Research on "Dynamic and Multi-Dimensional" Digital Art Teaching Design Based on the Concept of Maker in the Era of Digital Media

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Abstract:Objective: The purpose of this study is to explore the "dynamic and multi-dimensional" digital art teaching design based on the concept of maker in the era of digital media, and to analyze its theoretical basis, practical strategies and teaching effects, so as to promote the deep integration of art education and modern information technology, and cultivate students' innovation ability and interdisciplinary literacy. **Methods:** The study used a combination of theoretical analysis and practical cases to verify the effectiveness of the "dynamic and multi-dimensional" teaching mode through the teaching practice of the experimental school affiliated to the Central Academy of Fine Arts. **Results:** Digital art teaching based on the concept of maker can significantly stimulate students' interest in learning, improve their innovation ability and interdisciplinary literacy. Students have accumulated rich practical experience in project-based learning and teamwork, and their hands-on ability and teamwork ability have been significantly enhanced. However, in the process of teaching implementation, there are also challenges such as insufficient equipment stability and teachers' digital technology capabilities to be improved. **Conclusion:** With the rapid development of digital media technology, digital art teaching should develop in the direction of optimization of technical facilities, professional development of teachers, updating of curriculum content, deepening of interdisciplinary integration and expansion of international vision. In the future, it is necessary to further strengthen hardware support and teacher training, promote the internationalization process of digital art education, and lay the foundation for cultivating innovative talents.

Keywords: digital media technology; Maker Concept; dynamic, multi-dimensional teaching; Digital art

1 Introduction

With the rapid development of information technology, the digital media era has profoundly changed people's lifestyles, learning modes and artistic creations. In the field of education, traditional art teaching is facing

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unprecedented opportunities and challenges [1]. On the one hand, digital media technology has brought abundant resources and new forms of expression to art education, enabling it to break through the time and space limitations of traditional teaching and stimulate students' interest in learning and creativity. On the other hand, the growing demand for innovative talents requires art education not only to cultivate students' aesthetic ability, but also to pay attention to the comprehensive development of their innovative thinking and practical ability [2-4].

The rise of the concept of maker provides a new idea for the reform of art education. The maker concept emphasizes "Digital DIY (Do It Yourself), willingness to share and cooperate, and free design and creation", advocates the transformation of ideas into actual works, and promotes the deepening and dissemination of knowledge through practice and sharing. This concept is highly consistent with the essence of art education, because art itself is a kind of creative practice that requires students to explore, innovate, and express their thoughts and emotions through their works [5-8]. Introducing the concept of maker into art teaching can create a more open and free learning environment for students, stimulate their internal motivation, and cultivate their innovative spirit and practical ability [9].

In this context, the "dynamic and multi-dimensional" digital art teaching design came into being. This teaching model emphasizes the dynamics of the teaching process and the multi-dimensionality of the teaching content. The so-called "dynamic" refers to the fact that the teaching process is no longer a one-way transfer of knowledge, but through real-time interaction, instant feedback, and dynamic adjustment, so that the teaching content and methods can be flexibly changed according to students' learning progress and interests, so as to better meet the personalized learning needs of students [10-12]。 At the same time, the teaching content should also keep pace with the times, and integrate new technologies, new ideas and new forms of artistic expression in a timely manner to maintain the vitality and attractiveness of teaching. "Multidimensional" is reflected in the diversification of teaching content and teaching forms, which not only includes traditional art knowledge and skills, but also integrates interdisciplinary content such as programming, design thinking, and cultural studies, and broadens students' knowledge horizons [13-15]. At the same time, through multimedia, virtual reality, online interaction and other technical means, it provides students with a richer and three-dimensional learning experience.

The purpose of this study is to explore the theoretical basis, practical strategies and teaching effect evaluation of "dynamic and multi-dimensional" digital art teaching design based on the concept of maker in the era of digital media. Through an in-depth analysis of its application effect in practical teaching, the positive impact of its application on students' innovation ability, interdisciplinary literacy and interest in art learning is revealed, which provides a useful reference for the innovation and development of art education. This will not only help to promote the deep integration of art education and modern information technology, but also lay a solid foundation for cultivating innovative talents who can adapt to the future development of society.

2 Theoretical basis

2.1 Application of digital media technology in art teaching

Digital media technology has brought a new revolution to art teaching with its rich forms of expression, strong interactivity and convenience. Its application in art teaching is mainly reflected in the following aspects:

2.1.1 Enrich teaching resources and forms

Digital media technology provides a large number of online resources for art teaching, including high-definition artwork pictures, artist creation videos, virtual museum exhibitions, etc. These resources not only broaden students' artistic horizons, but also provide teachers with a variety of teaching materials [16]. Through the multimedia platform, teachers can present abstract art theories in the form of vivid images, animations and videos to help students better understand and accept.

2.1.2 Enhance teaching interactivity

Digital media technology is highly interactive and can break the time and space constraints of the traditional classroom. For example, teachers can publish course videos and courseware through the online platform, and students can review and learn at any time after class, while the platform can record students' learning data to help teachers understand students' learning and adjust teaching strategies. In addition, virtual reality (VR) and augmented reality (AR) technologies can create immersive learning experiences for students, making teaching more interesting and engaging [17-18].

2.1.3 Optimize the teaching effect

Digital media technology can simplify complex art techniques and creative processes through dynamic presentations, virtual modeling, etc., so that students can grasp relevant knowledge more intuitively. For example, 3D modeling software is used to dynamically display the spatial shape and motion characteristics of objects to help students understand the structure of artworks from multiple perspectives [19]. At the same time, digital painting tools and software provide students with a convenient creative platform, stimulating their creative interest and enthusiasm.

2.2 Application of the Maker Concept in Art Education

The concept of maker emphasizes innovation, practice and sharing, which is highly consistent with the goals of art education. Its application in art education is mainly reflected in the following aspects:

2.2.1 Cultivate students' innovative thinking

Maker education focuses on stimulating students' creativity and imagination, and encourages students to transform ideas into practical works through practice. In the art classroom, teachers can guide students to explore and innovate independently through project-based learning and teamwork, and cultivate their independent thinking and problem-solving skills.

2.2.2 Interdisciplinary integration

Maker education emphasizes the comprehensive application of interdisciplinary knowledge, and students can integrate multidisciplinary knowledge such as programming, design thinking, and material science into their art creation. For example, the interdisciplinary integration of 3D printing technology to transform digital designs into physical works, or the use of programming to control interactive installations, not only broadens students' knowledge, but also improves their comprehensive literacy [20].

2.2.3 Practice and sharing

Maker education advocates "learning by doing", through practical operation and teamwork, students can accumulate experience in practice and improve their hands-on ability and teamwork ability [21]. At the same time,

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sharing and communication is an important part of maker culture, and students can further improve their creativity by showcasing their work and getting feedback from others.

2.3 The connotation of dynamic and multi-dimensional teaching mode

The "dynamic and multi-dimensional" teaching mode is the concrete embodiment of digital media technology and the concept of maker in art teaching, and its core lies in breaking the fixed mode of traditional teaching and building a more flexible and diversified learning environment.

Dynamics emphasizes the real-time interactivity of the teaching process and the updatingness of the content, and teachers can adjust teaching strategies and content in a timely manner according to students' learning progress and feedback [22-24]. At the same time, with the real-time feedback of digital media technology, teachers can better understand the learning status of students, so as to achieve personalized teaching.

Multi-dimensionality is reflected in the diversity of teaching content and forms. On the one hand, the teaching content not only includes traditional art knowledge and skills, but also integrates interdisciplinary content such as programming, design thinking, and cultural studies. On the other hand, the teaching form provides students with a richer and more three-dimensional learning experience through a variety of technological means such as multimedia, virtual reality, and online interaction [25].

3. Instructional design and implementation

3.1 Design of Teaching Objectives

3.1.1 Knowledge and Skills

(1) Students can master the basic tools and creative methods of digital art, including the use of digital painting software (such as Photoshop, Procreate), 3D modeling software (such as Tinkercad, Blender) and related hardware equipment (such as drawing tablets and 3D printers).

(2) Students will be able to understand the application of digital media technology in art creation, including image processing, animation production, virtual reality and augmented reality.

(3) Students can use interdisciplinary knowledge (such as programming, design thinking, and materials science) to create art and improve their comprehensive literacy.

3.1.2 Process and Methodology

(1) Through project-based learning and teamwork, students are guided to explore and innovate independently, and cultivate their independent thinking ability and problem-solving ability.

(2) Students can transform theoretical knowledge into practical skills through the way of "learning by doing", and improve their hands-on ability and teamwork ability.

(3) Students can learn to use digital media technology to display and share art works, and improve communication and expression skills.

3.1.3 Emotional attitudes and values

(1) Stimulate students' interest in fine arts, cultivate their aesthetic ability and innovative spirit.

(2) Guide students to pay attention to social issues in the creative process, and cultivate a sense of social

responsibility and humanistic care.

(3) Through sharing and communication, cultivate students' sense of cooperation and sharing spirit, and enhance their self-confidence and sense of achievement.

3.2 Teaching content design

3.2.1 Foundation Courses

The first is the basic course of digital painting, which introduces the use of digital painting tools, including the basic functions and painting skills of drawing tablets, digital painting software (such as Photoshop, Procreate). Through tracing and creative exercises, students will be able to master the basic skills of digital painting.

The second is to cultivate graphic creativity and design awareness, combined with design thinking, guide students to carry out graphic creativity training, learn how to get inspiration from life, and use graphic language to express creativity.

Finally, learn to use color, and explain the basic principles of color, including hue, brightness, purity, etc., combined with digital media tools, so that students can master color matching and color matching skills through practical operations.

3.2.2 Practical Courses

In terms of digital picture book creation, students are guided to use digital painting tools to create picture books with the theme of "My Story" [26]. Students need to complete a complete picture book work from story conception, character design, and scene drawing. In this process, teachers can guide students to incorporate programming techniques to add interactive elements (e.g., sound, animation) to the picture book.

For virtual scene design, using 3D modeling software (e.g., Tinkercad, Blender), students can design a virtual scene, such as a futuristic city, a fantasy forest, etc. [27]. By learning the basic operations of 3D modeling, students will be able to master the skills of spatial modeling and scene layout, and experience the scenes they design through VR technology.

For the interactive installation art aspect, combining programming and electronic components (e.g., Arduino), students can design a simple interactive installation artwork. For example, make a light-controlled painting installation that draws different patterns according to the changes in light as the viewer approaches.

3.2.3 Interdisciplinary courses

Connecting programming with fine arts, students can learn how to control the motion, deformation, and interaction of graphics through simple programming languages such as Scratch. For example, design a simple animation that can be programmed to realize the character's actions such as walking and jumping.

It integrates design thinking and cultural research, guides students to think about art creation from a social and cultural perspective, and analyzes and solves practical problems in combination with design thinking methods. For example, with the theme of "hometown culture", a series of cultural and creative products with local characteristics are designed.

Turning "utopia" into "reality", combined with 3D printing technology, students can transform digital designs into physical works. By learning the basics of materials science, students are able to select the right materials to create and complete the production of the work through a 3D printer.

3.3 Teaching Methods and Means

3.3.1 Multimedia teaching

Teachers can use multimedia devices (e.g., projectors, whiteboards, large screen displays) to showcase high-definition artworks, videos of the creative process, virtual exhibitions, and more. For example, when explaining digital painting skills, teachers can use videos to show the creative process of professional artists, so that students can intuitively feel the use of painting skills. At the same time, with the help of online art resource platforms (such as virtual art museums, art websites), students can browse classic works of art from around the world and broaden their artistic horizons.

At the same time, through screen recording software (such as Camtasia) or real-time operation demonstrations, teachers can clearly show the process of operating complex digital tools to students. For example, when teaching 3D modeling software such as Blender, teachers can demonstrate the process of creating models, adding materials, and creating animations in real time. This dynamic presentation not only helps students better understand the steps, but also stimulates their interest in learning.

Finally, VR devices (e.g., Oculus Quest) or AR tools (e.g., ARKit) can be used to create immersive learning experiences for students [28]. For example, in the virtual set design course, students can enter the virtual space of their own design through VR equipment and feel the layout and effect of the scene in an immersive way. This immersive experience not only makes learning more fun, but also helps students better understand and optimize the design.

3.3.2 Interactive teaching

Use online learning platforms (e.g., Tencent Classroom, Classroom) to publish course videos, teaching courseware, assignments, and discussion topics. Students can submit assignments, participate in discussions, view peer work, and get timely feedback from teachers on the platform. For example, in a digital picture book creation project, students can share sketches of their work on the platform and invite classmates and teachers to comment on them.

Through the interactive features of the online platform, teachers can view students' progress and assignment completion in real-time, and give personalized feedback and suggestions. At the same time, students can also share their creative experience and promote common progress through mutual evaluation. For example, in a 3D modeling course, teachers can view students' work through an online platform, point out problems in a timely manner, and provide suggestions for improvement.

Divide students into small groups and work on projects to learn and create. During the implementation of the project, students need to work together to complete a complex creative task. For example, in an interactive installation project, each team is required to design an art installation that can interact with the audience, and the members are responsible for programming, circuit design, exterior design, etc. Through group work, students are not only able to improve their teamwork skills, but also learn and apply interdisciplinary knowledge through practice.

3.3.3 Makerspace and hands-on teaching

Schools should set up dedicated makerspaces equipped with tools and materials such as digital painting

equipment (e.g., drawing tablets, pen displays), 3D printers, electronic components (e.g., Arduino development boards), VR equipment, etc. The makerspace is not only a place for students to practice their creations, but also a platform for teachers to guide and students to communicate.

At the same time, the school should regularly organize students to carry out practical creative activities in the makerspace to encourage students to explore and innovate independently. For example, the "Digital Art Creation Week" is held, where students can freely choose the theme and format of their creation, and use the equipment and materials of the makerspace to complete their work. During the practice, teachers provide technical support and guidance to help students solve technical problems. It is also possible to work with digital media companies or art studios to bring in actual creative projects that involve students in the real creative process. For example, invite a professional designer or artist to campus and guide students through an actual digital art project. Through school-enterprise cooperation, students can not only improve their practical skills, but also understand industry trends and career requirements.

3.4 Evaluation of learning

3.4.1 Process evaluation

First, students' learning attitude and participation were evaluated by observing their performance in class, their speeches in group discussions, and their activity on online platforms. Then, in project-based learning, students' division of labor, collaboration and communication skills in small groups are evaluated. For example, learn how students are doing in a team through mutual evaluation among group members and teachers' observation records. Finally, the students' learning progress and growth are evaluated through the works and assignments submitted by the students at different stages. Teachers can build student learning profiles, record students' performance and progress in each project, and provide personalized learning suggestions for students.

3.4.2 Evaluation of works

It is evaluated from the aspects of creativity and innovation, technical performance, and artistic value. First of all, creativity and innovation: evaluate the creativity and uniqueness of students' works, and encourage students to break through traditional thinking and make bold innovations. For example, in the creation of digital picture books, the creativity of the story, the uniqueness of the character design, and the innovation of the interactive elements are evaluated. Secondly, in terms of technical performance: to evaluate the proficiency and effectiveness of students' use of digital media technology in their works. For example, in 3D modeling, evaluate the fineness of the model, the use of materials, and the smoothness of the animation. Finally, in terms of artistic value, the composition, color, and modeling of the work are evaluated from the perspective of art, and students are guided to pay attention to the artistry of the work. At the same time, combined with the theme and creativity of the work, the expression ability and appeal of the work are evaluated.

4 Evaluation of teaching effectiveness

In order to comprehensively and objectively evaluate the implementation effect of "dynamic and multi-dimensional" digital art teaching design based on the maker concept, this study adopts diversified evaluation

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methods, combining formative evaluation and summative evaluation, quantitative and qualitative evaluation, self-evaluation and other evaluation, and comprehensively analyzes the teaching effect from multiple dimensions.

4.1 Assessment Methods

(1) Questionnaire method

At the end of the teaching activity, a questionnaire is distributed to students to collect their feedback on teaching content, teaching methods, learning interests, technology application, etc. The questionnaire is designed to include multiple-choice and short-answer questions to understand students' overall feelings and suggestions for digital art courses.

(2) Interview method

Through one-on-one or group interviews with students, gain insight into their experiences during the learning process, the difficulties they encounter, and suggestions for improving the curriculum. The interview focused on students' mastery of digital technology, the stimulation of innovative thinking, and the improvement of teamwork skills.

(3) Observational method

Teachers observe students' learning behavior, engagement, and use of digital tools in the classroom. Observation indicators include students' performance in group discussions, autonomy in the creative process, adaptability to new technologies, etc.

(4) Work analysis method

The digital art works created by students are analyzed and evaluated from the dimensions of creativity, technology application, and artistic expression. The evaluation of the work not only focuses on the final result, but also evaluates the learning progress and ability improvement of the students in combination with their performance in the creative process.

4.2 Evaluation Indicators

(1) Students' interest in learning: Through questionnaires and interviews, the changes in students' interest in digital art courses were evaluated. The results showed that students showed a high interest in art courses that combined digital technology, and found the course content to be novel, interesting and challenging.

(2) Innovation ability: Evaluate students' innovation ability through work analysis and teacher observation. Students are able to use digital tools in the creative process to come up with unique ideas and translate them into actual works. For example, in a virtual set design project, students use 3D modeling and programming techniques to design creative virtual spaces.

(3) Technology application ability: Evaluate students' mastery of digital technology through their performance in practical projects. Students are proficient in the use of digital painting software (e.g., Photoshop, Procreate), 3D modeling software (e.g., Blender), and programming tools (e.g., Scratch) and apply them to art creation.

(4) Teamwork ability: Evaluate students' teamwork ability through group projects and teacher observation. Students are able to work in small groups to clarify the division of labor, communicate effectively, and work

together to complete complex creative tasks. For example, in digital picture book creation, students work as a team to complete the entire process from story conception to presentation.

(5) Interdisciplinary literacy: Through work analysis and interviews, students' ability to apply interdisciplinary knowledge is assessed. Students can combine multidisciplinary knowledge such as programming, design thinking, and materials science in the creative process, and show strong comprehensive literacy.

5 Practical case analysis

5.1 Background and Objectives

In the context of the digital transformation of education and the application of artificial intelligence in education, the Experimental School affiliated to the Central Academy of Fine Arts (CAFA) is actively exploring the deep integration of new technologies and art education [29]. By strengthening hardware construction and teacher training, the school promotes the application of new technologies in art courses, teaching management, curriculum construction, performance evaluation and club development, aiming to improve students' core literacy and teachers' ability to educate people.

5.2 Implementation Process

The school has developed a series of courses that integrate new technologies, such as digital painting, virtual reality art creation, etc., based on the characteristics of fine arts. Students create immersively by using digital painting software (e.g., Adobe Photoshop, Procreate) and virtual reality devices (e.g., VR headsets). A "dynamic and multi-dimensional" teaching mode is adopted, combined with online and offline teaching resources [30]. For example, through the online platform to post instructional videos and interactive tasks, students can learn and create independently after class.

Introduce new ways of digital education evaluation, such as online digital portfolios and virtual art exhibitions. Students' work can not only be displayed in a virtual art gallery, but also receive feedback from teachers and classmates through an online platform.

5.3 Effects and Reflections

Students show a higher level of interest and creativity in the creation of fine arts with new technology support. Through interdisciplinary projects, students are able to combine programming, design thinking, and art creation, and improve their comprehensive literacy. Teachers said that the application of new technologies not only enriches teaching methods, but also promotes the improvement of students' independent learning ability and teamwork ability. Despite the remarkable success of the new technology, there are still challenges in terms of equipment stability and student technical proficiency. The school plans to further strengthen teacher training and optimize teaching resources.

6 Summary

Based on the concept of makers, the "dynamic and multi-dimensional" digital art teaching design can significantly stimulate students' interest and creativity in learning, and improve students' innovation ability and interdisciplinary literacy. Through project-based learning and teamwork, students accumulate rich experience in practice, and improve their hands-on and teamwork skills.

Although this study has achieved certain results at the theoretical and practical levels, it still faces some challenges and limitations in the implementation process. The application of digital media technology requires corresponding hardware support, such as high-performance computers, 3D printers, VR equipment, etc. However, the hardware facilities of some schools are insufficient, which limits the comprehensive promotion of the teaching model. "Dynamic and multi-dimensional" digital art teaching puts forward high requirements for teachers' interdisciplinary knowledge and digital technology application ability. Some teachers have deficiencies in the mastery of digital technology and instructional design, and further training needs to be further strengthened. There are large differences in students' mastery of digital technologies, and some students may need more time and guidance to adapt to new learning tools and methods. This can lead to uneven teaching progress and affect the overall teaching effectiveness

Therefore, with the rapid development of digital media technology, digital art teaching will develop in the direction of optimization and popularization of technical facilities, professional development of teachers, continuous updating of curriculum content, deepening of interdisciplinary integration, and international vision and communication. On the one hand, schools and governments need to increase investment in digital equipment, optimize hardware facilities, and promote the wide application of digital media technology in art education. On the other hand, it strengthens the digital technology training of teachers, improves their interdisciplinary knowledge level and instructional design ability, and helps teachers better grasp the application methods of digital media tools through a combination of online and offline training courses. At the same time, the teaching content of art should keep pace with the times, integrate cutting-edge technologies such as artificial intelligence and virtual reality, and develop more innovative and forward-looking courses. In addition, it further deepens the integration of art and programming, design, materials science and other disciplines, explores more interdisciplinary teaching models and projects, and cultivates students' comprehensive literacy and innovation ability. Finally, we should pay attention to the cutting-edge trends of international digital art education, strengthen international cooperation and exchanges, and promote the international development of digital art education in China.

Through theoretical discussion and case analysis, this study comprehensively demonstrates the effectiveness and innovation of "dynamic and multi-dimensional" digital art teaching design based on the concept of maker. This teaching mode not only enriches the content and form of art education, but also provides students with a broader space for learning and development. In the future, with the continuous advancement of technology and the continuous updating of educational concepts, this teaching model is expected to be promoted in more schools, further promoting the modernization process of art education, and laying a solid foundation for cultivating innovative talents.

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