Middle School Art Teachers' Smart Teaching Ability under the TPACK Framework: Structural Model, Mechanism and Enhancement Strategy

Jianming Wang

School of Art and Design, SIAS University, Zhengzhou, China
Email: 410188665@qq.com

Abstract—**Aesthetic education is an indispensable part of the middle school education system, and educating people through aesthetics is an important mission of middle school art teachers. In the context of smart education, smart teaching centered around inspiring students' wisdom has put forward new requirements and challenges for teachers' teaching abilities. The smart teaching environment has forced middle school art teachers to upgrade and innovate their teaching abilities in five aspects: teaching, learning, management, evaluation, and thinking, giving birth to a "smart teaching ability" that meets the needs of smart education. Based on the Technical Pedagogical And Content Knowledge (TPACK) framework, the article constructs and elaborates on the structural model of smart teaching ability for middle school art teachers, including Intelligent technology application ability, smart teaching design ability, smart content integration ability, smart teaching evaluation ability, smart classroom management ability, and smart resource development ability. From the three dimensions of knowledge, skills, and emotional attitude, this article explains that smart teaching ability promotes the acquisition of knowledge such as sketching, color, and composition among middle school students, promotes the improvement of skills such as art perception, appreciation, and creativity among middle school students, and promotes the emotional development of aesthetic, humanistic, and innovative qualities among middle school students. This paper discusses the strategies for enhancing the intelligent teaching ability of middle school art teachers from three aspects: cultivating awareness and concepts of intelligent teaching, enhancing knowledge and skills of intelligent teaching, and strengthening collaboration and innovation of intelligent teaching. The aim is to provide theoretical and practical references for research in this field.**

Keywords—**Technical Pedagogical And Content Knowledge (TPACK), art teachers, structural model, mechanism, enhancement strategy**

I. INTRODUCTION

Throughout history, teaching ability has been the foundation of a teacher's standing. With the passage of time, education has gone through three stages of development: agricultural society, industrial society, and information society. Through the digital transformation of education, it is moving towards the stage of smart society [1]. The application of educational technology at different stages in teaching has driven the historical evolution of teachers' teaching abilities from traditional to modern, from single to comprehensive, and from homogeneity to alienation. Under the action of digital education strategy, smart education leads the digital innovation of education [2], and teachers' teaching abilities are bound to be upgraded accordingly. In 2023, the China Institute of Education and Finance at Peking University released a research report titled "National Survey on the Application of Information Technology in Primary and Secondary Education". It was found that the construction of information infrastructure in primary and secondary schools in China has reached the popularization stage, and teachers have basic information technology application abilities. The application of information technology in teachers' daily teaching has reached a high level, but the frequency of using smart classrooms is relatively low, and information technology is being practiced, tested, and tested the utilization rate of the evaluation teaching process is insufficient, and the innovation ability and smart teaching ability of information technology teaching are still insufficient. There is still significant room for development in the future.

In October 2020, the Chinese government issued the "Opinions on Comprehensively Strengthening and Improving the Work of School Aesthetic Education in the New Era". The "Opinions" require that school aesthetic education be regarded as an important carrier for cultivating morality and cultivating talents, and that aesthetic education be included in the entire process of talent cultivation at all levels and types of schools. Intended to improve students' aesthetic and humanistic literacy, and stimulate innovation and creativity. Middle school art education is one of the important components of aesthetic education work, and art teachers are the organizers and implementers of aesthetic education work. In the context of smart education, smart teaching with the goal of inspiring students' wisdom has put forward new requirements and challenges for the teaching ability of middle school art teachers. Currently, clarifying the classification and constituent elements of teaching ability of middle school art teachers, constructing a structural model of teaching ability of middle school art teachers in a smart teaching

environment, and explaining its mechanism of action can promote the professional development of middle school art teachers and effectively carry out aesthetic education work, which has important research significance and practical value.

II. THE CLASSIFICATION AND CONSTITUENT ELEMENTS OF TEACHING ABILITY OF MIDDLE SCHOOL ART TEACHERS

To clarify the classification and constituent elements of the teaching ability of middle school art teachers, it is first necessary to distinguish the two concepts of "teaching" and "teaching ability". "Teaching" refers to "informing and imparting knowledge. "Learning" refers to "seeking knowledge and mastering knowledge". Therefore, from the perspective of etymology, "teaching" is the process of helping students master knowledge, improve their knowledge level, skill level, and thinking ability through activities such as education and guidance. Teaching ability can be understood as the ability and talent of teachers in the process of education and teaching, including abilities and skills in teaching design, teaching implementation, teaching evaluation, helping students improve learning effectiveness, stimulating students' interest in learning, and enhancing their learning ability. From this, it can be inferred that the teaching ability of middle school art teachers refers to the educational and teaching ability to possess a certain level of art literacy and modern information technology knowledge, being able to use various teaching methods and means, unleashing one's creativity, creatively designing course content, and promoting the improvement of students' art literacy and creative ability. After sorting out, it can be summarized into five categories of teaching, learning, management, evaluation, and thinking, and fourteen constituent elements, as shown in Table I.

TABLE I. THE CLASSIFICATION AND CONSTITUENT ELEMENTS OF MIDDLE SCHOOL ART TEACHERS' TEACHING ABILITY

Classification of Teaching Abilities	Elements of Teaching Ability
Teaching	• Advanced teaching concepts • High information literacy • Curriculum design optimization • Innovation in teaching methods
Learning	• Solid artistic literacy • Strong learning ability • Outstanding innovation awareness
Management	• Efficient classroom management • Focusing on student growth
Evaluation	• Evaluate student knowledge • Evaluate students' skills • Evaluate students' emotions
Thinking	• Reflecting on the teaching process • Reflecting on student opinions

A. The Ability of Teaching

Teaching is the core of the teaching ability of middle school art teachers, mainly including: firstly, avant-garde teaching concepts. Middle school art teachers should attach importance to the innovation and reform of educational and teaching models, possess good educational and teaching research literacy, pay attention to cutting-edge research in education and teaching, actively explore advanced teaching methods and technologies, pay attention to the comprehensiveness of student development, and pursue the maximization of educational effectiveness. Secondly, there is a high level of information literacy. Modern information technology has become an indispensable part of art education. Teachers need to master interdisciplinary knowledge and modern information technology, such as using intelligent devices to create micro courses, developing multi sensory interactive resources, and being adept at using multimedia tools and software to demonstrate teaching content. The third is the optimization of course design. A good art course should have the characteristics of scientificity, flexibility, topicality, exploration, and comprehensiveness. Teachers need to have rigorous course design abilities, timely grasp new disciplinary developments and educational and teaching technologies, and combine local cultural and artistic characteristics with the actual needs of students to design teaching content and tasks that align with teaching objectives. Fourthly, innovation in teaching methods. Art teaching itself requires diverse teaching methods and means, and teachers should be able to flexibly apply various teaching methods, including explanation, demonstration, practice, interaction, collaboration, etc.

B. The Ability of Learning

Learning is the premise and foundation of teaching. It can be divided into: firstly, solid artistic literacy. Middle school art teachers should have a high level of artistic literacy, including good aesthetic ability, extensive art knowledge, proficient painting skills, and a deep understanding of art knowledge. Only with these basic qualities can art teachers better guide students to develop various aspects of art abilities. The second is strong learning ability. Middle school art teachers need to keep up with the latest developments and evolving trends in the art industry, learn the latest technologies and design concepts, and expand their knowledge and thinking horizons. Thirdly, there is a prominent awareness of innovation. Middle school art teachers should have creativity and innovative awareness, and be able to inject this innovative thinking into the teaching process to cultivate the innovative ability of art students.

C. The Ability of Management

Management is the guarantee of education. On the one hand, classroom management is efficient. Middle school art teachers should be able to flexibly arrange and adjust their teaching according to the needs and characteristics of different students, ensuring orderly teaching. On the other hand, it focuses on students' growth. Art teachers should understand students' personal characteristics, interests, and painting styles, be able to teach according to their aptitude, provide more care and encouragement, help students discover their own potential, stimulate their creative potential, and promote the personalized development of students' art creativity.

D. The Ability of Evaluation

Evaluation is feedback on teaching. According to the classification theory of teaching objectives proposed by American psychologist Bloom, middle school art teachers can objectively evaluate the completion of course objectives by analyzing and evaluating students' knowledge, skills, and emotional attitude development levels, thereby improving the teaching process and enhancing the quality of teaching. In terms of knowledge, students' mastery and understanding of basic art knowledge can be evaluated by setting written exams and analyzing their works. In terms of skills, students' hand drawing and creative abilities can be evaluated through daily assignments, exam works, and project works. In terms of emotional attitude, students' aesthetic literacy and art appreciation ability can be evaluated through research, classroom observation, and group discussions.

E. The Ability of Thinking

Thinking is for the improvement of teaching. It mainly consists of two parts: First, reflecting on the teaching process. After a complete teaching activity is completed, teachers need to reflect on the entire teaching process, review whether the teaching objectives are clear, specific, and clear, whether the teaching methods can achieve the teaching objectives, and whether they meet the needs and abilities of students. Reflect on whether the teaching content is substantial, vivid, systematic, and clear, and whether it meets the students' knowledge level, abilities, and interests. Whether teaching resources are rich, applicable, intelligent, and can effectively promote students' learning outcomes. Is the teaching method flexible, diverse, innovative, and interactive, and whether it makes students' learning effective and interesting. The second is to reflect on students' opinions. Teachers need to reflect on and adjust the teaching process based on students' feedback, in order to provide better guarantees for optimizing teaching design and improving teaching quality.

III. THE STRUCTURAL MODEL OF SMART TEACHING ABILITY FOR MIDDLE SCHOOL ART TEACHERS UNDER THE TPACK FRAMEWORK

Researchers have interpreted the concept of smart teaching ability from different perspectives. Some researchers believe that the smart teaching ability includes three dimensions: instrumental rationality, meaningful rationality, and value rationality. Its connotation is to interpret the "why" and "how" teachers can teach, and promote the development of students' intelligence [3]. Han, Sun, and Lu [4] have constructed an evaluation model for smart teaching ability in primary and secondary schools by using four primary indicators: Awareness of smart teaching, knowledge and skills of smart teaching, organization of smart teaching, and evaluation of smart teaching. Some researchers refer to it as the competence of smart teaching, emphasizing the talent of teachers in smart teaching. They believe that smart teaching is a core component of the intelligent education system, aiming to cultivate learners' high-level cognitive ability, critical thinking ability, and

creativity [5]. Zhao and Zheng [6] also refer to it as information-based teaching ability, believing that smart teaching ability is a transitional upgrade of information-based teaching ability [7]. In summary, this study believes that the concept of smart teaching ability is not simply the sum of "wisdom" and "teaching ability". It emphasizes that in a smart environment, environmental changes drive the overall improvement of teachers' teaching ability. For high school art subjects, smart teaching ability refers to the use of modern information technology and advanced art teaching concepts by art teachers in a smart teaching environment to carry out teaching activities, achieve personalized growth and comprehensive development of art students' quality, and achieve the goal of educating people and inspiring wisdom through aesthetics. It not only includes traditional teaching abilities, but also requires teachers to master innovative teaching methods and intelligent educational technologies, in order to better play the role of smart teaching. Through literature research, it has been found that research on the information technology teaching ability of middle school teachers is relatively common. The research on the smart teaching ability of middle school teachers is just starting, and there is little research on the smart teaching ability of middle school art teachers, which also provides an opportunity for this study.

TPACK is the abbreviation for Technical Pedagogical And Content Knowledge, which refers to the integration of technical subject teaching knowledge. It was proposed by American scholars Kohler and Mishra and mainly includes six core elements: Technical Knowledge (TK), Teaching Knowledge (PK), Subject Content Knowledge (CK), Technical Teaching Knowledge (TPK), Teaching Content Knowledge (PCK), and Technical Content Knowledge (TCK) [8]. In recent years, the academic community has continued to pay attention to the construction and development of the TPACK model, and has proposed theoretical models such as ICT-TPACK, AI-TPACK [9], G-TPCK [10], MC-TPACK [11]. They have explored the application of these models in improving the professional abilities of teachers in subjects such as foreign language [12], mathematics [13], music [14], physical education [15], and information technology [16], and have achieved certain theoretical and practical research results. Researchers unanimously believe that TPACK is an important framework for studying teachers' teaching competence [17], smart teaching ability evaluation [4], and teacher professional development [18], which has important guiding significance for teacher professional growth [19]. In the context of smart teaching, using the six core elements of the TPACK framework to analyze the smart teaching ability of middle school art teachers can generate a one-to-one directional relationship in logic and connotation, using "→" to indicate pointing, which are: TK → Intelligent technology application ability, PK → Smart teaching design ability, CK → Smart content integration ability, TPK → Smart teaching evaluation ability, PCK → Smart classroom management ability, TCK → Smart resource development capability, as shown in Fig. 1.
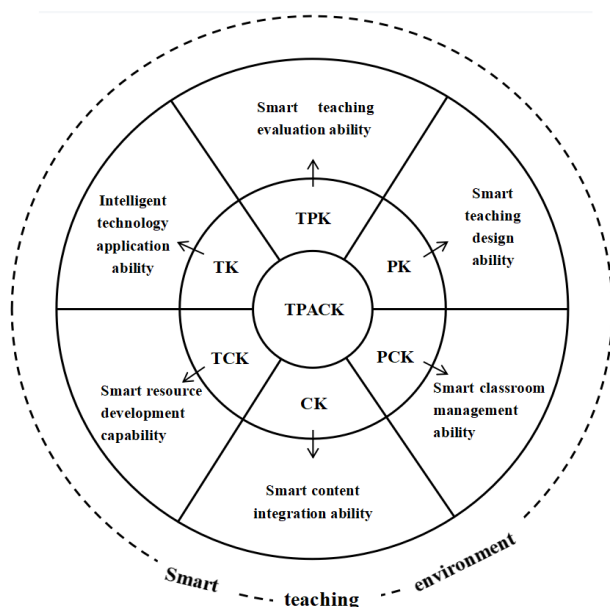
Fig. 1. The structural model of smart teaching ability for middle school art teachers under the TPACK framework.

A. TK Points to Intelligent Technology Application Ability

The application ability of intelligent technology belongs to the category of Technical Knowledge (TK). In the era of intelligence, high school art teachers not only need to master multimedia technology and teaching software (such as Photoshop, Illustrator, etc.), and flexibly apply smart classroom equipment for smart teaching, but also should be able to use intelligent technology for intelligent management, diagnosis, evaluation, etc. in the classroom [20]. The ability to apply intelligent technology has become an essential skill for teachers, helping art teachers quickly access teaching resources, design diverse learning activities and practical experiences, interactively display teaching content, provide targeted guidance and assistance to students in art creation and expression, and enable them to better experience the charm of art. Currently, middle school art teachers still face how to "adapt to changes", prepare for intelligent technology driven education and teaching, resolve ethical risks of intelligent technology, and truly improve technology [21].

B. PK Points to Smart Teaching Design Ability

The Smart teaching design ability is consistent with the connotation of Teaching Knowledge (PK). On the one hand, middle school art teachers need to understand the basic principles of education, be familiar with educational and teaching theories, and master knowledge of curriculum design, evaluation, and educational research methods. On the other hand, in a smart environment, through student portraits and learning data analysis, art teachers can more accurately understand students' cognitive needs and differences, provide personalized learning plans, digital resources, and teaching guidance for each student, and adaptively adjust teaching content and methods based on students' learning performance, making teaching design more in line with learners' characteristics and needs, thus better carrying out personalization Targeted art classroom

teaching can better cultivate students' art literacy and aesthetic awareness. Smart teaching design skills can also help teachers better solve various problems outside of the classroom. If students encounter difficulties, teachers can help students solve problems through online tutoring, remote collaboration, and mutual assistance.

C. CK Points to Smart Content Integration Ability

Subject Content Knowledge (CK) is the cornerstone of smart teaching for middle school art teachers. In the traditional teaching environment, middle school art teachers need to master systematic knowledge in the field of art, including art history, painting techniques, design software, etc. On this basis, art teachers can better understand and grasp the overall art education ideas, coordinate the direction and objectives of art teaching, and better promote the development of art education and teaching. Under the guidance of subject knowledge, teachers can better guide students to learn art knowledge, help students master art painting techniques, enable them to understand the expressive power and artistic connotation of art works, and improve students' art literacy and innovation ability. In the era of intelligence, generative artificial intelligence technologies and products represented by ChatGPT can assist teachers in lesson preparation, research, and training activities. High school art teachers are bound to have the ability to integrate intelligent content, improve work efficiency, and promote teacher growth and professional development [22].

D. TPK Points to Smart Teaching Evaluation Ability

Technical Teaching Knowledge (TPK) is the integration of technical knowledge and teaching knowledge, while smart teaching evaluation is the use of intelligent technical knowledge to diagnose and evaluate teaching. The connotation and purpose of the two are consistent. On the one hand, smart teaching evaluation relies on advanced evaluation techniques and algorithms to achieve intelligent evaluation of students' learning processes and results. It can provide targeted teaching plans and suggestions, thereby improving teachers' ability to design, analyze, and reflect on courses, and promoting continuous improvement, optimization, and innovation in the teaching design of art courses. On the other hand, art teachers use intelligent evaluation tools to evaluate students' painting works, such as Artistic Vision, PaintSense, and CreativeArt, which are developed based on deep learning and image recognition algorithms. By analyzing the lines, textures, shapes, composition, colors, techniques, and other aspects of students' painting works, they evaluate the artistry and innovation of the works, and provide corresponding ratings and suggestions.

E. PCK Points to Smart Classroom Management Ability

Teaching Content Knowledge (PCK) is the integration of teaching knowledge and subject content knowledge. Smart classroom management ability refers to the ability and measures of teachers to efficiently coordinate the combination of various educational resources in a smart classroom environment, and improve the informatization, digitization, and intelligence of teaching process

management. In the process of smart classroom management, teaching knowledge is required to ensure the orderly operation of the classroom, as well as subject knowledge to promptly answer students' doubts. Middle school art teachers should be adept at efficiently collecting various types of teaching information, synthesizing and analyzing various forms and sources of data in the classroom, and systematizing and standardizing the information to help teachers make more accurate and efficient decisions in teaching.

F. TCK Points to Smart Resource Development Capability

Technical Content Knowledge (TCK) is the integration of technical knowledge and subject content knowledge. Intelligent resource development capability refers to the development of smart teaching resources, learning tools, teaching games, etc. through the use of technologies and tools such as artificial intelligence and big data. In the development process, technical knowledge and subject content knowledge are needed, so TCK is consistent with the meaning of intelligent resource development capabilities. Middle school art teachers should be proficient in smart teaching tools and software, such as smart classroom equipment, smart teaching whiteboards, teaching games, etc. And can utilize various simple and easy-to-use intelligent technologies to develop art teaching

resources, including teaching videos, teaching cases, etc. For example, using the AI painting tool Midjournal to develop three-dimensional character materials for use in middle school sketch classrooms as teaching materials, which is convenient and fast, and can also build more interesting, practical, and challenging learning scaffolds for students, thereby better stimulating their exploration, thinking, and creative abilities.

IV. THE MECHANISM OF SMART TEACHING ABILITY FOR MIDDLE SCHOOL ART TEACHERS UNDER THE TPACK FRAMEWORK

The mechanism of the smart teaching ability for middle school art teachers under the TPACK framework is shown in Fig. 2. In the field of smart teaching, the teaching ability of middle school art teachers is not only caused by the changes in the context of "smart environment+teaching ability", but also by the organic integration and overall ability improvement of smart teaching environments such as smart classrooms, smart tools, and smart resources as the main body, which is a qualitative leap and upgrade of teachers' teaching ability. Art teachers use "Smart teaching ability" as the driving force to enhance students' aesthetic literacy, cultivate sentiment, warm the soul, and stimulate innovative and creative vitality from three dimensions of knowledge, skills, and emotional attitude, so as to truly promote middle school aesthetic education.
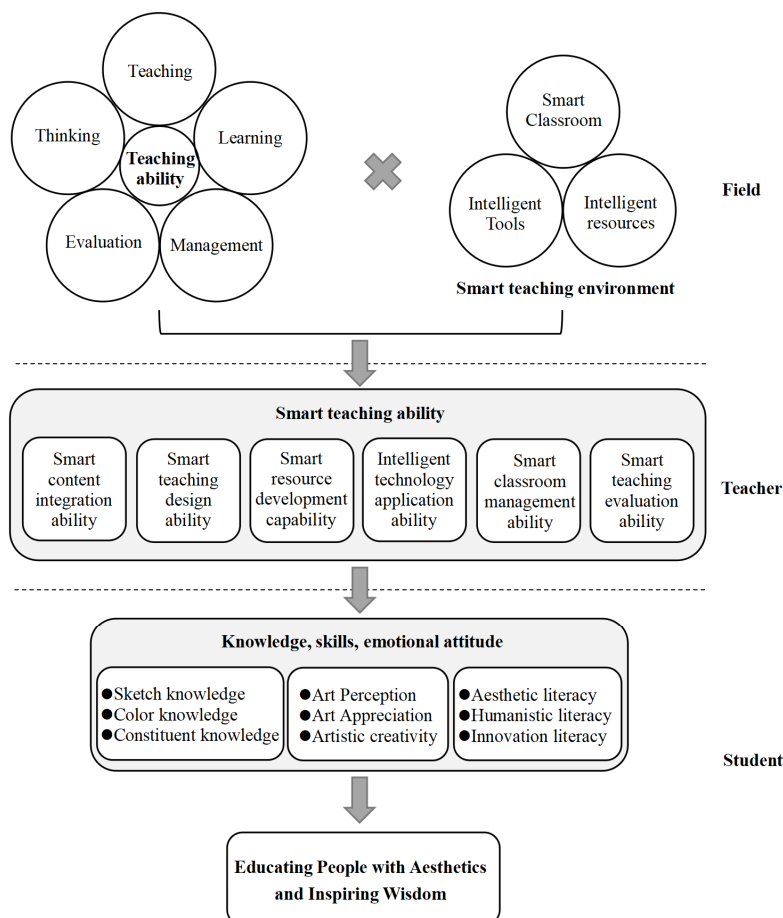

Fig. 2. The mechanism of smart teaching ability for middle school art teachers under the TPACK framework.

A. In Terms of Knowledge Objectives, Promoting the Acquisition of Sketch, Color, Composition, and other Knowledge among Middle School Students

Aesthetic education is one of the components of the "moral, intellectual, physical, aesthetic, and labor" five educations. It is an important link in the modernization of Chinese education and a continuation of the all-round development of Marxism related to human beings [23]. Art education is an important means of middle school aesthetic education work, and its core courses include "Sketching", "Colorful", "Composition", "Sketching", etc. The main purpose is to cultivate middle school students' aesthetic ability and humanistic literacy. Knowledge objectives are an important dimension of Bloom's classification theory of teaching objectives. Some researchers have pointed out that differentiated stratification of knowledge objectives can accurately adapt students to personal development goals and achieve a return to the essence of education [24]. However, in the traditional classroom environment, there are problems such as single learning resources, traditional teaching materials, and unified teaching methods, which lead to low interest in learning for students and hinder the acquisition and personalized development of art knowledge. In a smart teaching environment, rich media resources, diverse interactive teaching materials, and personalized teaching methods make it possible for high school art to be taught according to students' aptitudes. By adopting differentiated knowledge goals to customize diversified and personalized teaching plans, students' interest and creativity in art are stimulated, allowing them to experience the joy of art creation, effectively solving the pain points in traditional classrooms, and promoting their acquisition of art knowledge.

B. In Terms of Skill Objectives, Promoting the Improvement of Middle School Students' Skills in Art Perception, Appreciation, and Creativity

There are mainly three aspects: Firstly, developing multi sensory interactive teaching resources to stimulate students' artistic perception. Developing multi sensory interactive art teaching resources through media technologies such as VR/AR/MR, providing students with interactive experiences and allowing them to freely explore and understand art works in virtual spaces. Digital collections can help students better understand and appreciate modern art works, and enhance their artistic vision and perception. Secondly, create immersive experiential teaching scenarios to enhance students' artistic appreciation. By creating immersive teaching scenarios through holographic projection and educational metaverse, middle school students can be more realistically exposed to and learn different art forms, improve their overall aesthetic and artistic appreciation abilities, and better understand and grasp the connotation of art works. Once again, construct diverse and fun practical activities to develop students' artistic creativity. The smart teaching environment can carry out diverse and interesting practical activities through intelligent devices and digital creative tools, promote students' cooperation and exchange, broaden their creative thinking and artistic expression, stimulate their creativity and imagination, and enhance their artistic creativity.

C. In Terms of Emotional Attitude Objectives, Promoting the Emotional Development of Middle School Students' Aesthetic, Humanistic, and Innovative Qualities

The achievement of emotional attitude goals is the purpose of art teaching, and students' art perception, appreciation, and creativity correspond to aesthetic literacy, humanistic literacy, and innovative literacy, respectively. In the smart teaching environment, hardware equipment, teaching resources, classroom management, and evaluation methods have been comprehensively improved, which is bound to bring positive guidance to the shaping of middle school students' art literacy. Through intelligent technology, art teachers can provide art students with a more diverse, vivid, and interactive aesthetic experience. For example, using Zbrush and Blender software to create 3D digital models can help students deeply explore art concepts such as shape, structure, and center of gravity, promoting their creative thinking and artistic imagination. By using AR glasses or VR headwear devices, students can travel to different times and spaces, experience different art forms and cultures, and thus enhance their aesthetic literacy. By integrating excellent traditional Chinese cultural ideological and political elements into art teaching and showcasing art cases that integrate regional cultural characteristics, students' humanistic literacy can be subtly improved. Through intelligent evaluation technology and platforms, real-time diagnosis of students' learning situation and art creation level is provided, and targeted improvement measures and innovative ideas are proposed. Using digital drawing boards, iPads, and other devices for digital painting can help art students better capture elements such as lines, structures, and contours, improve their composition and creative abilities, and help students improve their innovation literacy.

V. The Enhancement Strategy of Smart Teaching Ability for Middle School Art Teachers under the TPACK Framework

In the information age, technology has deeply penetrated into the field of education, and the TPACK framework aims to guide teachers to deeply integrate technology with subject teaching, in order to improve students' innovation ability, problem-solving ability, and critical thinking. For middle school art teachers, the TPACK framework provides a new perspective to examine and enhance teaching abilities. Cultivating and enhancing the intelligent teaching ability of middle school art teachers is a comprehensive process, which can be achieved through strategies such as cultivating awareness of intelligent teaching, enhancing knowledge and skills of intelligent teaching, strengthening collaboration and innovation in intelligent teaching, and enhancing the intelligent teaching ability of middle school art teachers.

A. Cultivating Awareness and Concepts of Intelligent Teaching

Firstly, in the digital age, teachers actively update their teaching concepts and embrace the trend of digitalization and intelligence in education. Smart teaching is not only an emerging teaching method, but also a brand new teaching concept. Through smart teaching, teachers can better stimulate students' interests, tap into their potential, and cultivate their innovation and problem-solving abilities. Secondly, enhance the information literacy of teachers. In the digital age, the operation skills of smart teaching equipment have become an essential basic quality for teachers. Teachers need to be proficient in various teaching hardware, software, and tools, as well as have knowledge of professional software related to art, in order to better guide students in creativity and learning. Thirdly, cultivate innovative teaching thinking among teachers. Traditional teaching methods can no longer meet the needs of the digital age, and teachers need to rely on advanced technologies and tools, such as artificial intelligence, virtual reality, etc., to innovate teaching methods. Teachers can learn new teaching concepts and methods by participating in innovative education seminars, observing the teaching processes of other excellent teachers, and attempting to apply these concepts and methods to their actual teaching. Fourthly, teachers need to develop the concept of integrating teaching with other disciplines. Art is a highly comprehensive discipline that can be integrated with many other disciplines for teaching. Teachers can collaborate with teachers from other disciplines to jointly carry out interdisciplinary projects or courses, allowing students to learn art while also being exposed to knowledge and skills from other disciplines. This interdisciplinary teaching approach can cultivate students' comprehensive qualities and abilities, making them more competitive in future learning and work.

Enhancing the awareness of intelligent teaching among middle school art teachers in the digital age of teaching is a very important task. The implementation of measures such as updating teaching concepts, improving information literacy, and cultivating innovative teaching thinking among teachers can help them better adapt to the educational needs of the digital era, and improve teaching quality and effectiveness.

B. Enhancing Knowledge and Skills in Smart Teaching

Improving the knowledge and skills of intelligent teaching for middle school art teachers requires multiple approaches. By enhancing technical knowledge, teaching method knowledge, subject content knowledge, and integrating technical subject teaching knowledge, continuously improving professional skills, promoting the continuous development and progress of middle school art teaching, and making it a true "smart" teacher.

1) Enhance Technical Knowledge (TK)

Proficient in various educational technology tools, such as art and design software, multimedia teaching software, etc. Learn new methods of using technology for art creation and teaching, such as digital painting, 3D modeling, etc. Pay attention to the application of emerging technologies in art education, such as Virtual Reality (VR), Augmented Reality (AR), etc.

2) Enhance Teaching Knowledge (PK)

Learn and master various teaching methods and strategies to meet the learning needs of different students. Understand and practice the student-centered teaching philosophy, focusing on cultivating students' innovative thinking and practical abilities. Master effective classroom management skills and create a positive learning atmosphere.

3) Enhance Subject Content Knowledge (CK)

Gain a deep understanding of professional knowledge and skills in the field of art, including art history, art theory, and art creation. Pay attention to the latest trends and developments in the field of art, and constantly update your knowledge system. Improve one's ability to appreciate and create art works, in order to better guide students.

4) Enhance Technical Pedagogical And Content Knowledge (TPACK)

Integrate technology, teaching methods, and subject content knowledge organically to form unique intelligent teaching knowledge and skills. Explore and practice the application of technology in art teaching, utilizing technology for art creation, display, and evaluation. Collaborate with teachers from other disciplines to carry out interdisciplinary teaching activities and projects, and cultivate students' comprehensive literacy.

5) Continuously improving professional skills

Middle school art teachers can continuously update their knowledge and skills by participating in training, seminars, and workshops related to educational technology and art education. Join professional communities or networks, share experiences and resources with other art teachers, and grow together. Participate in educational research projects, explore new smart teaching methods and strategies, and promote innovative development of art education.

C. Strengthening Collaboration and Innovation in Smart Teaching

1) Strengthen collaboration and communication among teachers

Teaching under the TPACK framework requires teachers to have interdisciplinary integration abilities, therefore, strengthening cooperation and communication among art teachers is very important. Teachers can learn about the teaching methods and concepts of related subjects by participating in subject teaching and research activities, communicating with teachers from other subjects, and better integrating knowledge and skills from different subjects to design courses that better meet the needs of students. In addition, establish cooperative relationships with teachers from other disciplines, educational technology experts, and parents to jointly promote the comprehensive development of students.

2) Provide personalized training and support

The actual situation and ability level of each art teacher vary, therefore, providing personalized training and support is very important. Schools can develop personalized training plans and support programs tailored to the actual situation and ability level of each teacher, helping them better enhance their intelligent teaching abilities.

3) Encourage teachers to innovate and reflect on teaching

Encourage art teachers to try new teaching methods and techniques to enhance their teaching effectiveness and attract student interest. At the same time, teachers can also reflect on their teaching practice experience, constantly explore and try new teaching methods and approaches, identify existing problems and shortcomings, and develop improvement plans. Continuously trying new teaching methods and strategies in teaching practice to find the most suitable learning method for students. Maintain close communication and feedback mechanisms with students, understand their learning needs and difficulties, and adjust teaching strategies in a timely manner.

VI. SUMMARY

The smart teaching ability of middle school art teachers plays an important role in achieving educational modernization and cultivating aesthetic education talents. The six elements of the TPACK framework correspond one-to-one with the six components of the smart teaching ability of middle school art teachers, and the six core competencies are mutually supportive and interdependent. Under the TPACK framework, the improvement of the smart teaching ability of middle school art teachers is a constantly developing process that should be continuously studied, practiced, and reflected on. Middle school art teachers need to understand the development trends of educational technology, be proficient in using various digital, intelligent, and humanized teaching tools, network resources, and teaching platforms, be able to integrate these technologies with course content, and use them to guide the teaching process and evaluation, continuously explore new technologies and tools to assist in smart teaching, improve their educational technology level, and shape their technical knowledge competence. Teachers need to continuously expand their educational knowledge and domain knowledge depth, combine them with practical teaching needs, scientifically and reasonably apply this knowledge to adapt to the constantly evolving modern teaching, better stimulate students' learning interest and potential, enable students to improve the quality and level of art works through continuous exploration, practice, and creation, and improve their personal artistic literacy and expression ability. In addition, teachers need to actively participate in various learning and exchange activities, such as subject lectures, lectures, art competitions, and art curation activities, both inside and outside the school, to broaden their artistic horizons and subject knowledge.

CONFLICT OF INTEREST

The author declares no conflict of interest.

FUNDING

REFERENCES

[1] Z. Zhu and J. Hu, "Practical logic and development opportunities of digital education transformation," *E-education Research*, pp. 5–15, 2022.
[2] Z. Zhu, "Smart education leading future school education innovation," *Basic Education*, pp. 5–20, 2021.
[3] X. Yang and Y. Xie, "Smart teaching ability: The dimension of teacher ability in the era of smart education," *Educational Research*, pp. 150–159, 2019.
[4] X. Han, M. Sun, and H. Lu, "What can we do: Evaluation of smart teaching ability of primary and secondary school teachers," *Modern Educational Technology*, pp. 66–75, 2022.
[5] Z. Zhao and Q. Zheng, "Identification of key elements of competence for university teachers in a smart learning environment," *Journal of Xiangtan University (Philosophy and Social Sciences Edition)*, pp. 118–122, 2020.
[6] Z. Xu, "Policy content, evolution logic, and possible trends of teachers' informationization teaching ability," *Modern Educational Technology*, pp. 44–51, 2021.
[7] Z. Yao, "Research on the generation of smart teaching ability of university teachers from the perspective of educational informatization transformation and upgrading," *Journal of Yunnan Open University*, pp. 12–19, 2022.
[8] J. Jiao and H. Zhong, "Research topics and progress on Technology Teaching Method Content Knowledge (TPACK)," *Journal of Distance Education*, pp. 39–45, 2010.
[9] Z. Yan, J. Fu, Y. Zhu, *et al.*, "Integrating Artificial Intelligence Technology into Subject Teaching Knowledge (AI-TPACK): Connotation, teaching practice, and future issues," *Journal of Distance Education*, pp. 23–34, 2020.
[10] X. Yang, Y. Xie, R. Gou, *et al.*, "Research on the G-TPCK framework for teachers in the era of smart education," *Modern Education Technology*, pp. 32–41, 2021.
[11] Q. Yu, "Research on the development of MC-TPACK for mathematics teachers in an online learning community," East China Normal University, 2022.
[12] Z. Wei, X. Hu, Y. Liu, *et al.*, "A case study on the development of TPACK for university foreign language teachers in the post MOOC era," *Electronic Teaching of Foreign Languages*, pp. 103–108, 2021.
[13] J. Zhang, R. Chen, X. Lu, *et al.*, "Research on "internet plus" mathematics teachers' TPACK competency training mode -- taking Wuhou District Junior Middle School mathematics teachers' network sketchpad training as an example," *Journal of Mathematics Education*, pp. 1–8, 2022.
[14] Y. Zhou and J. Cao, "Research on the O2O model of music education in normal universities under the TPACK framework," *People's Music*, pp. 64–67, 202.
[15] B. Cong and Y. Jin, "Research on improving the informatization teaching ability of college physical education teachers in the era of informatization 2.0," *Journal of Shenyang Institute of Physical Education*, pp. 40–48, 2021.
[16] J. Zhou and Z. Wang, "How to deeply integrate information technology and subject teaching – Teaching reasoning based on TPACK," *Research on Electronic Education*, pp. 20–26, 2021.
[17] J. Wang, S. Wang, and W. Chen, "A TPACK based blended teaching competency model for university teachers," *China Distance Education*, pp. 26–34, 2022.
[18] Z. Wei, D. Lin, Y. Liu, *et al.*, "The professional development of open university teachers based on narrative action research: Using TPACK as a framework," China Electronic Education, pp. 122–129, 2022.
[19] Z. Wei, X. Hu, and X. Shao, "How Muke teaching practice promotes the development of TPACK for university teachers," *Modern Distance Education Research*, pp. 53–62, 2021.
[20] H. Li, "Future classroom research based on intelligent technology: Observation and evaluation," East China Normal University, 2020.
[21] Y. Wang, P. Wan, W. Zhao, *et al.*, "Science and technology for the good: A new development direction for international "Artificial Intelligence+Education" – Interpretation of "Artificial intelligence

in education: Opportunities and challenges for sustainable development"", *Open Education Research*, pp. 23–32, 2019.

[22] N. Yu and Y. Zhang, "ChatGPT/The impact of generative artificial intelligence on education: A new frontier of the great power game," *Journal of East China Normal University (Education Science Edition)*, pp. 15–25, 2023.

[23] Y. Xin, "Research on the development of high school art education in China from the Perspective of the function of aesthetic education," Lu Xun Academy of Fine Arts, 2018.

[24] Y. He and L. Zhang, "Exploring the differentiation and stratification of curriculum knowledge objectives under the background of "double reduction," *Teaching and Education*, pp. 4–7, 2023.