity shows in the support for equality and multiculturalism. These shared values affect the whole school atmosphere and have a big influence on teachers and students [46]. Also, a humanistic culture that cares about the emotional needs and personality development of teachers and students helps to build students' positive social emotions. This boosts their motivation for learning, and improves teaching quality 49.

The cultural Atmosphere is seen in belonging, ethnic cultural integration, and other aspects. A sense of belonging is a key part of school culture, meaning whether teachers and students feel recognized and supported by the school [46]. For teachers, this shows in their willingness to stay at the school long-term and how they feel about leadership support [50]. To promote a sense of belonging, schools can build a teacher support system, like offering regular training and work recognition.

The school cultural system is affected by many factors including region, ethnicity, and rural social culture [51]. Rich and diverse ethnic cultures provide schools with unique resources, such as ethnic arts and traditional handicrafts. Combining these resources with digital teaching resources helps develop courses with local features, which enriches teaching content [52].

3. Methodology

3.1. Research Design

This study employs a qualitative descriptive design, which is particularly suited for understanding the real experiences and situations of specific groups [50]. This approach aligns with the main purpose of this study, which is to investigate digital teaching resources and teaching quality in rural primary schools in Yunnan, China [53]. By exploring the actual practices deeply, this study ensures that results are based on data and provide useful insights [54]. Therefore, this study conducts semi-structured interviews as the primary method to collect data in order to explore participants' personal experiences and perspectives on the digital transformation of rural primary education [55].

3.2. Participants and Sampling

This study uses purposive sampling to address the research questions. First, Yunlong County, Yunnan Province, China, was selected as the research area. Its typical features—multi-ethnic population, mountainous terrain, and digital transformation status—make it representative for exploring rural education digitalization issues. Based on this, three townships were selected from Yunlong County. These three townships are similar in terms of economic development, educational resources, and cultural background, which helps minimize the influence of regional differences on the results.

From each primary school (coded CXX, BFX, MJX), 2 school leaders (Principal and Vice Principal of Academic Affairs) and 3 frontline teachers were selected, totaling 15 participants. School leaders were selected based on position to ensure administrative perspectives. The selection of teachers considered title, age, and gender balance to cover different views and experiences, including young and senior teachers from different subjects. The details of the participants are shown in Table 1.

Table 1. Basic Information of Interviewees

School Code	Interviewee Code	Gender	Age	Position
	C1	Male	40	Principal
	C2	Female	37	Vice Principal (Academic)
CXX	C3	Female	26	Teacher
	C4	Male	44	Teacher
	C5	Male	50	Teacher
	B1	Male	43	Principal
	B2	Female	32	Vice Principal (Academic)
BFX	B3	Female	27	Teacher
	B4	Male	42	Teacher
	B5	Female	48	Teacher
	M1	Male	46	Principal
	M2	Female	33	Vice Principal (Academic)
MJX	M3	Female	25	Teacher
	M4	Male	40	Teacher
	M5	Female	45	Teacher

3.3. Data Collection and Instrumentation

The data collection process utilized face-to-face in-depth interviews to interact directly with school administrators and teachers, obtaining their genuine feelings and experiences regarding educational digitalization practices, school culture, and teaching quality [56].

Regarding the design of interview tools, the researchers developed an outline based on the cultural system theory discussed in the literature review and invited 6 experts in the field to conduct a validity survey. For school leaders, a school leadership interview outline was developed (see Table 2), focusing on the implementation of school digitalization policies and decisions regarding teaching resource allocation [53]. For frontline teachers, a teacher interview outline was designed based on teaching practice and school culture, to deeply understand teachers' experiences, challenges, and teaching strategies under the background of educational digitalization [52].

Table 2. Interview Outline for School Leaders and Teachers

Interviewee	Questions
Leaders	1. How do you evaluate the implementation of the Yunnan Province 2022-2025 Digitalization Promotion Action in terms of policy implementation, resource allocation, and technical support?
	2. What are the current main channels for obtaining software digital teaching resources (e.g., PPT courseware, online course videos, exercise software, etc.)?
	Follow-up: 2.1 What problems have you encountered during the resource acquisition process?
	3. What types and disciplines do existing software digital resources cover?
	4. What hardware digital resources are currently equipped in the unit?
	Follow-up: 4.1 What is the actual usage frequency of these hardware devices?
	5. From the perspective of school culture construction, what measures has the school taken to promote digital teaching?
	6. During the process of promoting digital teaching, what events have left a deep impression on you?
Teachers	1. What incentive measures has the school taken?
	2. How effective are the incentive measures taken by the school in motivating you to use digital teaching resources?
	3. How would you rate your mastery of digital teaching resources?
	4. What is the impact on teaching quality during the process of using digital teaching resources compared to before their use?

3.4. Ethical Considerations

This study strictly adhered to ethical research principles and the principle of voluntary participation. Participants participated freely, without coercion, and retained the right to withdraw at any stage without reason [53]. Informed consent was obtained by clearly explaining the research objectives, the details of the information needed, usage, and potential risks. The ethics approval number for this study is DPUHREC033/67.

3.5 Data Analysis

This study uses thematic analysis to process data. To ensure objectivity, the process included four main steps: data organization, text analysis, data coding, and data analysis and verification [56]. First, data organization involved transcribing interview recordings word for word into text immediately after the interviews to ensure data accuracy. Then, text analysis was done by reading and analyzing the interview texts. Next, during the data coding phase, based on the themes found, the study used NVivo software to help code the interview data. It used open coding, axial coding, and selective coding to label every meaningful text segment [52]. Finally, the analysis step involved analyzing the coded data and counting the frequency of different themes to understand the importance of various issues in the interview data [52].

For reliability, in the data organization phase, interview recordings were transcribed, notes were organized, and interviewee information was recorded in time to ensure data accuracy [57]. In the data coding phase, strict coding methods were used to analyze the text and build theoretical models, improving the stability of the research.

For validity, triangulation was used by comparing stories of the same phenomenon from interviewees at different levels (leaders, teachers) to find potential differences[58]. External validity was improved through detailed descriptions of the research setting, and by returning research results to 6 key interviewees for checking to ensure theoretical explanations matched actual experiences [58].

4. Research Results

4.1. Current Status of Digital Teaching Resource Inputs

This study utilized NVivo 12 software to conduct three-level coding analysis on the survey data, aiming to analyze the current status of educational digitalization teaching quality implementation and the process by which digital teaching resource inputs impact teaching quality. Through interview data analysis, five themes and seven sub-themes were derived, as shown in Table 3.

Table 3. Thematic Classification of Digital Teaching Resource Inputs

Category	Themes	Sub-themes
Policy mechanism	1.Policy Resource Suspension; 2. Failure of Grassroots Demand Response	Strong top-down initiative, Difficult grassroots execution; Mismatch between resources and rural needs
Software Resource Input	1.Low-Configuration supply of software resources 2.Teaching Practice Dilemmas	Large disparity in resource quality; Teaching practice dilemmas; Unbalanced disciplinary coverage Poor local adaptability of resources
Hardware Resource Input	Imbalance between Investment and Operations/Maintenance	Disparities in basic equipment coverage and usage Differences in usage frequency and user groups

4.1.1. Policy mechanism

(1) Theme 1: Policy resource suspension

In the process of advancing digital education, a significant "suspension" phenomenon exists between policy resources and grassroots teaching reality.

On one hand, education authorities often allocate resources through projects and special funds, but the distribution method is often top-down and does not fully match the actual situation of rural schools and the abilities of teachers [25]. Some resources, such as high-end equipment and unified platforms, do not fit the teaching pace, causing resources to be difficult to use or equipment to sit idle. On the other hand, the

implementation of policies lacks continuous checks and evaluation. After resources are given, there is often a lack of training and maintenance support, leading to a problem where investment is more important than operations and hardware is more important than usage, which stops policies from effectively improving teaching results [59].

The interviews showed a strong tendency among leadership to complete tasks just to meet requirements, often hiding actual problems.

"Advancing normally according to superior requirements." (M2)

However, beneath this compliance lies a recognition of misalignment:

"Resource adaptability is poor; advanced resources do not match actual rural needs." (B1)

(2) Theme 2: Failure of grassroots demand response

Network stability, equipment update speeds, and digital classroom coverage vary greatly between regions and schools, and some schools still face practical problems of "having network but unstable, having equipment but aging" [60]. At the same time, a technical support system has not been well established. Many schools rely on temporary external services or teachers fixing it themselves; once technical problems occur, the teaching process is easily interrupted. Also, the gap between digital teaching resources and local teachers' abilities is still large. Teachers often need technical guidance that is more specific and continuous, rather than one-off or general training [37].

"Completed full coverage of multimedia classrooms for the whole school, equipped with smart interactive whiteboards, but the quality of equipment varies." (C1)

"Maintenance is insufficient, equipment failures are frequent, network stability is poor. Although some teachers have attended repair training, they are still unfamiliar." (B2)

4.1.2. Software Resource Input

(1) Theme 1: Low-Configuration supply of software resources

Currently, the supply of digital educational software resources and rural teaching practice presents a significant "low-configuration" phenomenon. Although resource acquisition channels are increasingly diverse—teachers can obtain materials through open platforms, institutional sharing, commercial procurement, and school-based development—the distribution of quality is extremely uneven [37]. A large amount of resource content suffers from severe homogenization, rough design, or detachment from curriculum standards, making it difficult to apply directly to real classrooms. This leads to teachers spending excessive energy on screening and integration, with limited actual teaching utility.

"Currently usable digital resource platforms include the National Smart Platform, Seewo Whiteboard, and other network platforms; searching for teaching tips on Douyin (TikTok) and Xiaohongshu. School procurement, standardized resource libraries. But the usage situation varies." (B1)

"Some teachers use Seewo, Smart Primary and Secondary School, Douyin, Xiaohongshu, and Zuoyebang well, but some teachers don't know how to use them, or the platforms and content don't match." (B2)

(2) Theme 2: Failure of grassroots demand response

During resource usage, copyright restrictions and technical thresholds further constrain accessibility and usability. Many high-quality resources are restricted by commercial licensing or closed platforms, and schools cannot afford continuous subscription fees. Simultaneously, some tools involve complex operations and high equipment performance requirements, mismatching the actual technical capabilities of rural teachers and school infrastructure conditions, forming realistic obstacles where resources exist but are hard to use, and tools exist but are hard to operate [27].

> "Resources corresponding to the new textbooks are somewhat scarce. Resource adaptability is poor; advanced resources do not match actual rural needs." (B1)

> "Lacking 'rural flavor'—advanced resources are mostly urban cases, disconnected from the life experiences of rural children." (B1)

A deeper issue lies in the lack of resource adaptability and localization. Many digital teaching contents are modeled on urban educational contexts, creating barriers in cultural background, language expression, case selection, and difficulty gradients regarding the learning experiences and cognitive levels of rural students[24]. Also, there is a clear imbalance between subjects. Resources for main subjects like Chinese and Mathematics are quite rich, while digital resources for Music, Art, Science, and local culture courses are lacking or of low quality. This lack of resources not only limits the diversity of teaching, but also makes the resource problem worse for rural schools in achieving digital teaching for all subjects [38].

> "In the teaching process, there is often a mismatch in resource adaptability and localization. For example, some students haven't seen a train, so it's troublesome when talking about trains." (M1)

> "Lack of copyright—sources of some resources are unclear, posing legal risks in use. Lack of skills—complex interfaces, numerous plugins, older teachers shy away." (B1)

> "Allocation of digital teaching resources in subjects: Chinese, Math, English coverage 100%; Science 60%; Music, Art, PE each 20%." (C1)

4.1.3. Hardware Resource Input

(1) Theme 1: Imbalance between Investment and Operations/Maintenance

Although initial investment in hardware equipment for schools during the digital education transformation has significantly increased, at the level of actual operation and long-term maintenance, there is a clear phenomenon of prioritizing investment over maintenance and construction over usage. This imbalance is first reflected in the significant gap between basic equipment coverage and usage [10]. Although surveyed schools are equipped with multimedia classrooms, computers, and tablets, actual effective utilization rates vary. Some equipment remains idle for long periods due to incompatibility with teaching software, difficulties in upgrading, or lack of supporting resources, meaning "having equipment does not equal being able to teach."

> "The school has electronic whiteboards and multimedia classrooms, but some bought several years ago have never been used." (C2)

> "Our school has electronic whiteboards, recording studios, and multimedia rooms. In the teaching process, the recording studio is basically unused." (M2)

At the specific usage level, significant differences exist between usage frequency and groups. On one hand, equipment usage relies heavily on a minority of young teachers with high technology acceptance or specific subject teachers (e.g., IT, Science), while usage by middle-aged/older teachers or humanities teachers is relatively limited and passive. On the other hand, student usage opportunities are mostly concentrated in IT courses or specific project activities, with insufficient breadth of normalized, interdisciplinary integration into daily teaching [19].

> "Older teachers use electronic whiteboards a lot, but basically no one uses other hardware equipment. Other hardware equipment is only occasionally used by young teachers." (M2)

> "In the school tablet usage process, tablets are used by one class in multiple groups queuing up, while other classes don't use them. The class that uses them also uses them for IT courses, basically not for other subject courses." (M2)

Constraints also stem from systemic bottlenecks in network conditions and technical maintenance. Rural schools have insufficient network bandwidth and poor stability, making it difficult to support smooth online teaching or resource access for multiple classes simultaneously. Simultaneously, schools generally lack professional school-based technical maintenance teams; slow response to equipment failures, lagging system updates, and difficulties in software installation and debugging have become the norm. External technical support often has long cycles and high costs, failing to meet the immediate needs of daily teaching [31].

> "Network bottlenecks—remote campuses have insufficient bandwidth. Downloading high-definition micro-classes takes more than 20 minutes, often requiring restarts due to disconnection." (C2)

> "The school has no one to repair computers. Once during class, the electronic board broke. Following that, our class didn't use it for a month. During a small holiday, the principal went to the county to hire someone to fix it." (M4)

The study distills the core category of digital teaching resource input status as: The misalignment between policy resources and actual needs constrains digitalization efficacy. Specifically, although superior policies have powerfully promoted hardware coverage and resource introduction, during execution, the lack of adaptability between resources and needs, coupled with weak continuous maintenance and technical support, leads to digital teaching resources failing to fully exert their expected effects in actual application [43]. The "acclimatization issues" of software resources and the uneven use of hardware equipment jointly constitute the principal contradiction of digital teaching resource inputs in rural primary schools, constraining the overall improvement of teaching quality.

4.2. Analysis of Cultural Factors

This study utilized NVivo 12 software to conduct three-level coding analysis on the survey data, aiming to analyze the process by which digital teaching resource inputs impact teaching quality. Through interview data analysis, eight themes and twenty sub-themes were derived, as shown in Table 4.

Table 4. Thematic Classification of Influencing Factors

Category	Themes	Sub-themes
Shared Value Orientation	Institutional Drive	Incorporating digitalization into teaching routines; Organizing training and technical support; Performance assessment alienating teaching
	Teacher-Student Efficacy Recognition	Affirmation of digitalization improving teaching quality; Improvement in student learning effects; Teacher professional development needs
Teacher Sense of Belonging	Generational Differences	High turnover intention among young teachers; High reality pressure for middle-aged teachers; Strong emotional rootedness among older teachers
	Emotional Maintenance	Humanistic care enhancing teacher retention intention; School understanding and support for teacher families
Ethnic Cultural Integration	Innovative Inheritance	Digitalization assisting ethnic culture teaching; 2Digital means disseminating local culture
	Conditional Limitations	Digital equipment and network shortages constraining teaching; Teacher digital capabilities affecting inheritance
Home-School Collaborative Culture	Differential Interaction	Active communication in one-child families; Insufficient communication in multi-child families
	Innovative Connection	Language barriers affecting communication; Improving communication through digital means; Parent committees as bridges of culture and communication

4.2.1. Shared Value Orientation

(1) Theme 1: Institutional Drive

School institutional arrangements are key to promoting the use of digital teaching resources. Schools can organize special training, set up real-time technical support systems, and assign staff to answer questions. This helps to lower the difficulty of using technology and reduce teachers' anxiety. At the same time, including digital resource use in routine teaching inspections shows its necessity from the management level, helping teachers form regular habits [50]. These measures create an environment that combines support and requirements, providing a solid guarantee for the effective use of digital teaching.

> "Conducting training to familiarize with tool operations, establishing technical support groups, arranging dedicated personnel to solve teacher usage problems in real-time." (B3)

> "In digital resource application, including it in normal teaching routine inspections makes teachers feel it is both necessary and useful." (B1)

In terms of performative culture, performance assessment has produced a clear alienating effect on teaching behavior. This is manifested specifically as: First, an orientation valuing form over substance leads to superficial digitalization applications. Second, the phenomenon of "performative application" is prevalent, where technology use becomes a means to cope with inspections. Finally, teacher burdens are increased, as formalistic assessments consume a large amount of teaching energy [27].

> "Scan-code answer participation rate requires reaching over 90%, but mostly it's just simple clicking, lacking deep interaction." (B5)

> "Every semester, 20 smart classroom videos must be recorded for evaluation, forcing everyone to perform classes, which instead increases the burden." (C4)

> "To meet digital teaching indicators, teachers need to spend a lot of time preparing presentation materials, affecting normal lesson preparation." (M1)

(2) Theme 2: Teacher-Student Efficacy Recognition

Regarding focus on teacher and student growth, school incentive measures present a dual orientation of tool empowerment and developmental care. Teachers not only affirm existing support but also generally express a need for deeper professional development, such as expecting high-quality resource design and production training led by industry experts to systematically improve their own informational teaching capabilities [24]. Substantive teaching improvements brought by digital resources become the most powerful evidence for efficacy recognition [62].

> "From a professional development perspective, hope the school provides more high-quality digital teaching resource production training to help improve personal capabilities, such as inviting industry experts for in-depth training." (B4)

> "Dynamic visual stimulation and instant feedback precisely hit the short attention span of rural children: wandering off times dropped from an average of 6 times per class to 2 times; in-class quiz accuracy improved by 15%." (B3)

4.2.2. Teacher Sense of Belonging

(1) Theme 1: Generational Differences

Teachers' sense of belonging presents distinct age-stratified characteristics. Young teachers often focus more on professional growth and organizational identification, expecting to gain development opportunities through technology integration; while senior teachers focus more on teaching autonomy and respect, with their sense of belonging stemming more from a stable institutional environment and team support [63]. This difference leads to significant distinctions in emotional response and participation willingness among teachers of different age groups during the process of adapting to digital teaching resources.

> "The sentiment of wanting to go to cities or places with better conditions is more prominent among young teachers under 30." (B1)

> "The emotion of wanting to leave is comparatively high among young teachers over 30." (B4)

> "Among teachers aged 30 to 40, many are teaching away from home. This stage requires balancing family, child education, or elderly care. Reality pressure is relatively high, so a portion of non-local teachers have thoughts of leaving." (B5)

> "Whereas for teachers over 40, the sense of responsibility for this job is getting heavier, and basically none want to leave." (B3)

(2) Theme 2: Emotional Maintenance

Simultaneously, the school's emotional maintenance of teachers presents a dual logic where caring support coexists with structural differentiation. On one hand, schools provide emotional support to teachers through leadership care, team building, and public recognition, enhancing their organizational belonging. On the other hand, in structural arrangements such as resource allocation, training opportunities, and evaluation incentives, implicit differentiation based on teaching seniority, discipline, or position still exists. This weakens the effect of emotional maintenance to a certain extent, especially affecting the continuous investment willingness of some teachers in the digital teaching transformation [27].

> "Fortunately, the school is especially understanding of us, never forcibly detaining us, and actively asks with concern. They try their best to lend a hand where they can coordinate. This humanistic care warms our hearts." (M3)

4.2.3. Ethnic Cultural Integration

(1) Theme 1: Innovative Inheritance

Digital technology provides new pathways and methods for the innovative inheritance of ethnic culture. Through digital means such as audio, video, 3D modeling, and virtual reality, ethnic languages, songs, dances, skills, and rituals can be systematically recorded, visually reproduced, and innovatively transformed [52]. This not only helps preserve cultural essence, allowing it to break through spatio-temporal constraints, but also enables traditional culture to reach the younger generation in more vivid and interactive forms by integrating into school curricula, developing digital cultural creative products, and building online exhibition halls.

> "The school also encourages us to record high-quality classroom teaching, organizing it into teaching videos to participate in various levels of teaching competitions. Last year, several teachers' videos won awards, which not only brought glory to the school but also gave us more motivation to explore digital teaching." (M3)

(2) Theme 2: Conditional Limitations

Applying ethnic culture digitally faces many practical difficulties. The main limitation is the imbalance of resources and technical conditions; many schools and communities lack high-quality digital recording equipment, stable networks, and professional software and talent [60]. Secondly, cultural translation itself involves cognitive and technical thresholds. How to perform appropriate digital coding and artistic re-creation without damaging cultural authenticity requires profound cultural understanding and interdisciplinary capabilities. These limitations constitute bottlenecks that urgently need to be broken in the process of deep digitization and educational inheritance of ethnic culture.

> "The school's digital conditions are indeed limited... either multimedia equipment is insufficient, or network signals are unstable... so far, we haven't tried using digital means for ethnic culture classes." (C3)

> "Superior departments also encourage the development of local school-based curricula... but our school really doesn't have the conditions to open them. The core issue is still that there aren't enough teachers. Existing teachers mostly juggle several subjects... they simply can't spare the energy to teach school-based curricula. It's quite a regret in our hearts." (C3)

4.2.4. Home-School Collaborative Culture

(1) Theme 1: Differential Interaction

Home-school communication presents active and structural differences. On one hand, the communication "temperature difference" is obvious: schools usually act as the institutionalized initiator, with communication content revolving around academic performance, school affairs, and management requirements, possessing strong normativity and periodicity [64]; while feedback from the family end is often passive, fragmented, and situational [65], and its participation depth is easily affected by parents' digital literacy, leisure time, and educational expectations [66]. On the other hand, communication channels and cognition are

also stratified: some families skilled in using digital platforms can maintain high-frequency, deep interaction with teachers; while some families still rely on traditional, one-way notification modes, or even teeter on the edge of "lost contact," which exacerbates the information and understanding gap in home-school educational synergy.

> "Most parents of one-child families are willing to communicate with teachers about student situations at school and will prepare necessary digital learning equipment for children at home." (B5)

> "First, in some second or third-child families in ethnic minority areas, parents may need to undertake more farming or migrant work tasks, spending less time accompanying children. Their initiative to communicate with teachers is relatively insufficient, and they lack the awareness to configure digital equipment for children." (B2)

(2) Theme 2: Innovative Connection

To narrow the gap, schools are trying new communication methods to build better connections [67]. For example, some schools not only use common social platforms to post information, but also develop their own home-school apps. This changes communication from just "notifying matters" to "building the process together". Additionally, through organizing "Digital Parent Workshops" and inviting parents to participate in online open days and curriculum co-evaluation, schools empower parents, enhancing their digital participation capabilities and educational understanding [68]. These practices not only broaden communication channels but also attempt to reconstruct home-school relations.

> "On one hand, pushing bilingual (Mandarin + local ethnic minority language) communication information through class WeChat groups. On the other hand, changing parent meetings into 'field-side parent meetings' and online bilingual parent meetings, flexibly adjusting time and form to facilitate parent participation." (C2)

> "Second, some ethnic minority parents have language communication barriers (only speak their own ethnic language, cannot speak Mandarin). Even if they want to communicate with teachers, there are certain difficulties." (B2)

According to the research results, this study constructs a digital teaching impact model. The model posits "Teacher Sense of Belonging" as the System Cornerstone and "Shared Value Orientation" as the Core Driver. These elements are situated within the dual external contexts of "Ethnic Cultural Integration" and "Home-School Collaborative Culture." Teacher sense of belonging is the bedrock of the entire system; its stability directly determines the continuity and stability of digital teaching applications. Shared value orientation is the engine and heart of the system. Through school institutional incentives and professional development support, it provides power and direction for digital teaching and feeds back into the enhancement of teacher belonging [69]. Ethnic cultural integration and home-school collaborative culture act as dual external environments and cultural contexts influencing the core system [70]. Ethnic culture provides characteristic development content and opportunities for digital teaching but also brings hard constraints of resource adaptability and teacher shortages. Home-school collaborative culture is the external support for collaborative child-rearing extending from school to family; its diverse structure and communication barriers also pose challenges. The ultimate goal of all factors is to promote the effective application of digital teaching resources and finally achieve the enhancement of teaching quality. In summary, this model

profoundly reveals that enhancing digital teaching quality in rural primary schools cannot rely solely on technology and resource inputs but must adopt a more macroscopic, systemic cultural perspective.

5. Discussion

Regarding the execution status of digital teaching quality in rural primary schools in Yunnan, basic construction such as hardware equipment and multimedia classrooms has seen initial success under policy promotion. However, a structural imbalance exists where equipment arrives at schools but is not effectively used. Network bottlenecks, insufficient maintenance, and differences in teacher technical literacy lead to uneven application effects, aligning with research conclusions regarding the disconnect between technical investment and usage, and the triple constraints of educational technology [19]. Software resource supply is sufficient but shows a clear urban-centric tendency [39], with low matching to rural students' life experiences and new textbook needs. Furthermore, insufficient teacher resource processing capability further constrains benefit transformation [37]. Teaching quality presents characteristics of polarization and "good process, weak results." Teacher quality differences become the key factor affecting learning effectiveness, verifying the view that educational technology is essentially a cultural practice rather than a mere technological upgrade [18].

Regarding the process by which digital teaching resource inputs impact teaching quality, the study finds that the cultural system is the core connecting resource input and teaching quality, consistent with the view in social system theory that school culture affects teaching behavior [71]. Specifically, shared value orientations influence teachers' attitudes and willingness to use digital resources through institutional promotion and efficacy recognition. Teacher sense of belonging presents different characteristics due to age group differences, directly determining the continuity and stability of digital applications [49], fitting relevant research on how the consistency of teacher emotional support and professional needs affects engagement [49]. Ethnic culture is a rich teaching resource, and digital presentation can enhance student learning motivation, but its transformation is limited by equipment shortages and teacher shortages [52]. In home-school culture, different family structures lead to significant differences in student digital resource acquisition and support [71].

6. Conclusion

This study selected 15 subjects from three rural primary schools in Yunlong County, Yunnan Province as the participants. Based on the "Input—Process—Output" logic of the social system model, and through semi-structured interviews, the research was conducted around three core issues: the status of digital teaching resource inputs, influencing mechanisms, and improvement pathways. Four main conclusions were drawn: first, under policy promotion, the digital hardware facilities in rural primary schools have gradually improved, and software resource channels are diverse, yet systemic faults such as insufficient resource adaptability, weak technical support, and uneven usage frequency constrain the effective enhancement of teaching quality. Second, the cultural system emerged as a critical influencing factor, in which the four-dimensional factors of shared value orientation, teacher sense of belonging, ethnic cultural integration, and home-school collaborative culture jointly shape resource usage effects, thereby verifying the influence of culture on teaching behavior within social system theory. Third, the impact of digital resources on teaching quality presents structural characteristics, showing obvious enhancement in the teaching process—such as significantly improved classroom interactivity through digital means—while improvement in learning outcomes remains limited due to factors like family support and the review/consolidation of resources. Finally, enhancing teaching quality requires multi-dimensional measures, including improving resource localization, conducting stratified teacher training, and building a collaborative cultural ecology, rather than relying solely on single technical inputs.

7. Implications

To explore ways to enhance teaching quality via digital teaching resources, this study proposes three collaborative paths supported by literature: First, improve resource adaptability and maintenance by developing localized resources and building standardized maintenance systems. This aligns with actual rural teaching needs and lays a solid foundation for teaching preparation [72]. Second, strengthen teacher professional development and shared values by building multi-level training models [68]. This promotes learner-centered interaction and cultivates a culture of mutual assistance to improve teaching effectiveness, which matches the theory that effective schools must be learning organizations [39]. Third, build a cooperative home-school and ethnic integration environment. By integrating ethnic culture into digital teaching to boost learning motivation, and optimizing home-school interaction through bilingual communication and flexible parent meetings, it reinforces teacher belonging to ensure teaching continuity and promotes continuous improvement in learning results [68.] In summary, improving rural education digitalization quality is not just a technical issue but a systemic project. It requires the combined efforts of resource supply, teacher development, and cultural ecology. This study deepens relevant theoretical understanding and provides feasible suggestions for practice.

8. Limitations and Future Recommendations

This study primarily discussed how digital teaching resources affect teaching quality, but it overlooked the cost-benefit relationship of digital investment and did not consider high cost-performance resource allocation.

Therefore, future research should select multiple rural areas with different economic levels, ethnic cultures, and locations for comparison. By increasing the sample, research can better understand policy mechanism and regional differences in using digital teaching resources. Furthermore, mixed methods and long-term tracking can be employed to investigate the optimal combination of resources under limited investment.

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Conflict of interest

The authors declare no conflict of interest

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