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Constructing the Core Competencies of Smart Teaching for Chinese Pre-service Art Teachers in Higher Education

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Abstract: *Amid the rapid advancement of smart education, the development of smart teaching core competencies has emerged as a focal point in educational research and practice. Drawing upon competency theory and adopting the Iceberg Model to structure capabilities, this study systematically reviews smart teaching competency frameworks proposed by international organizations and major nations. Anchored in the context of China's art education, it explores the theoretical connotation and structural composition of smart teaching core competencies for preservice art teachers. The study suggests that these competencies should encompass not only general abilities such as technology application, instructional organization, and evaluative feedback, but also discipline-specific attributes—such as digital media–based aesthetic facilitation and immersive instructional design. Based on this perspective, a preliminary three-layered competency structure is proposed, integrating explicit knowledge and skills, implicit awareness and dispositions, and cross-dimensional integrated capabilities. This framework provides theoretical support for the subsequent construction of competency indicator systems and empirical analysis, while also offering guidance for the digital transformation of art education and the enhancement of teachers' digital literacy.*

Keywords: *Core Competencies for Smart Teaching; Art Education; Teachers' Digital Literacy; Competency Framework Construction*

1. INTRODUCTION

With the widespread application of emerging technologies such as artificial intelligence (AI) and big data in education, smart education is gradually becoming a mainstream direction in global educational development (Shu & Gu, 2023). Smart education not only represents a technological transformation but also embodies a learner-centered pedagogical paradigm, emphasizing personalization, interactivity, and intelligence (Badshah et al., 2023). To adapt to this transformation, the competency structure of teachers urgently requires reconstruction (Yuan et al., 2024), and smart teaching core competencies have thus emerged as key qualities for teachers to navigate the digital transformation of education (Goel et al., 2024).

In the field of art education, the integration of smart teaching necessitates greater emphasis on discipline-specific characteristics such as creativity, multisensory engagement, and aesthetic facilitation (Wu, 2023). However, the current training system for pre-service art teachers in China remains relatively traditional and has yet to effectively incorporate AI into art education methodologies (Chen et al., 2024). Existing research on smart teaching competencies has largely focused on general disciplines, neglecting the inherent tension in art education between technological integration and creative freedom (Park, 2023), as well as lacking dimensionally structured studies on the application of technologies such as virtual reality and generative AI in art classrooms (Wang, 2024). Moreover, mainstream competency frameworks tend to emphasize technical proficiency while failing to adequately address the importance of creative expression and aesthetic literacy in art instruction (Lewandowska et al., 2023).

Although studies on smart teaching competencies have made progress, significant gaps remain in the context of art education, particularly regarding the clarity of competency structures and the articulation of practice-oriented dimensions. In the training of pre-service art teachers, critical competencies such as creative guidance, multimodal interaction, and technology integration—essential to smart education—are yet to be systematically defined. Therefore, it is imperative to construct a core competency framework aligned with the characteristics of art disciplines to support the transformation of education through well-prepared talent. This study undertakes a structured exploration in response to these theoretical gaps and practical demands

2. Conceptual Analysis of Smart Teaching Core Competencies

Smart teaching core competencies refer to the comprehensive capabilities that enable teachers to integrate information technologies, pedagogical principles, and learner needs within smart education environments to achieve instructional goals and enhance learning outcomes (Liu & Wang, 2023). The essence of these competencies lies not in the technology itself, but in how teachers effectively embed technological tools into content delivery, instructional methods, and learner support strategies to improve educational effectiveness (Anderson et al., 2022).

Current research generally conceptualizes smart teaching core competencies as a multi-dimensional construct, encompassing technological application, instructional design and innovation, personalized learning support, classroom management and teacher–student interaction, as well as educational data analysis and awareness of digital ethics (Abdul-Raof & Hatib, 2022). These dimensions highlight the complex and context-responsive nature of such competencies, requiring not only digital skills but also creative pedagogical decision-making in dynamic teaching scenarios (Steinert, 2009).

From a theoretical perspective, the TPACK (Technological Pedagogical and Content Knowledge) framework emphasizes the dynamic integration of technology (T), pedagogy (P), and content knowledge (C) to form a unified instructional capacity (Mishra & Koehler, 2006). The SAMR model (Substitution – Augmentation – Modification – Redefinition) further illustrates a four-level approach for embedding technology in teaching, aiming to deepen instructional innovation and transformation (Zamri & Azlan Mohamad, 2025).

While these frameworks provide valuable foundations for understanding the structure of smart teaching core competencies, they are primarily developed for general education teachers and fall short in addressing the discipline-specific requirements of art educators—particularly in aspects such as creative guidance, multimodal integration, and aesthetic experience (Park, 2023). It is therefore necessary to construct a competency framework that aligns with the unique characteristics of art education, which serves as both the theoretical basis and practical goal of this study.

3. Application of Competency Theory Framework in This Study

Competency Theory, proposed by McClelland in the 1970s, advocates replacing traditional intelligence and academic testing with assessments based on individuals' observable behaviors in actual work settings, in order to more accurately predict job performance (Wang, 2024). A key concept within this theory is the Iceberg Model of Competency, which posits that competencies are composed of both explicit elements—such as knowledge and skills—and implicit elements—such as social role, self-concept, traits, and motivation (Thadani et al., 2015). While the explicit elements, visible above the metaphorical waterline, are easier to observe and train, the implicit elements lie below the surface and, though harder to measure, exert a profound influence on performance (Musa & Ahmad, 2019). In recent years, with the acceleration of digital transformation in education, Competency Theory has gained increasing relevance in both teacher education and student capability assessment (Jaramillo et al., 2024).

In the context of smart teaching, teachers' competency demands have expanded beyond mere technical operation to encompass multidimensional integrative literacy. This is particularly true in the field of art education, where teachers are expected not only to possess technical proficiency in digital tools but also to demonstrate implicit competencies such as aesthetic facilitation, cross-media creativity, and the ability to inspire learning motivation (Ji & Yang, 2023). As such, traditional models centered solely on explicit skills are insufficient for capturing the full range of smart teaching core competencies required of pre-service art teachers.

To address this challenge, the present study builds upon the Iceberg Model of Competency by incorporating the contextual characteristics of China's smart education reforms and the pedagogical demands of art education. Accordingly, a three-tiered structural model of smart teaching core competencies is proposed, consisting of a conceptual level, a supporting level, and an operational level.

Level	Main Competency Dimensions	Competency Characteristics	Examples
Conceptual Level	Educational Philosophy, Teaching Motivation, Aesthetic Awareness	Primarily implicit; value-driven	Understanding the value of smart teaching, Aesthetic leadership
Supporting Level	Instructional Design, Technology Integration,	Blending explicit and implicit elements	Designing intelligent instructional plans

	Strategic Literacy		
Operational Level	Instructional Implementation, Technological Application, Classroom Management	Primarily explicit; focused on practical application	Use of teaching platforms, AI-assisted instructional implementation

This three-tiered competency structure is not only logically aligned with the Iceberg Model of Competency but also offers a practical framework for the systematic cultivation of smart teaching competencies among pre-service teachers. The conceptual level emphasizes the foundational role of educational beliefs and aesthetic literacy; the supporting level highlights the intermediary function of integrating technology with instructional content; and the operational level reflects the concrete enactment of teachers' smart teaching practices. Through the construction of this model, the study provides a structured theoretical foundation for the subsequent design of competency indicator systems and the exploration of developmental pathways for teacher professional growth in smart education contexts.

4. Comparative Analysis of International and Chinese Research on Smart Teaching Core Competencies

In recent years, international organizations and major developed countries have released various digital competency frameworks for teachers, underscoring the central role of smart teaching in educational modernization. The Organisation for Economic Co-operation and Development (OECD), in its Digital Education Outlook 2023, emphasizes that teachers should possess cross-disciplinary integration skills, technological adaptability, and innovative teaching abilities to meet the demands of rapidly evolving learning environments. The United Nations Educational, Scientific and Cultural Organization (UNESCO), in its 2018 ICT Competency Framework for Teachers, highlights a progressive model of competencies—from technological proficiency to pedagogical practice and professional development—advocating for a systemic integration of technology with educational philosophy. In addition, the International Society for Technology in Education (ISTE), through its ISTE Standards for Educators (2016), articulates smart teaching competencies across dimensions such as designing technology-rich learning experiences, making data-informed decisions, and fostering students' digital literacy.

While these frameworks offer clear direction in areas such as technological integration and classroom innovation, they exhibit two notable limitations: first, they overemphasize general technological skills while lacking discipline-specific guidance—particularly for subjects like art education, which highly value aesthetic experience and creative expression. Second, they tend to focus on operational capabilities while neglecting intrinsic drivers such as teachers' aesthetic literacy, pedagogical beliefs, and creative motivation, which are often omitted from the core dimensions of competency structures.

In the Chinese context, the advancement of smart education has also placed a strong emphasis on the development of teachers' smart teaching competencies. The Ministry of Education of the People's Republic of China (2022), in its Digital Literacy of Teachers policy, identifies the need for teachers in the digital era to develop competencies in technological awareness, instructional innovation, data literacy, and ethical sensitivity, with a strong emphasis on deep integration of technology and curriculum. The China National Academy of Educational Sciences (2023), in the Report on China Smart Education 2022, further advocates for a "fully ambient and multidimensional" digital education ecosystem, placing higher demands on teachers' professional competencies.

Contemporary academic studies on smart teaching competencies in China have largely focused on constructing general competency frameworks and developing evaluation indicators. For example, Manakul, Somabut, and Tuamsuk (2023) investigated the smart teaching abilities of junior high school teachers in Thailand, while Othman and Shen (2025) explored the construction of an evaluation system for vocational teachers' occupational competencies in China using big data technologies. However, most of these studies employ generalized methodological approaches and fall short of addressing the practical demands of art education—such as creative instruction, aesthetic facilitation, and the integration of multimodal technologies—thus lacking a clear articulation of the relevant competency elements.

Dimension	**International Frameworks on Smart Teaching Competencies**	**Chinese Policies and Research**	**This Study's Response and Innovation**
Structural Hierarchy	Focus on technical operations and classroom	Emphasizes digital literacy but lacks	Constructs a three-tiered model: Conceptual–

	innovation; lacks hierarchical structure	structural refinement	Supporting–Operational
Competency Types	Emphasis on general competencies such as technology integration and data analysis	Biased toward technical knowledge and platform use	Integrates subject-specific competencies such as aesthetic guidance and creative design
Competency Element Levels	Primarily explicit competencies; implicit drivers are often neglected	Focus on operational aspects; limited attention to values and cognitive drivers	Incorporates both explicit and implicit elements using the Iceberg Model
Consideration of Implicit Factors	Frequently overlook teachers' motivation, beliefs, and values	Rarely address aesthetic awareness and motivational activation	Emphasizes implicit factors as driving forces for smart teaching
Scope of Application	Targeted at K–12 or general educators; lacks subject specificity	Mainly concerned with general disciplines in universities or vocational colleges	Focuses on the practical needs of pre-service art teachers in higher education

In response to the commonalities and limitations identified in both international and Chinese frameworks of smart teaching competencies, this study proposes a three-tiered competency structure model—comprising the conceptual, supporting, and operational levels—which reflects a localized interpretation of smart teaching and integrates the disciplinary characteristics of art education. Grounded in competency theory, the model emphasizes the integration of explicit technical practices with implicit educational beliefs, providing a structured representation of the core competencies that pre-service art teachers should possess in smart education environments.

Specifically, the conceptual level highlights internal qualities such as aesthetic leadership, pedagogical beliefs, and self-directed development, serving as the foundational driver of smart teaching behavior. The supporting level focuses on instructional design, pedagogical strategy integration, and technological coordination, functioning as the intermediary scaffold for smart teaching. The operational level emphasizes instructional implementation, the application of AI tools, and classroom management, representing the external enactment of smart teaching effectiveness. These three interconnected levels not only delineate the hierarchical relationships among competency elements but also illustrate the logical alignment between theoretical underpinnings and pedagogical practice. This model not only provides a theoretical foundation for the construction of a competency indicator system but also offers systematic guidance for curriculum design and faculty development in smart teaching within higher art teacher education.

5. Disciplinary Characteristics of Smart Teaching Core Competencies in Art Education

The application of smart teaching in art education extends beyond the mastery of technological tools; it also involves the deep integration of pedagogical beliefs, creative expression, and multisensory learning experiences (He, 2020). The smart teaching core competencies required of pre-service art teachers not only include the use of advanced technologies to build immersive learning environments and the application of data analytics to support personalized learning, but also the ability to design curricula that integrate art, technology, and educational philosophies (González-Fernández et al., 2024).

First, art education emphasizes multisensory expression and creative guidance, which places unique demands on smart teaching competencies. In a smart education environment, teachers must be proficient in tools such as virtual reality (VR), augmented reality (AR), digital painting, and 3D modeling to create immersive learning experiences for students (Abdelrahman & Wang, 2023). These technologies not only overcome the media limitations of traditional instruction but also enhance students' artistic perception and creative expression through visualized interactions (Liu et al., 2021). Data collected via smart terminals can also assist teachers in accurately assessing students' aesthetic preferences, composition habits, and stylistic tendencies, enabling a learner-centered approach to instructional adjustment (Yefimenko et al., 2021).

Second, art education requires a balance between structural organization and instructional flexibility. Smart teaching necessitates that teachers adopt Outcome-Based Education (OBE) principles, aligning student characteristics with course objectives to design open-ended and inquiry-based instructional processes (Zhao & Xue, 2024). Methods such as project-based learning, interdisciplinary integration, and problem-driven instruction are increasingly applied in smart art education, reinforcing students' collaboration, communication, and problem-solving skills in artistic contexts (Mohd Hawari & Mohd Noor, 2020).

Third, smart teaching awareness in art education is reflected in teachers' sensitivity to educational change and their adaptive capacity. Pre-service art teachers are expected to possess forward-looking digital literacy and educational ethics, recognizing that smart education is not merely an accumulation of digital tools, but a systemic reconstruction of instructional models (Manzano, 2023). They must be autonomous learners who continually engage with the frontiers of educational technology and effectively integrate them into instructional design.

Finally, smart teaching requires teachers to develop data-driven assessment capabilities. Teachers must be able to interpret and use educational data—such as learning process records and the developmental trajectories of student artwork—to conduct dynamic diagnoses and provide personalized feedback that drives both instructional improvement and student growth (Liu & Qin, 2022). In the context of art education, this competency places greater emphasis on formative assessment over summative evaluation, advocating for developmental and student-centered feedback approaches.

In sum, smart teaching core competencies in art education demonstrate distinct disciplinary characteristics: they require proficiency in technology, cross-disciplinary integration, creative facilitation, and deep pedagogical awareness. This competency model is not only a critical foundation for the modernization of art education but also a key pathway for upgrading pre-service art teachers' digital literacy and professional development.

6. CONCLUSIONS AND THEORETICAL IMPLICATIONS

Against the backdrop of accelerating smart education, the development of teachers' smart teaching core competencies has become a key driver for improving educational quality and achieving equity. Grounded in the Iceberg Model of Competency, this study systematically reviewed domestic and international frameworks and policy trends related to smart teaching competencies. By focusing on the disciplinary characteristics of art education, it constructed a preliminary theoretical model of smart teaching core competencies for pre-service art teachers.

The findings suggest that the integration of technology and aesthetics, the support for personalized expression, and the need for interdisciplinary instructional design in art education all demand a composite structure of smart teaching competencies. These competencies include not only technical application, instructional design, and classroom organization, but also deeper dimensions such as teaching awareness, ethical responsibility, student guidance, and aesthetic leadership. They manifest as a blend of explicit and implicit elements, clearly tiered structures, and practice-oriented features. Competency theory offers a logical foundation for this structure; international comparisons provide structural references and content enrichment, while Chinese policies and educational practices offer realistic foundations for localization.

This study contributes to the field in three key ways: (1) It clarifies the layered nature and internal logic of smart teaching competencies from the perspective of competency theory; (2) It incorporates discipline-specific competency elements aligned with the unique features of art education; and (3) It provides a theoretical basis for the construction of competency assessment frameworks and future empirical research.

The construction of smart teaching core competencies for pre-service art teachers is not merely a technological innovation but also a convergence of educational philosophy, disciplinary identity, and professional growth. Future research may apply methods such as the Delphi technique and Analytic Hierarchy Process (AHP) to refine the competency indicators and conduct empirical validation, thereby supporting reforms in higher art teacher education and professional development initiatives.

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