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Cultural Cognition in the Digital Transformation of Calligraphy Education Conflict and Adaptation Strategies

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Abstract

Against the backdrop of digital technology deeply integrating into the education sector, calligraphy education, as a core carrier for inheriting China's fine traditional culture, is facing a profound game between technological instrumental rationality and cultural value rationality. This conflict profoundly affects the effectiveness of traditional culture in rooting moral education and infiltrating aesthetic education for students. This study focuses on the cultural cognitive conflicts emerging in the digital transformation of calligraphy education, and constructs an integrated analytical framework based on the "Technology Acceptance Model (TAM)" and "Cultural Adaptation Theory". Through mixed research methods, it analyzes four major conflicts in the digital transformation of calligraphy education: the rupture between technological tools and cultural carriers, the collision between educational concepts and technological logic, the fault between cultural identity and technological acceptance, and the gap in urban-rural education resource allocation. Among them, cultural adaptability perception is the key variable regulating technology acceptance and cultural identity. Based on this, this study proposes a four-dimensional adaptation strategy: the construction of a "culture-enhanced" digital ecosystem, the reconstruction of a "technology-culture" dual-helix training system, the cultivation of calligraphy cultural consciousness in the technological era, and the establishment of a governance system of "ensuring fundamentals, promoting balance, and strengthening innovation". This strategy provides a theoretical path and practical scheme for resolving the binary opposition between "technological alienation" and "cultural conservatism" in the digital transformation of calligraphy education, enabling calligraphy education to give full play to its core role of rooting moral spirit and infiltrating the soul with aesthetic education in the digital age, and providing theoretical support and practical paradigms for cultivating new-era talents with cultural subjectivity.

Keywords: Calligraphy Education; Digital Transformation; Cultural Cognitive Conflict; Adaptation Strategy; Technology Acceptance Model

1. Introduction

(1) Problem Statement

In the continuous digital transformation of calligraphy education, avoiding the loss of writing personalization and the hollowing out of cultural expression has become an urgent key problem to be solved. At present, some scholars engaged in calligraphy font development and calligraphy teaching software design are constrained by their limited cognition of Chinese characters and calligraphy. They not only lack practical writing skills, but also find it difficult to accurately judge the quality of fonts and reasonably adjust semi-finished products. At the same time, the unbalanced development of calligraphy education and the uneven digital literacy of teachers further exacerbate the difficulties for teachers to use digital teaching technology. Taking the "standard font library" generated by big data algorithms as an example, it has obvious shortcomings in daily teaching applications: some glyphs have low recognition in long reading, and lack the interpretation of cultural background knowledge. This makes it difficult for most teachers to proficiently use digital copying platforms, and some teachers even feel that technology has impacted the traditional master-apprentice inheritance model, ultimately hindering the steady progress of the digital transformation of calligraphy education.

Current digital tools mainly focus on "efficiency improvement", but have significant deficiencies in the technological transformation of "cultural experience", leading to the development dilemma of "advanced technology but anemic culture". In addition, the resource allocation of calligraphy education between urban and rural areas also shows a significant imbalance. "Take Guangdong Province as an example, the coverage rate of digital calligraphy classrooms in the Pearl River Delta region is significantly higher than that in rural areas of eastern, western and northern Guangdong, showing a 'digital divide' in the technological empowerment of urban and rural education resources. This unbalanced resource allocation not only restricts educational equity, but also may lead to the inheritance of calligraphy culture being limited to economically developed regions." This unequal resource allocation not only widens the urban-rural education gap, but also hinders the inheritance and development of calligraphy culture among a wider group of people. How to ensure the popularity and fairness of calligraphy education under the background of digital transformation has become an urgent key problem to be solved.

(2) Research Significance

In the academic research field, this study has significant theoretical significance. At the level of educational technology, this study breaks through the framework limitation of traditional educational technology research that is limited to instrumental rationality, innovatively introduces cultural cognitive theories, such as Hofstede's Cultural Dimension Theory and Fei Xiaotong's Cultural Consciousness Theory, and deeply analyzes the digital transformation process. By constructing a "technology acceptance - cultural adaptation" coupling model, it successfully builds a bridge for the interdisciplinary research between educational technology and cultural communication, expands the research scope of this interdisciplinary field, and provides a brand-new theoretical framework and analytical path for subsequent relevant research. From the perspective of calligraphy culture, this study focuses on the cultural cognitive conflicts and adaptation strategies in the digital transformation of calligraphy education, deeply excavates the cultural logic and educational laws behind it, which not only

enriches the theoretical connotations of educational technology, cultural pedagogy and calligraphy, but also opens up a brand-new research perspective for understanding the inheritance mechanism of traditional culture in the modern technological environment, and provides a referable research strategy for the theoretical development of related disciplines.

In terms of practical application, the research results have extremely high practical guiding value. Aiming at the practical problems faced in the digital transformation of calligraphy education, the four-dimensional adaptation strategy proposed in this study provides a practical operational guide for calligraphy education practitioners. At the technical dimension, constructing a "culture-enhanced" digital ecosystem, and deeply integrating calligraphy cultural elements into digital teaching tools and platforms with advanced technical means, not only significantly improves the interactivity and interest of calligraphy education, stimulates learners' interest and participation, but also ensures the effectiveness and accuracy of digital tools in inheriting calligraphy culture, and avoids the loss and deformation of cultural connotation in the digitalization process. At the educational dimension, reconstructing the "technology-culture" dual-helix training system, and organically integrating modern digital technology education with calligraphy culture education, helps to cultivate interdisciplinary talents who not only master modern digital technology proficiently, but also deeply understand the connotation of calligraphy culture, and meet the urgent social demand for diversified and high-quality development of calligraphy education. In addition, this digital-based inheritance mode of calligraphy culture breaks through the limitations of region and language, builds a convenient bridge for the international communication of calligraphy culture, and effectively enhances the international popularity and influence of Chinese culture.

(3) Main Research Objectives

This study takes "cultural cognitive conflicts and adaptation strategies in the digital transformation of calligraphy education" as the core theme, adopts a method combining qualitative and quantitative research based on grounded theory, and integrates the Technology Acceptance Model (TAM) and Cultural Adaptation Theory. It first proposes an adaptation system covering three dimensions of technological ethics, educational ecology and cultural governance, and then constructs a cognitive and behavioral analysis framework for the digital transformation of calligraphy education, so as to resolve the binary opposition between "technological alienation" and "cultural conservatism". By clarifying the core elements of cultural cognitive conflicts, constructing an analytical framework, proposing adaptation strategies and verifying their effectiveness, this study provides comprehensive theoretical support and practical guidance for the digital transformation of calligraphy education, and promotes the organic integration and sustainable development of culture and technology in calligraphy education in the digital age. The main research objectives are as follows:

First, refine the core dimensions and generation mechanism of cultural cognitive conflicts, and broaden the research scope of the digital transformation of calligraphy education. This study adopts the qualitative research method of grounded theory, goes deep into the actual scenes of the digital transformation of calligraphy education, and collects abundant case materials and interview data. Through the detailed analysis and induction of these materials, it accurately refines the core dimensions of cultural cognitive

conflicts, such as the conflict between traditional calligraphy cultural values and modern digital technology concepts, and the contradiction between the inheritance mode of calligraphy education and digital innovation methods. At the same time, it deeply analyzes the generation mechanism of these core dimensions, explores the influencing factors of culture, society, technology and other aspects behind them, and reveals the internal logic and evolution law of cultural cognitive conflicts in the process of the digital transformation of calligraphy education. The achievement of this objective will help to broaden the research scope of the digital transformation of calligraphy education, and provide a more solid theoretical foundation and clear research direction for subsequent research.

Second, construct a cognitive and behavioral analysis framework for the digital transformation of calligraphy education, to realize the early prediction and timely resolution of contradictions in the integration of culture and technology. Integrating the Technology Acceptance Model (TAM) and Cultural Adaptation Theory, fully considering the cultural characteristics of calligraphy education and the technical requirements of digital transformation, this study constructs a comprehensive and systematic cognitive and behavioral analysis framework for the digital transformation of calligraphy education. This framework will cover the cognitive attitude, acceptance willingness and use behavior of the main bodies of calligraphy education (teachers, students, etc.) towards digital technology, as well as the regulatory role of cultural factors in it. Through this analytical framework, we can predict in advance the possible contradictions and problems in the process of the integration of culture and technology, such as the impact of students' traditional cultural concepts on their acceptance of digital calligraphy learning tools, and put forward targeted solutions in a timely manner, so as to provide effective decision-making basis and guidance methods for the smooth progress of the digital transformation of calligraphy education.

Third, summarize the common laws of different calligraphy education practice cases, and improve the feasibility of the implementation plan for promoting the digital transformation of education. This study collects and sorts out the practical cases of the digital transformation of calligraphy education in different regions and different educational levels, and conducts an in-depth analysis of these cases by using quantitative research methods. Through comparative research, it summarizes the common laws and successful experience of different cases in dealing with cultural cognitive conflicts and realizing the integration of culture and technology, such as some regions focusing on the integration of cultural connotation in the construction of digital resources for calligraphy education, and some schools balancing technology application and cultural inheritance in the innovation of teaching mode. Based on these common laws, it puts forward a set of universal and operable implementation plan for the digital transformation of calligraphy education, and explores the application mode and effect difference of the plan in different situations, so as to provide empirical support and practical reference for improving the feasibility of the implementation plan for the digital transformation of calligraphy education.

2. Literature Review

(1) Research Status of the Digital Transformation of Calligraphy Education

The digital transformation of calligraphy education is a hot field in the current integration of culture and technology, and existing

research is mainly carried out from the perspectives of technology application, cultural inheritance and existing problems. At the level of technology application, intelligent hardware has become the research focus. Wang Dongling (2023) explored the innovative expression of traditional calligraphy in the digital age with the digital art practice of "chaotic calligraphy", which provided a new artistic perspective and practical path for the digitalization of calligraphy education, and demonstrated the new vitality endowed by digital technology to traditional calligraphy. At the dimension of cultural inheritance, scholars focus on the adaptability between technology and culture. Sun Xiaoyun (2024) pointed out that the core of calligraphy education is Chinese character cultural identity education, and emphasized that digital technology should serve the step-by-step construction of cultural understanding, which pointed out the direction of cultural inheritance for the digitalization of calligraphy education. Guo Sixuan (2025) believed that new communication media such as calligraphy apps play a significant role in promoting the digital communication of calligraphy, but need to adhere to the ontology of culture and art, which delimits the cultural boundary for technology application. However, the existing research presents an unbalanced state of "technology enthusiasm, cognition indifference". Statistics of relevant papers in CNKI in the past five years show that research on "technology implementation" accounts for as high as 68%, while research on "cultural cognition" only accounts for 12%. This indicates that the current research focuses too much on the technical level, and pays insufficient attention to the deep-seated problems such as cultural connotation and educational concepts behind the digital transformation of calligraphy education. Overall, the research on the digital transformation of calligraphy education has made certain progress in technology application and cultural inheritance, but the problem of unbalanced research structure is prominent. Future research should continue to deepen the application of technology, while increasing the exploration of cultural cognition, realize the deep integration of technology and culture, and promote the healthy development of the digital transformation of calligraphy education.

(2) Research Progress of Cultural Cognitive Conflict

The research on cultural cognitive conflict has shown a multi-dimensional development trend in the field of education. From the perspective of theoretical model construction, based on Berry's cross-cultural adaptation theory, researchers found that the integration of technology and education triggers "cultural shock". The Technology Acceptance Model proposed by Davis (1989) was expanded into the UTAUT model by Venkatesh et al. (2003), which introduced variables such as "social influence" and "facilitating conditions", and provided a quantitative framework for analyzing individuals' acceptance attitude towards educational technology. However, it focuses on technical factors and is insufficient in the in-depth excavation of the deep connotation of culture. When discussing the cross-border integration of contemporary handicraft art and science and technology, Zhou Yong (2023) proposed the construction of an experimental teaching system such as parametric teaching, which provided a practical direction for dealing with cultural cognitive conflicts, but it mostly stays at the level of concept advocacy, and lacks specific implementation strategies and effect evaluation.

At the level of digital era transformation, Su Fugen (2025) pointed out that the digitization of knowledge production and dissemination, educational media and scenes are the main causes of the transformation of teacher-student relationship. Although digital

technology empowers education, it also leads to the alienation of teacher-student relationship in epistemology, communication theory and ontology, which macroscopically reveals the impact of digital culture on traditional educational relations, but does not deeply analyze the specific formation mechanism of cultural cognitive conflicts in the process of alienation. In the field of calligraphy education, the construction of cultural identity follows the three-tier structure of "cognition-emotion-behavior": the cognitive layer requires understanding the historical origin of calligraphy, the emotional layer relies on aesthetic experience, and the behavioral layer is manifested as the willingness to inherit. However, if the current digital teaching only stays at the level of technical operation, it will cause the "cognition-emotion fracture" of cultural identity, highlighting the urgency of the deep integration of technology and culture.

(3) Research Deficiencies

Current research on cultural cognitive conflicts in the digital transformation of calligraphy education has significant defects. First, the research on conflict classification and action mechanism is fragmented, a systematic classification system has not been established, and there is a lack of dynamic analysis framework for the interaction of core conflicts such as "technological tools and cultural carriers" and "educational concepts and technological logic", resulting in vague identification of the essence of conflicts and inaccurate prediction of evolution laws. Second, the solutions present a technocentric tendency, relying too much on tool optimization and teaching method adjustment, ignoring the systematic reconstruction of cultural ecology and the construction of institutional guarantee mechanism, so it is difficult to realize the fundamental resolution of conflicts. Third, the research on group differences is seriously insufficient, and there is a lack of empirical investigation on the heterogeneous characteristics of primary and secondary school teachers and university teachers, urban and rural students in terms of cultural cognitive schema and technology acceptance threshold, leading to the weakening of the universality of adaptation strategies.

The accelerated iteration of digital technology and the inheritance and innovation of calligraphy culture form a dual tension, and it is urgent to construct an accurate identification and dynamic adjustment mechanism of cultural cognitive conflicts. This study can reveal the game law between cultural value and technological rationality in the digital transformation by establishing a conflict classification matrix and action model; by proposing the reconstruction path of cultural ecology and institutional guarantee scheme, it can provide theoretical support for solving the dual dilemmas of "technological alienation" and "cultural aphasia"; by developing differentiated adaptation strategies, it can improve the inclusiveness and sustainability of the digital transformation of calligraphy education. Under the background of the deep integration of digital civilization and traditional culture, this study has important strategic value and practical urgency for constructing a digital transformation paradigm of calligraphy education with Chinese characteristics.

3. Theoretical Framework

(1) Cultural Adaptation Theory: The Dynamic Process of Conflict and Reconstruction

In the process of digital tool application, users' psychology and behavior present phased evolution characteristics: in the initial stage, novelty triggers strong interest and drives users to explore actively; in the frustration stage, technical limitations induce

dissatisfaction and expose human-machine adaptation problems; in the adaptation stage, users gradually construct a technology use paradigm through cognitive adjustment and skill acquisition; in the innovation stage, they achieve a deep symbiosis between technology and culture, forming a two-way empowerment mechanism.

In this process, Fei Xiaotong's cultural consciousness theory of "appreciating the beauty of one's own and that of others" realizes two-way construction in the digital field: on the one hand, it deconstructs the traditional calligraphy cultural genes with digital resources, and realizes the explicit expression of culture through data visualization and interactive design; on the other hand, it reconstructs the communication path of calligraphy relying on technical characteristics, maintains the core aesthetic elements such as brush and ink charm and composition layout in virtual reality, augmented reality and other media, and finally achieves a digital cultural ecology of "the beauty of all in harmony".

(2) Technology Acceptance Model (TAM): Localized Revision in Educational Scenarios

On the basis of the classical TAM model (Figure 1), this study integrates the special attributes of calligraphy education and introduces a new variable: Cultural Perceptual Usability (CPU).

Perceived Usefulness (PU): The auxiliary role of digital tools in the improvement of techniques (including accurate stroke analysis) and cultural understanding (such as interpreting the stories behind stele inscriptions by pushing historical stories, etc.);

Perceived Ease of Use (PEU): The friendliness of the user interface and learning cost;

Cultural Perceptual Usability (CPU): Whether the tool is consistent with the cultural logic of calligraphy, focusing on whether the electronic pen supports the expression of traditional calligraphy techniques such as "central tip brushwork" and "lifting, pressing, turning and transitioning".

The hypothesis of the revised model is: CPU has a positive impact on PU and PEU. These three factors jointly act on Behavioral Intention (BI), and affect the reconstruction of cultural cognition through sustained Usage Behavior (UB).

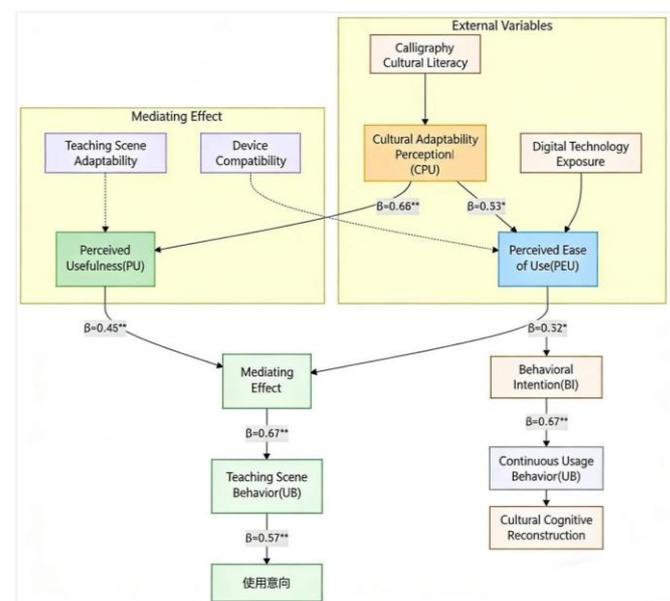


Figure 1 Flowchart of Technology Acceptance Model (TAM)

(Source: Author's own)

4. Research Methods

(1) Mixed Research Design: Triangulation to Ensure Reliability and Validity

This study adopts a comprehensive research paradigm that combines quantitative data to reveal patterns with qualitative research to explain mechanisms.

1. Quantitative research: Questionnaire survey based on the modified Technology Acceptance Model (TAM) (see Figure 2 and Figure 3).

Sample selection: This study employed a stratified sampling strategy, selecting calligraphy teachers from primary and secondary schools (N1=80), calligraphy majors from universities (N2=60), and general calligraphy course students from regular universities (N3=120) as research subjects. The sample was drawn from Chengdu, Sichuan Province, with a guaranteed 25% rural representation.

Measurement tools (technical acceptance dimension): A 7-point Likert scale was used, including PU (6 items, "The digital tracing system aids in understanding calligraphic structure"), PEU (4 items, "I can quickly master the use of calligraphy apps"), and CPU (5 items, "The tool embodies the creative concept of 'preconception in brushwork'").

Control variables: including gender, teaching/learning years, region, and ownership of digital devices.

Data analysis: Using AMOS 26.0 software for structural equation modeling (SEM) analysis, this study aimed to verify the influence pathways of CPU on PU/PEU, as well as the correlation between technology acceptance and cultural identity.

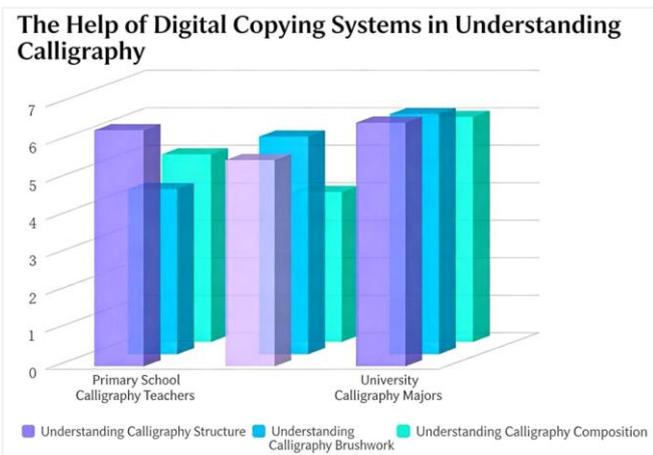


Figure 2 Partial questionnaire survey of the Technology Acceptance Model (TAM)

(Source: Author's own)

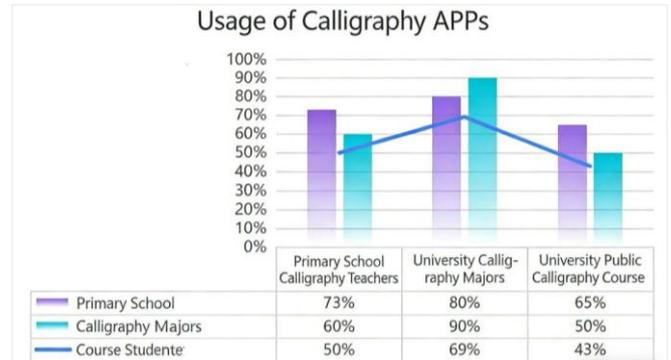


Figure 3 Partial questionnaire survey of the Technology Acceptance Model (TAM)

Source: Author's own

2. Qualitative Research: Multi-subject in-depth Interview and Case Tracking

Study Subjects: This study employed purposive sampling to select individuals with representative characteristics, including educational administrators (2 heads of university calligraphy schools), teachers (2 rural teachers, 2 urban key high school teachers, and 1 university doctoral supervisor), students (2 high school students, 2 calligraphy majors, and 1 non-major college student), and technology developers (1 engineer from an educational technology company).

Interview Outline : What challenges have you encountered when applying digital tools in teaching that conflict with traditional pedagogical approaches? Please provide specific examples to illustrate.

As a tech developer, how do you balance maintaining tool functionality with preserving cultural heritage?

How does digital teaching differ from traditional classroom instruction in shaping your understanding of calligraphy art?

Analysis Method: This study employed NVivo 12 software for coding analysis, sequentially undergoing open coding, axial coding, and selective coding, aiming to extract key elements of core conflict categories and adaptation strategies.

(2) Data Collection and Analysis Process

Preparation Phase (September to October 2024): Complete the questionnaire design, interview outline formulation, and contact with the participating schools and enterprises;

Implementation Phase (November 2024 to January 2025): Distribute questionnaires online through Tencent Questionnaire platform, conduct offline in-depth interviews (the interview content is recorded and transcribed into text), and record on-site observation notes of cases;

Analysis Phase (February to March 2025): Perform Confirmatory Factor Analysis (CFA) and path analysis on quantitative data, conduct grounded theory coding on qualitative data, and carry out cross-case comparative analysis on case data;

Validation Phase (April 2025): Ensure the reliability and validity of the research through member checking (inviting respondents to check the coding results) and triangulation (comparing the consistency of quantitative and qualitative conclusions).

5. Analysis of Cultural Cognitive Conflicts in the Digital Transformation of Calligraphy Education

(1) Conflict Between Technological Tools and Cultural Carriers: Symbolic Fracture at the Material Level

While digital writing devices like styluses and touchscreens have achieved paperless goals, they disrupt the physical memory inherent in traditional writing. The brush's elasticity, rice paper's ink-absorbing properties, and ink's aromatic qualities collectively create a multisensory cultural experience. Digital tools' standardized pressure-sensitive technology cannot fully replicate the tactile nuances of traditional writing—such as the "conical strokes in sand" or "traces of leaking roof." Intelligent tracing systems often decompose stele rubbings into standardized strokes like "12 horizontal and 8 vertical types," overlooking the subtle variations within the same rubbing. For instance, the "horizontal strokes" in the Jiucheng Palace Liquor Spring Inscription (Figure 4) exhibit different angles depending on their context.

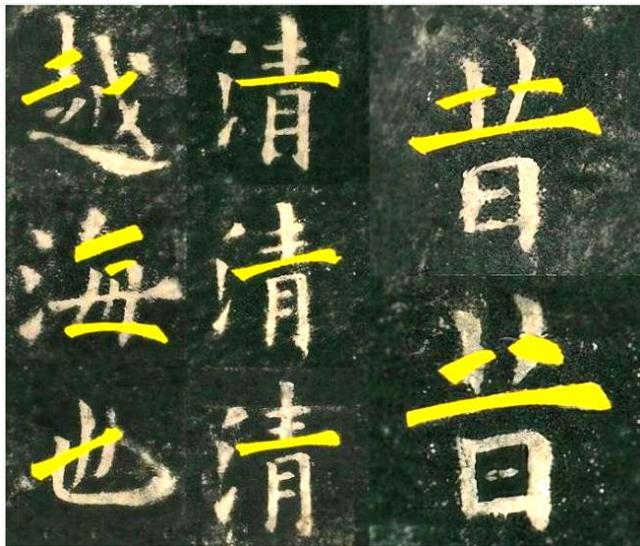


Figure 4 Different Positions of the Horizontal in the Inscription of Nine-Decade Palace

(Source: Author's own)

(2) Conflict Between Educational Concepts and Technological Logic: Paradigm Collision at the Value Level

When discussing the goal conflict between technical efficiency and cultural nurturing, we find that digital teaching pursues accurate feedback and rapid progress, while traditional calligraphy education emphasizes the profound accumulation of "ten years of sharpening a sword", and focuses on the gradual comprehension of culture in the process of copying. In the dilemma of technology dispelling and reconstructing teacher authority, on the one hand, the intelligent demonstration of the digital platform weakens the technical authority of teachers. Students may find that AI teachers write more standard than real teachers, which leads to the decline of teachers' enthusiasm for demonstration. On the other hand, the dependence on technology triggers a crisis of cultural interpretation ability. Some teachers can operate the software proficiently, but cannot explain why Yan style mostly uses central tip brushwork or the cultural origin of stele studies and model calligraphy studies, thus appearing the alienation of teacher role with proficient technology but anemic culture.

(3) Conflict Between Cultural Identity and Technological Acceptance: Intergenerational Fault at the Cognitive Level

The younger generation of students have a high degree of adoption of digital tools, 92% of whom frequently use mobile phone copybook applications, but their sense of identity with traditional culture is relatively insufficient. According to relevant survey data, only 41% of students can identify more than five types of calligraphy, and 28% of students define calligraphy as "beautifully written characters", failing to deeply understand the profound meaning of calligraphy as "the visual expression of Chinese philosophy". Among teachers with more than 20 years of teaching experience, 65% show resistance to technology and prefer traditional teaching methods to digital tools. The core of this contradiction is that, on the one hand, teachers are worried that the use of technology may make students unable to even master the correct writing posture, and on the other hand, they have to face the policy pressure from the education administrative department to promote smart classrooms. This conflict is usually manifested as "formal application" in teaching practice, that is, digital platforms are only used in open classes, and daily teaching activities still rely on traditional blackboard demonstration.

(4) Conflict in the Allocation of Urban and Rural Education Resources: Digital Divide at the Spatial Level

The "Matthew Effect" of hardware facilities is particularly prominent in the education field. Schools in developed eastern regions are generally equipped with holographic projection calligraphy classrooms and AI calligraphy evaluation systems, while rural schools in western regions mostly stay in the traditional teaching mode of a blackboard plus a copybook. Among rural calligraphy teachers in the central and western regions, only 18% have received professional technical training, and 32% of teachers cannot even use basic calligraphy software. This difference leads to completely different teaching effects of the same digital resources in different regions. Urban students can use APPs for creative calligraphy design, while rural students regard these digital tools as a new learning burden due to operational difficulties.

6. Adaptation Strategies in the Digital Transformation of Calligraphy Education

(1) Technical Level: Constructing a "Culture-enhanced" Digital Ecosystem

First, develop a brush and ink touch simulation system, realize the dynamic simulation of the resistance sense of the electronic pen on the touch screen through pressure sensors and vibration feedback technology, and intelligently adjust the shade of ink color according to the writing speed, to restore the physical characteristics and aesthetic experience of traditional writing. Second, build a cultural decoding database of stele inscriptions and model calligraphy, integrate the creation background, technical atlas and related literature of classic works, form a three-dimensional resource matrix of "image-text-audio", and support users to activate multi-modal cultural interpretation through stroke interaction. Third, implement a "digital-physical" dual-track strategy in the basic teaching stage, build a cross-media creation platform, require digital works to internalize the traditional core elements such as brushwork and composition, realize the organic unity of technological empowerment and cultural inheritance, and avoid the dissipation of the ontological value of calligraphy caused by media conversion.

(2) Educational Level: Reconstructing the "Technology-Culture" Dual-Helix Training System

Construct a "three-dimensional integrated" curriculum module, covering the use of digital copying software and online calligraphy communities (10% of class hours), brush writing training and copybook copying (60% of class hours), and the evolution history of Chinese characters, calligraphy aesthetics, calligrapher stories and other content (30% of class hours). Realize the teaching cycle of "understanding principles online - experiencing Tao offline". The online part learns calligraphy theory through MOOC platforms, and uses APP for basic stroke training; the offline part is for teachers to demonstrate the subtle changes of "lifting, pressing, turning and transitioning" on the spot, and organize calligraphy gatherings to let students experience the state of mind-hand correspondence in rice paper and ink; the integrated part uses digital platforms to record the offline creation process, generate a heat map of the brush movement track, and assist students in analyzing the differences between their own works and classic works. Innovate the evaluation system, establish a two-dimensional scoring standard of "technical indicators + cultural indicators", ensure that the proportion of cultural indicators in primary and secondary schools is not less than 40%, and introduce cultural originality indicators in colleges and universities.

(3) Cultural Level: Fostering the "Calligraphy Cultural Consciousness in the Technological Era"

Construct a digital resource library of Chinese character cultural gene map, take Chinese character radicals as key nodes, vividly show the evolution of the "water" radical in a variety of calligraphy styles, such as the smooth beauty of seal script and the calm sense of official script, and link to the detailed explanation of *Shuowen Jiezi* and the appreciation of related poems, such as the grandeur of "The river flows eastward" and the soft beauty of "Small bridges, flowing water and houses", aiming to help students deeply understand the cultural logic behind the form, pronunciation and meaning of Chinese characters. Offer a series of courses on calligraphy and life, teach the auspicious culture in the writing of Spring Festival couplets, the literati elegance of fan calligraphy, and the symbolic significance of seal cutting and personal identity, so that students can realize that calligraphy is not only an art form, but also an embodiment of cultural lifestyle. We oppose the aesthetic concept of technical standardization and emphasize the creative inheritance of calligraphy art. Introduce a cross-cultural comparative perspective, and help students understand the unique cultural connotation of Chinese calligraphy such as "expressing meaning through form" and "harmony between man and nature" by comparing the similarities and differences between Chinese calligraphy, Japanese calligraphy and Arabic calligraphy, so as to improve cultural recognition. Create a digital calligraphy cultural space, integrate campus calligraphy corridors with AR technology, VR calligraphy classrooms, and blockchain calligraphy works library, to provide students with an immersive learning environment.

7. Conclusion and Prospect

This study focuses on the digital transformation of calligraphy education, and reveals the four-dimensional cultural cognitive conflicts of material, value, cognition and space, whose essence is the game between technological instrumental rationality and cultural value rationality. By constructing an integrated model of "technology acceptance - cultural adaptation", it is found that cultural adaptability perception is the core element to resolve conflicts, and then a four-dimensional adaptation strategy of

technological innovation, educational reconstruction, cultural empowerment and institutional guarantee is proposed, which provides a feasible path for the transformation goal of "technological empowerment without cultural loss".

As a major cultural province, Sichuan has unique advantages and practical value in the digital transformation of calligraphy education. In terms of technological innovation, develop an intelligent evaluation system adapted to Sichuan dialect and local calligraphy styles to enhance the cultural adaptability of technology; in terms of educational reconstruction, combine Sichuan's rich calligraphy cultural resources, such as Sanxingdui calligraphy elements and stele inscriptions of famous Bashu calligraphers, to develop school-based digital courses; at the cultural empowerment level, use digital technology to restore the ancient Shu calligraphy creation scene and enhance students' cultural immersion; in terms of institutional guarantee, establish a sharing mechanism of urban and rural calligraphy education digital resources to narrow the regional gap, and provide replicable and popularizable experience for other regions.

Although this study has limitations such as insufficient cases of rural schools and the limitation of cross-sectional data on long-term tracking, it is necessary to conduct in-depth longitudinal research in rural areas in the future to observe the dynamic impact of digital teaching on students' cultural identity, and explore the challenges of generative AI on the "originality" and "humanistic spirit" of calligraphy and formulate ethical norms. In the future, with the continuous development of artificial intelligence technology, the digital transformation of calligraphy education will face more opportunities and challenges. On the one hand, technologies such as generative AI may bring new possibilities for calligraphy creation and promote the innovative development of calligraphy art in the digital age; on the other hand, it is necessary to ensure that technology does not weaken the humanistic spirit and originality of calligraphy while inheriting calligraphy culture. Through continuous research and practice, we have reason to believe that calligraphy education will glow with new vitality in the digital age and contribute new strength to the inheritance and development of China's fine traditional Chinese culture.

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